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Good luck or good governance? The recovery of Celtic Sea herring

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ABSTRACT

The herring stock in the Celtic Sea collapsed in 2004. The stock is managed under the European Union's (EU) Common Fisheries Policy (CFP), but with a large measure of local stakeholder involvement through the Pelagic Advisory Council and a local Irish stakeholder committee. An iterative process, initiated by the local committee culminated in a formal rebuilding plan, which ran until 2012, by which time, the stock had fully recovered. Subsequent analyses of stock development over this period suggest that the stock was already recovering by the time the final plan was implemented. Did the stock rebuild by good fortune or did the governance measures put in place achieve their aims? This question is answered by way of examination of stock trends over time, analyses of the main elements of the rebuilding measures, including a management strategy evaluation (MSE) along with analyses of the legal and institutional arrangements in Ireland and in the EU CFP, including the development of the Pelagic Advisory Council. Important innovations in the CFP are revealed as having been crucial for the rebuilding process.

1. Introduction

Fish stock collapses have been a feature of recent decades. Rebuilding stocks to levels that can deliver maximum sustainable yield has become a central goal of fisheries management, including in the new EU CFP. Rebuilding plans have been implemented for fish stocks in Europe with varying degrees of success [1,2].

One of the success stories is the Celtic Sea herring. It began to decline in the late 1990s, collapsing in 2004, but recovered again by 2012. Rebuilding efforts were developed in consultation with the industry. An iterative stop-start process ensued which eventually led to a formal rebuilding plan in 2008. However, subsequent analyses of the stock show that rebuilding was already underway before that time. Would recovery have happened anyway, as it appears to have done after an earlier collapse? The first recovery took place even though quota cuts were but partially implemented, fishing mortality (F) only modestly reduced and no rebuilding measures established.

This paper examines the evidence to investigate if the recovery would have happened anyway, or whether governance changes had an impact. This is done by using the latest benchmark assessment, a management strategy evaluation, a historical overview of periods of collapse and recovery and an evaluation of stakeholder engagement in the management process. The analytical methods used are outlined, and results described and discussed in sequence, with conclusions being made. Some consideration is given to the transferability of lessons for management of other European fisheries.

2. Materials and methods

The latest benchmark stock assessment as conducted by ICES, [2] was used to provide estimates of key stock parameters: fishing mortality ($F_{2-5\ \text{winter rings}}$), recruitment and spawning stock biomass (SSB). In particular the effect of rebuilding measures on F was evaluated. This is because reviewers of rebuilding efforts have pointed out that success usually requires immediate reductions in fishing mortality. The effect of the rebuilding efforts on reducing F was evaluated. The rebuilding efforts considered were cuts in catch and the introduction of a closed area (2001–2003; 2007–2012).

The number of vessels participating in the fishery was quantified. These data were obtained from the EU logbook catch declarations data held by the Irish Marine Institute. A filter of 200 t annual landings was applied to exclude vessels taking incidental by-catches of herring.

In order to calculate the contribution to overall mortality from within the closure area, partial fishing mortalities were computed. Overall fishing mortality at age and year on the stock from the latest benchmark ICES assessment [2] were split according to the proportion of overall catch in numbers taken from that area.

By way of comparison with the earlier collapse and recovery, mean weights at age at spawning time were extracted from the ICES assessment [2] This was to evaluate the relative contribution of individual fish to spawning stock biomass. Mean weight at age and year was divided by the corresponding numbers in the catch and re-grouped to produce a time series of mean weight across all ages per

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Table 1
Details of what-if scenarios tested by MSE.

Start year	Recruitment regime	Initial catch	Target F	Management trigger	Description
1980	Low as in 1970s	Average 1975–81	Fpa	1/3 of high SSB[a]	Recruitment did not improve
2000	Low, 1998–2004	Catch in 2000	Fpa	Bpa	Recruitment did not improve
2000	Low, 1998–2004	Catch in 2000	Fpa	None	No rebuilding effort
2000	Long term average	Catch in 2000	Catch fluctuation ± 10%		Catch inertia
2008	Long term average	Average 2004–08	Fpa	None	Absence of EC rule

[a] at this time the re-opening target SSB was proposed by ICES as one third of the highest observed SSB in the series.

year.

In order to evaluate which measures, if any, effected recovery, a management strategy evaluation (MSE) was performed. This was to evaluate if recovery would have happened if:

1. Recruitment did not improve as it was observed to do.
2. Total catch remained the same rather than having been reduced.
3. The EU initiatives were not implemented.

These questions were explored with reference to both the recent stock collapse, and the earlier one in the 1970s. Management strategy evaluation followed the procedures used to evaluate the rebuilding plan [3] using a framework already developed [4,5]. The settings used in the MSE are shown in Table 1. The general approach taken was to test various historic scenarios using the most modern perception of the stock, the 2015 benchmark assessment, in an *ex post* analysis. Thus the target fishing mortality reference point and those for limit and target precautionary biomass are modern values [6]. Simulations of the early recovery period mimicked the management procedure of the period as closely as possible. Simulated populations were reconstructed by re-sampling from a pre-defined stock recruitment relationship. The stock recruitment relationship in each case was chosen to reflect average or poor conditions, depending on the scenario. Average conditions were modelled from a long term average up to the period immediately before the start point in each case.

3. Results

3.1. History of collapses and recoveries

The stock collapsed on two occasions, in the 1970s and again in the early 2000s (Fig. 1). In both cases high fishing mortality and low recruitment were observed before collapse in spawning stock biomass below the limit reference point level. In each instance, the stock recovered, with strong year classes recruiting.

The first collapse was probably caused by very high F on pre-recruits in a nursery ground industrial fishery outside the stock management area [7]. The first recovery was not accompanied by a formal rebuilding plan, nor any rebuilding measures other than 0-TAC, which was not effective to reduce catch. Some recovery in SSB occurred before the fishery was re-opened in 1982, but good recruitment was only recorded after re-opening (the 1981 recruitment is irrelevant as it would not have been well estimated at the time). Recruitment improved and recovery benefitted from this good fortune. Fishing mortality remained very high, however, after the stock recovered. This high F was only sustained by a prolonged period of above average recruitment in the 1980s and early 1990s.

The first recovery is all the more remarkable because F was so high, both during the collapse and after. A key factor in the first recovery was that the stock was composed of fish that attained a large size. Mean weights of fish at spawning time (used to calculate SSB) were on average one third higher than during the second collapse (Fig. 2). Therefore, the contribution per recruit to stock biomass was much greater in the earlier period, requiring fewer individual fish to achieve a given stock biomass. The second recovery could not benefit from these large fish. Rebuilding required more individual fish to be allowed to survive and therefore the second recovery required a greater input of recruits than the first.

The second collapse began in 1998, with recruitment being poor since 1996. F peaked at almost 0.7 in 2000, and stock biomass slid to below the limit reference point by 2004.

3.2. Formal management and stakeholder engagement

The stock has been managed by TAC since 1974, and that was the only formal management measure in place for many years. However throughout the 1980s there was a degree of stakeholder involvement, culminating in an attempt to regulate target fishing mortality through box closures on spawning grounds [8]. This initiative led to a series of box closures that still exist. That measure is not part of this study, because it was not a rebuilding measure.

The Irish industry formed a new committee in 1998, due to concerns that there was a lack of older fish in the catches, and low abundance estimates from acoustic surveys [7]. The committee worked towards its first rebuilding measures in 2001 (Table 2). Thus, the committee was ahead of ICES in formally recognising that the stock was in a poor state. An iterative process developed, within this committee, reacting to and in turn influencing developments at an EU level. Table 2 shows the scientific advice from ICES and the actions taken by the Irish stakeholder committee. There were four actions. The first was the closure of the recruit-spawner box, which varied in temporal duration in each season. The second was a procedure that vessels should “move on” to other fishing grounds if fish below a threshold minimum size were caught. The third was removal of the need to register catch each year to remain eligible for a license, the “use it or lose it clause”. Finally there was a procedure to divert part of the TAC away from spawning fish. Table 2 also shows the basis upon which the EC authorities framed the TAC for that season.

These measures were prompted by, from 1999, a general scarcity of fish, pessimistic results from acoustic surveys, and from 2002, pessimistic ICES scientific advice. These measures (Table 2) were as follows:

1. A minimum size of 23 cm TL,. increased to 25 cm TL during 2002, and moving on provision.
2. Closure of Division VIIaS, the main area where fishing took place and where aggregations were densest.
3. Diversion of quota from spawning time to feeding time to reduce numbers of fish caught per tonne. This was implemented to varying degrees in 2002, 2003 and 2004.
4. Removal of a “use it or lose it” provision for license holders from 2002 onwards.

It is not clear whether item 1 it was applied, and it is not considered further. However measure 2 was largely followed, being un-officially implemented by peer-pressure within the industry. Measure 3 was implemented by the Irish authorities. Measure 4 was also implemented in official policy and did lead to a marked reduction in the number of vessels participating in the fishery (Fig. 3). The effect of this licensing