which struck me with particular force, was the reminder to read the source literature that describes the validation of the behavioural model in question. While this research is often not easily available online, it can indicate limitations in current models and reviewing the literature could aid decisions about better alternatives. I wonder how many researchers have in fact followed this sage advice to go back to the source literature.

These guidelines, if read and used, will help behavioural scientists to improve the quality of the science that they obtain from animal research, and should also help them to ensure that the Three Rs have been properly considered and that their research is ethically justifiable.

Guiding Principles for Behavioural Laboratory Animal Science: LASA, BAP, BNA & ESSWAP (2013). A4, 61 pages. Available at http://www.lasa.co.uk/publications.html.

Robert Hubrecht,
UFAW

FAWC Report considers the welfare of farmed fish

Within England, Scotland and Wales the Farm Animal Welfare Committee (FAWC) acts as an advisory body to government, and others, and periodically publishes reports that cover issues considered important to the welfare of farmed animals. FAWC believes that all farmed animals should have 'a life worth living' and increasingly 'a good life'.

The latest Opinion published by FAWC explores the welfare of farmed fish for human consumption within Great Britain (GB). FAWC last considered farmed fish welfare in 1996. Since this time fish welfare science has greatly advanced and, similar to other farming sectors, the aquaculture industry has undergone a period of increasing intensification with fewer, but larger units. Fish farming is the second largest livestock sector in GB (following broiler chicken production) and in 2012 approximately 35 million salmon were harvested in Scotland (the vast majority of salmon farming in GB takes place in Scotland).

The Opinion focuses on the welfare of finfish, specifically Atlantic salmon and rainbow trout, although other species are also mentioned (including brown trout, sea bass, halibut and tilapia) and the welfare of wrasse is briefly commented upon (wrasse are not themselves farmed for human consumption but considerable numbers are used on salmon farms to help control sea lice, a disease problem in farmed salmon).

The Report opens with a general background of the industry and follows with an overview of: relevant regulations and legislation; international considerations; and commercial and other codes of recommendations. It is apparent from the report that in GB there is currently limited legislation to protect fish welfare. The Animal Welfare Act 2006, and the Animal Health and Welfare (Scotland) Act 2006, afford fish a basic level of protection (due to a duty of care requirement and prevention of unnecessary suffering), but fish are excluded from the more detailed Welfare of Farm Animals (England) Regulations 2007 (and similar legislation in Scotland and Wales). In effect, there are no legislative requirements or codes of recommendations that specify how fish should be kept during production. To fill this void, various industry bodies have already put in place their own codes of practice (or are in the process of doing so) and FAWC acknowledges industry efforts in this regard: "Industry has been proactive in developing and implementing standards of good practice and information exchange is supported by industry organisations". However, FAWC also note that these standards vary in detail and may differ in their requirements for smolting, fasting, removal of dead fish and use of medicines.

Other legislation relevant to fish keeping is also commented upon and includes the Aquatic Animal Health (England and Wales) Regulations 2009 (which cover fish health and disease control), The Aquaculture and Fisheries (Scotland) Act 2013, and the Veterinary Medicines Regulations (VMR) 2011. Additionally, fish farming is affected by environmental legislation due to restrictions on the amount of medicines which may be used to treat fish disease due to the discharge of medicines into fresh and sea water.

FAWC goes on to examine fish welfare issues in more detail. Water quality is considered to be the most important factor affecting fish welfare. Other issues raised include: fin damage, disease transmission and social behaviour (eg feed competition, displacement of subordinate fish, territoriality); bacterial and viral diseases; parasites; skin damage; crowding before and during transport; handling of fish out of water; genetics (many eggs are imported and there may be a mismatch of genotype to environment); and nutrition.

Understanding and managing fish welfare is no easy task since there are still many gaps in our knowledge on the biological and behavioural needs of fish. There is also wide variation in needs between species. FAWC compare salmon and trout to halibut — halibut, unlike salmon and trout, is a bottom-dwelling fish and they may lie on top of each other in farmed situations if adequate loose substrate is not provided, this is likely to have implications for fish welfare. Farmed halibut also experience greater variation in growth than salmon and trout, and disparities in fish size can lead to inter-fish aggression, also a welfare issue. Variation in domestication can add another layer of complexity. Carp may be considered domesticated, since they have been kept in captivity for hundreds of years, and over time they have been selectively bred for reduced mortality and increased growth. Farmed salmon, however, are still considered semi-wild since they are only 3 to 15 generations removed from their wild ancestors. The needs of domesticated fish can be very different to those of their semi-wild counterparts.

Additionally, a number of features inherent to fish farming systems make assessing and managing fish welfare challenging, such as: very large group numbers (tanks or pens may hold in excess of 100,000 fish); limited viewing opportunities (often only the surface of a pen is visible which raises difficulties when monitoring, inspecting and for individual identification); and operational variation (farms may consist of on-shore tanks, freshwater systems or sea pens).

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Another obstacle to achieving good fish welfare at present, and highlighted by FAWC, is that people do not empathise with fish as they do with other mammals. FAWC notes that: "Perceptual barriers exist to giving fish full ethical consideration. Humans typically identify more closely with farmed mammals than they do with fish, due to a range of biological and habitat differences".

It is clear from the Report that ensuring farmed fish welfare is adequately catered for is complex and challenging. However, it appears that the aquaculture industry is engaged in progressing fish welfare and the first of the nine conclusions drawn by FAWC reflects this: "FAWC recognises that many or most fish farmers and the aquaculture industry as a whole have addressed this subject [fish welfare] seriously, within the historical and economic constraints of the systems that they use, and made many improvements that have improved the welfare of many fish".

FAWC goes on to make a number of recommendations, including that the Welfare of Farmed Animals Regulations are extended to include fish. Additionally, FAWC advise that: "Industry should develop systematic approaches to (a) monitoring of environmental parameters and of live fish for welfare outcomes by both visual and automatic methods, (b) responding to both observed health and welfare problems and morality, with management adjusted against expectations, and (c) compiling and sharing data across farms where this is not already done".

The Opinion concludes with a final recommendation: "Fish are able to detect and respond to noxious stimuli, and FAWC supports the increasing scientific consensus that they experience pain. We therefore recommend that deliberations on management and other processes should be made on this basis". FAWC stress that more research is needed to ensure that the needs of fish are better understood and to achieve a similar level of understanding of fish welfare afforded to other farmed species. FAWC urges industry, research organisations and governments to collaborate to achieve these worthy aims.

The welfare of farmed fish at slaughter is not considered within this Opinion. FAWC expect to publish their comments on the killing of farmed fish later in 2014.

FAWC Opinion on the Welfare of Farmed Fish (February 2014). A4, 40 pages. Farm Animal Welfare Committee. Available for download from the FAWC website: http://www.defra.gov.uk/fawc/advice-2/opinions/ or by contacting the FAWC at the following address: Area 5E, Nobel House, 17 Smith Square, London SW1P 3JR, UK.

E Carter,
UFAW

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