POSSIBLE CHANGES TO CONSERVATION LIMITS AND STOCK ASSESSMENT IN ENGLAND

Introduction

One of the principal objectives of the AST/EA/IFM workshop **Salmon Assessment in England: Time to Take Stock?,** which was held on 14 July 2016 in Telford[1], was to help develop options for changes to conservation limits (CLs) and stock assessment systems as part of the Five Point Approach to the Conservation of Salmon in England developed by the Environment Agency and its partners.

The workshop itself did not attempt to reach conclusions or make recommendations, but various ideas for change were discussed. This note draws on the presentations and discussion at the workshop to suggest a number of possible changes to the current system. These include technical adjustments to CLs, changes to the compliance assessment system, steps to make the whole system easier to understand, and, in the longer term, consideration of alternative Biological Reference Points (BRPs). The greatest scope for improvement in the short term, however, is in the methods used for estimating numbers of returning adults.

While I have benefitted from advice from a number of people in producing this note, it has not been formally endorsed by the workshop or by any organisation.

One important point that emerged from the workshop was that many anglers find conservation limits and the methods used to undertake assessments of stocks and conservation limit compliance difficult to understand. There was general agreement that not only should improvements in the current arrangements be considered but that efforts were also needed to make the whole system more transparent and to increase confidence in it; these will be as important as technical changes to these systems. However, it must be recognised that the development of assessment methods inevitably involves some complex statistics, and it is important not to oversimplify the approach simply to make it more understandable to non-scientists.

..Moreover, while we need to acknowledge that there are weaknesses in current methods for assessing stock levels, it is also important to emphasise that these need not affect the conclusions drawn from these assessments. While there will inevitably be substantial margins of error around central estimates of stock levels, these will only be significant if they affect an overall trend, or change a compliance category. Devoting more resources to assessing stock levels would undoubtedly improve them, but unless the improved assessments showed that the previous ones were

[1] The Presentations given at the workshop can be found at https://ifm.org.uk/ifm-salmon-stock-assessment-workshop/

significantly wrong, the resources in question would be better used to address the factors adversely affecting stock levels.

Conservation Limits

In most respects the CL setting process for England and Wales has remained unchanged since they were first calculated in 1996; although the stated intention was to refine the methods over time. However, with limited exceptions the basic assumptions, models and model parameters have not been updated. Elsewhere, for example Ireland, CLs have been updated as new data have become available**.**

There is a strong case for reviewing these models and making adjustments to CLs as appropriate, and subsequently for keeping the process under review.

CLs in England and Wales[2] are set in accordance with the current advice from ICES and NASCO using an agreed methodology. They are based on the River Bush stock-recruitment (S-R) relationship, which is adjusted for separate parts of each river to take account of wetted area, stream order, altitude and fry and parr densities for stream type. The original data used in the model were relatively imprecise and could be updated and improved using modern GIS techniques, for example to assess juvenile and spawning habitat more accurately**.** Ideally, a full river habitat inventory, based on a wide range of data, should be developed (this would have many wider benefits for river management and conservation).

Other parameters, such as grilse/MSW ratios, sex ratios, average sizes and average egg production per female, are used in the development of CLs and the values of these could also be reviewed on a river-by-river basis and subsequently updated at regular intervals.

The current CL model combines freshwater and marine stages; in effect, it is a full lifecycle model. The marine stage requires information on marine survival rates, and reducing these rates produces lower CLs. This was done in 2003, when the assumed rates were reduced from 25% and 15% (which may have been too high originally), for grilse and MSW fish respectively, to 11% and 5%. These are still unrealistically high, but reducing them again would further reduce CLs, which many would find counter-intuitive and which would conflict with the policy commitment in the Five Point Approach to maximise smolt output. Setting more easily achieved CLs could also mask continuing problems during the freshwater phase and run counter to any longer term objective to adopt a BRP based on freshwater production (see below). For these reasons, it would be sensible for adjustments to current CLs to be confined to freshwater parameters, and for no change to be made to marine survival percentages while the current CL model remains in use.

[2] While this note focuses on England, the systems in Wales are identical, and similar changes could be considered there. .

CLs in a number of other jurisdictions, such as Ireland and France, are based on a method developed by the EU-SALMODEL project that uses S-R relationships drawn from 15 rivers which are related to latitude and adjusted using wetted area. In reviewing the current CLs, it would be informative to consider the values obtained by the SALMODEL and other approaches.

Assessment of returning adults

Reliable, validated and monitored fish counters are the most effective method of assessing numbers of returning adults, but given the costs (in particular the annual running costs), they will never be operational on more than a limited number of rivers. However, it is crucial to have an adequate number of representative index rivers with effective fish counters. Given the cost of installing and operating new counters, the first step should be to ensure that effective use is made of existing counters.

For the great majority of rivers, rod catches are likely to remain the only realistic way of assessing the number of returning adults. Key issues are the reliability of catch reports and of methods for estimating angler exploitation rates (in terms of the percentage of the run caught, not killed) which are used to estimate total returns from the catch data.

While overall catch return rates are generally good, anecdotal evidence suggests that the quality is variable. Efforts to improve the quantity and quality of catch returns will, no doubt, continue, but it needs to be recognised that it is very difficult to achieve a complete record of all fish caught; catch returns are always likely to be incomplete, albeit including the majority of the catch, and it is doubtful that increasing the proportion reported will substantially improve the overall accuracy of the estimates. The catch returns also include data on effort, but these are not always reliable.

Exploitation rates for each river have been derived from a simple model based on estimates for 12 rivers and effort data in 1993/94, and these fixed values are now used each year. However, exploitation rates are heavily influenced by factors such as flows and angling conditions, which affect both catchability and angling effort, and there is a need for methods which take these into account on an annual basis. For example in Scotland river flow is used to adjust run size estimates from rod catches.

Ways of improving catch and effort data were explored in a workshop organised by the Atlantic Salmon Trust in March 2015[3]. Although this focused on sea trout, the conclusions are equally applicable to salmon. The workshop in question concluded that the most effective use of resources would be to concentrate on identifying sources of bias in catch and effort returns and on calculating their effect so that

[3] http://www.atlanticsalmontrust.org/latest-news/sea-trout-catch-and-effort-workshop-report.html

correction factors could be applied. This could be done by developing carefully designed stratified samples on chosen index rivers, using selected volunteers**.**

In the meantime, where there are alternative sources of catch and effort data, such as returns from fishery owners, the EA could explore the reasons for differences between local returns and the official catch and effort returns with local interests; it could, if appropriate, then consider using adjusted figures to calculate the number of returning adults for the purpose of compliance assessments.

Compliance Assessment.

The present system is complicated and hard to understand, even for fisheries managers, and has important flaws. Its essence is genuinely simple however: the current objective of managers in England and Wales (the Management Objective) is that stocks should not fall below their CLs in more than 1 year out of 5, or 20% of the time over the long term. To achieve this, the stock size that managers aim to achieve (the Management Target) is set well above the CL ; it is typically around 35% higher than the CL.

However additional complexity has been introduced into the system , linking trends in river stock performance to predictions of future abundance , in order to forecast stock levels against CLs in five years' time.. This makes assumptions about continuing linear stock trends which are untenable. The figures below show the percentages of rivers in the different assessment categories in the two most recent Annual Assessments, with the percentages forecast five years' previously (in 2009 and 2010 respectively) in brackets. Given the differences between the 'forecasts' and the actual figures, the value of this particular exercise is questionable.

	2014 (2009)	2015 (2010)
	%	%
Not at Risk	0 (9)	0 (19)
Probably Not At Risk	10 (36)	5 (31)
Probably At Risk	67 (39)	45 (34)
At Risk	24 (16)	50 (16)

Furthermore the probabilistic reporting metrics used (e.g. probably at risk, probably not at risk, etc.) are also confusing. The benefits of the simple compliance test (above) appear to have been lost in the attempt to make the process more comprehensive.

When evaluating the status of a stock it is nevertheless informative to consider the recent trend in stock abundance as well as the current level of abundance, so alternative ways of doing this need to be considered. One option would be to use a 5

year period of observations, and /or non-linear analysis, which would better reflect recent trends in the stock size; this, though, would greatly increase the uncertainty of the assessment.

Consideration also needs to be given as to how this is reflected in the formal compliance assessment. It might make the system easier to understand if this confined itself to the year being reported on, with a simple indication of whether there was a significant positive or negative trend in stock abundance. More detailed calculations of trends could then be available on request**.**

Decision Structure

The purpose of compliance assessment is to ascertain whether stocks are exceeding their CLs, and to enable remedial action to be taken if they are not. It is therefore important for the EA's Decision Structure to be reviewed alongside the rest of the CL, assessment and compliance system.

Currently, decisions are linked to the forecast probability of falling within a particular category in five years' time. Given the weakness of the current forecasts (discussed above), consideration could be given to basing decisions on current assessments, with various decision trees linked to the actual status of the stock – At Risk etc.

In accordance with NASCO's Precautionary Approach to Salmon Management, which calls for the 'formulation of pre-agreed management actions in the form of procedures to be applied over a range of stock conditions', the introduction of automatic measures such as zero exploitation, linked to pre-determined thresholds, could also be considered**.**

Presentational Issues

There is no doubt that the current system is difficult to explain to fishermen, or indeed anyone without a reasonable grasp of statistical theory. It is regrettable that 20 years after the introduction of CLs, many people still question their value, and do not understand how they work, particularly as the principles underlying them are relatively simple. More needs to be done to explain the system in straightforward terms.

There are also changes to the ways in which the current system is described that could help anglers and others understand it better. For example, CLs are set in terms of eggs deposited, but they would be more understandable to anglers if they were described in terms of the number of spawners needed to achieve the egg deposition target. Of course, the number of spawners might need to be adjusted from time to time to reflect changes in size at age and hence eggs per female, and changes to the MSW/grilse ratio need further thought. But such adjustments would be easy to explain, and figures for the number of adults returning to spawn would be simple to understand.

As suggested above, the compliance assessment would be easier to understand if it was based on the year being reported on. Moving away from a system based on

forecast probabilities would make it desirable to change the current classifications; these could be replaced by the terms recently adopted by NASCO in its new Stock Classification System: Not at Risk, Low Risk, Medium Risk and High Risk

Alternative Biological Reference Points.

CLs are based on Maximum Sustainable Yield (MSY), as recommended by NASCO. Alternative BRPs are under consideration in Canada, including one based on achieving a proportion of the freshwater carrying capacity. The Angling Trust's Angling Advisory Group has apparently suggested catchment smolt targets, and it may be worth considering a BRP based on freshwater production. This would avoid the problem described above caused by declining marine survival, and would fit in with the policy objective of maximising smolt output.

However, there are difficulties with this approach. Very few rivers have any way of measuring smolt numbers, so smolt output would need to be derived in other ways. In reality, numbers of returning adults would probably have to remain the key metric. Moreover, with a BRP based on freshwater production, any reduction in marine survival would make it necessary to increase the smolt target to compensate. While this has attractions in policy terms, it would involve reductions in exploitation rates and greater restrictions on angling. Moreover there is an upper limit on freshwater production. It would be important to ensure that these implications were fully understood.

Additional reference points could also be introduced, for example a lower critical point below which no exploitation would be permitted.

In the short term introducing alternative BRPs would not be practical, but the EA and Defra should keep the issue under review and ensure that they are aware of ideas being developed in other fisheries jurisdictions. Consideration could be given to setting up a scientific and technical advisory group, involving experts both from government and its agencies and interested parties, to provide advice on annual salmon stock assessments and possible management actions; such a body is an integral part of the assessment system used in Ireland.

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