What next for fish welfare

Craig MacIntyre - This article is adapted from Craig's PhD thesis that aimed to investigate the relationship between water quality and the welfare of farmed rainbow trout

Water Quality

There have been calls from non-governmental organisations for the setting of prescriptive limits for certain water quality parameters, e.g. Compassion in World Farming (Lymbery 2002), however at the conclusion of this study there is no evidence that setting such limits would be practical or would benefit the welfare of farmed trout. The main issue with prescriptive water quality limits is what appropriate limits are. There is no scientific basis for the setting of prescriptive water quality limits, as toxicological studies often give disparate or conflicting recommendations for safe levels, the test conditions bear little resemblance to conditions found on commercial trout farms, and the duration of exposure affects how fish respond to water quality. Current UK trout industry guidelines for dissolved oxygen (DO) suggest a minimum of 6mg/l. There is some evidence that the effects of deteriorating water quality are ameliorated by maintaining DO above 5mg/l under experimental conditions (Ben North, unpublished data), which suggests that current industry guidelines are adequate for welfare. Following an epidemiological study into water quality interactions with trout welfare, where 44 trout farms were visited twice, sampling 3700 fish from 189 different systems, it does not appear as if poor water quality is a major problem on UK trout farms, as there was no consistent effect of water quality on welfare. Trout farmers are aware that poor water quality can lead to poor welfare, which is against their economic interests, and it appears that generally farmers are maintaining water quality at a level that does not result in poor welfare. However, this finding should not encourage farmers to abdicate from their responsibilities for monitoring the main water quality parameters, arguably DO and temperature. A telephone survey of 109 trout farmers in 2005 showed that only 54% of trout farmers measured DO. There is a growing need for farmers to be able to demonstrate that fish are provided with suitable environmental conditions, and with the availability and relatively low cost of DO probes (with thermometers) (around £300), it is suggested that all trout farmers should have DO probes and be capable of measuring DO and temperature.

Disease

It is well recognised that within the UK trout industry, disease is one of the primary factors that can affect fish welfare (North et al. 2008, Read 2008, Wall 2008). A disease outbreak within a population is often accompanied by an increase in mortality levels, and while death itself is not a welfare issue, the process of dying is (Wall 2008). The epidemiological study found that poor welfare was associated with disease, irrespective of which disease was involved and how many diseases the population had been exposed to.

Farming Purpose

Fish farmed for restocking fisheries generally had better welfare than fish farmed for the table market. This might have been because restocking fish were provided with better environmental and husbandry conditions more conducive to good welfare, or that restocking farmers selected fish during grading based on the general condition of their body and fins, disposing of those fish with poor welfare. The data were unable to provide any explanations for the association between better welfare and restocking practices. Table fish are generally farmed more intensively than restocking fish, however none of the risk factors associated with intensification affected welfare, such as poor water quality, stocking densities, numbers of fish in a unit, biomass in a unit or oxygenation. Other aspects of farming that may differ between table and restocking production and were not recorded for this study are, inter alia, feeding rate, specific growth rates over the production cycle, frequency of grading, method of grading (hand versus automated) and if fish are 'pushed on' or 'held back' to meet market demands. Several fish farmers commented that having to 'push on' or 'hold back' a batch for retailers resulted in poor welfare. One restocking farmer felt that the main difference between table and restocking fish lay in grading, with restocking fish graded by hand, rather than pumped through an automated system, and being graded less frequently than table fish. Table farmers are often under pressure to produce fish of a specific size, which leads to greater frequency of grading, while restocking farmers often have greater latitude with size of the fish at point of sale.

On-Farm Welfare Assessment

There are currently no on-farm welfare assessment schemes for rainbow trout in the UK, although it is understood that the RSPCA, through its Freedom Foods scheme, are preparing welfare standards for the UK trout industry (J. Avinezious, RSCPA, pers. comm). In order to improve the welfare of farmed rainbow trout, it will be necessary for farmers to participate in a welfare assessment scheme that seeks to safeguard or improve welfare standards.

On-farm fish welfare can be measured using fish-based (the responses to the environment) parameters and/or resource-based (i.e. requirements for good welfare) parameters (Main et al. 2003). Resource-based measures are easier to measure than fish-based measures, however fish-based parameters provide the most direct insight into how the fish is coping with its environment. Any on-farm welfare assessment scheme should contain both fish- and resource-based parameters to ensure that the welfare of fish is safeguarded and important environmental effects on fish are not overlooked.

Improving fish welfare

There are 3 suggested stages in the process of improving the welfare of farmed animals; 1) assessment of welfare, 2) identification of risk factors, 3) interventions in response to the risk factors (Whay 2007). This thesis has contributed to the first 2 stages, providing a method for assessing welfare and identifying risk factors that contribute to poor welfare. In order to drive improvements in fish welfare, interventions are required.

Interventions have been defined as "a systematic attempt to change peoples' behaviours" (Rutter & Quine 2002 cited in Whay 2007). Improvements in fish welfare can only be brought about if stakeholders in the industry are engaged and motivated to make changes. Awareness of welfare has grown considerably in the past decade with UK trout farmers (Read 2008), who have been active participants in fish welfare research (e.g. North et al. 2006a, b, Hoyle *et al*. 2007, Ellis *et al*. 2008, this thesis). Within the UK trout industry, a successful intervention improved the welfare of farmed trout at slaughter, with a humane slaughter method developed through collaboration between farmers, DEFRA, retailers, an NGO and welfare scientists, and implemented throughout the industry (Read 2008).

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Water quality or disease stress? Or just feeding?

Stock management strategies to optimise growth potential in on-growing of marine fish

In January 2007, a three-year SARF (Scottish Aquaculture Research Forum) studentship was awarded to Dr Herve Migaud, Dr Andrew Davie and Dr David Penman, Reproduction and Genetics Group, for a PhD project titled "Research and development of stock management strategies to optimise growth potential in on-growing of marine fish". The project is being conducted by Mairi Cowan, a former MSc student at the Institute of Aquaculture.

A major problem in the on-growing stage of marine aquaculture is sexual maturation where fish direct energy into gonadal development resulting in commercial loss (reduced growth and flesh quality) and potential genetic interaction with native stocks through broadcast spawning or spawning interaction by escapees.

The PhD project aims to investigate, develop and refine two of the main management strategies used to address problems of maturation in the on-growing industry: 1) photoperiodic regulation of maturation and 2) production of monosex populations. Research is based on the two most commercially important marine species in the UK, Atlantic cod and Atlantic halibut.

Regarding photoperiod manipulation, during the first year, work has focussed on photoperiod management in Atlantic cod by looking at the feasibility of new lighting technology (i.e. cathode lighting), more specifically its effects on cod light sensitivity and stress response. Results indicate no severe adverse welfare effects from such lighting technologies and as a follow up it is planned to provide guidelines as to the appropriate deployment of these systems in large scale ongrowing cages. The next two years of the project will involve the development and validation of a novel molecular assay to measure the expression of kisspeptin related genes. Expression analyses of these genes in cod will help characterise the onset of sexual maturation as well as define the initiation of the reproductive cycle during the decreasing winter photoperiod. Ultimately this is intended to provide a more accurate indication of the onset of sexual maturation in Atlantic cod.

In terms of monosex production, the project involves the development of monosex populations of Atlantic halibut, with the attainment of all-female stocks as the primary production goal. Female Atlantic halibut grow faster than males and can be harvested well in advance of maturation. During the first project year preliminary work has been conducted to establish sex-reversed halibut broodstocks which will generate, in the long-term, a basis for traditional monosex population generation. In the next two years, for the first time in fish, the potential for generating monosex populations using a novel semen sexing technique proven in terrestrial agriculture (i.e. cattle) will be investigated.

Overall this project aims to improve the competitiveness and sustainability of the marine aquaculture industry within the UK by developing and/or refining potential remediation techniques of sexual maturation as well as developing new tools to further our understanding of puberty in two of the main commercially important farmed marine species, cod and halibut.