The Welfare of Farmed Fish

A rainbow trout (*Oncorhynchus mykiss*)

In the UK, Atlantic Salmon and Rainbow Trout are the main species used in fish farming. The UK salmon industry represents one of the largest in the world, along with Norway and Chile. In Scotland, 203,881 tonnes of Atlantic Salmon were produced in 2019[1] , the highest level ever recorded in the country. Other species are farmed such as brown trout, sea bass, halibut and tilapia, which together represent approximately 1% of UK fish production. Although there is consensus that fish can feel pain, they are usually not afforded the same detailed welfare protection as terrestrial farm animals.

Fish natural history and behaviour

The evolution of fish began more than 500 million years ago during the Cambrian Period. The ability of fish to adapt and undergo evolutionary changes has allowed their very wide distribution – in fact, they can be found in nearly all natural bodies of water. It has been estimated that there are over 32,000 different species of fish. Among them, less than half are freshwater species (freshwater constitute less than 1% of available global water) and the others are seawater species. Some fish can be found in both waters, such as the Atlantic salmon (*Salmo salar*) which migrates from freshwater to seawater following a physiological transformation, and who will return to freshwater to spawn (release of eggs and sperm).

Although many vertebrates have evolved from fish-like ancestors, the primitive aspect of fish is often wrongly associated with a lack of sophisticated behaviours and cognition. In their review, Pouca and Brown[2] highlighted major research areas related to fish cognition. For example, fish have been shown to display good numerical skills and are able to differentiate between smaller and larger social groups, with accuracy comparable to that of mammals and birds. These quantitative abilities help the fish to decide where to forage and can be used for predatory defence or mate choice.

Complex social behaviours such as social learning, individual recognition and dominance hierarchies have also been observed. Individuals may for example rely on more knowledgeable fish to locate food, shelter or predators. Studies showed that fish were able to collect information on conspecifics and to behave according to different circumstances. For example, when out of view of a dominant male, non-dominant fish express behaviours they would normally not display in the presence of a dominant male, such as aggressive behaviours or courting females[3] . Another area of fish research is spatial cognition. Fish are able to navigate using a number of different techniques such as magnetic fields, landmarks or cognitive maps. For example, studies have shown that rock-pool dwelling gobies, who need to find their home pool before the tide goes out, use cognitive maps and are able to remember the location of neighbouring pools for several weeks after being experimentally removed[4].

Finally, the question of whether or not fish can feel pain is more and more discussed within the scientific community. From an evolutionary perspective, the ability to react to noxious stimuli allows animals to withdraw, as well as to remember painful experiences in order to prevent them in the future. Studies have shown that rainbow trout who were injected in the lip with acetic acid and bee venom behaved in a way that shows they were experiencing pain around their mouths - including rubbing the painful area on the gravel at the bottom of the tank. When the trout were given morphine, these behaviours would stop[5]. Although there is a debate within the scientific community, the current evidence shows that fish have complex social behaviours and needs, problem solving skills and good memories.

Commercial fish production

Aquaculture is the fastest growing food-producing sector which accounts for over half of the fish used for food globally. Around the world, approximately 580 aquatic species are currently farmed. In the UK, the main species produced are the Atlantic salmon followed by the rainbow trout. Other species such as halibut, sea bass or tilapia are farmed at a much smaller volume. The salmon industry in the UK is mostly concentrated in the Scottish Highlands and the Islands where 203,881 tonnes of Atlantic salmon were produced in 2019[1]. According to the FAO, the UK imported USD 4.1 billion of fish and fishery products in 2015, and exported the equivalent of USD 2.5 billion.

Fish are farmed in both freshwater and seawater. There are several different production systems such as closed systems (where water is artificially circulated or re-circulated/reused) or open systems (where fish are contained in more natural bodies of water, such as ponds or sea enclosures).

The production cycles in farmed fish are usually longer than in terrestrial animals. Salmon can be grown for up to three years, while halibut fish can be grown for up to five years.

Around 16,000 tonnes of rainbow trout are produced on an annual basis in the UK. Most of these are farmed in freshwater in tanks, ponds, netting cages and raceways. A small quantity is also farmed in seawater in Scotland.

Production systems

ATLANTIC SALMON PRODUCTION CYCLE

Egg production

Atlantic salmon eggs are generally imported from other countries to the UK but this trend is changing as egg production within the UK increases. The individuals used for breeding purposes, called broodstock, are usually kept in shore-based salt water tanks. Approximately two months prior to the collection of eggs (a process called stripping), broodstock are moved into freshwater tanks.

The eggs are then fertilised in hatcheries by mixing them with seminal fluid (also called *milt)*.

The eggs are disinfected and hardened to prevent diseases such as *Saprolegnia.*

The eggs are then laid on trays, and any infertile eggs are removed by ‘shocking’ the eggs while transferring them from one container to another.

Nursery

The eggs hatch into ‘alevins’ or ‘yolk sac-fry’ that will stay at the bottom of the trays until the yolk sac is absorbed. The alevins start to rise up into a water column when they are ready for first feeding. These ‘first feeding fry’ are then transferred to larger indoor tanks. At around 5g, the young salmon are sorted by size (and are then referred to as ‘parr’), to avoid dominance hierarchies developing. During the parr stage, some may be moved to freshwater lochs while the rest are kept in tanks.

Credit: E. Peter Steenstra/USFWS

An Atlantic salmon yolk sac-fry

Smoltification

The ‘smoltification’ process usually occurs between 6 and 12 months post-hatching and involves a number of morphological, behavioural, and biochemical changes to the fish which allow them to adapt to the seawater environment. In salmon farming, this process is influenced by the change in day lengths. Prior to smoltification, most salmon are vaccinated against the major seawater diseases.

Ongrowing phase

Once the fish are ready for seawater, they will be moved to sea pens for one to two years. Seawater maximum stocking densities can vary depending on the country of production. During the ongrowing phase, fish are fed daily and allowed space to exercise. If required, the fish will also be treated against naturally occurring parasites.

Key welfare issues

WATER QUALITY

Water quality represents one of the most important elements in fish farming as changes can result in negative welfare consequences. For example, a lack of oxygen (O^2) can lead to respiratory distress in the fish, while a higher concentration can lead to conditions such as gas bubble disease and can cause embolisms in alevins. It has also been shown that elevated carbon dioxide (CO^2) can affect growth rates and disturb the acid-blood balance of the fish.

Parameters such as pH, temperature, light, and metal levels are also very important. Alevins are very sensitive to extreme pH, and low pH coupled with low oxygen levels and high metal concentrations can result in high mortalities. Temperature and light will have an influence on feed intake, and some studies have suggested that continuous light could lead to eye damage in fish. Extreme and rapid changes of temperature have been linked to deformities and severe stress in salmon[7] . Finally, it has been shown that the presence of metals such as Aluminium can impair the efficacy of the fish's gills.

HANDLING

Grading

Grading is primarily used to reduce the development of dominance hierarchies in freshwater when differences in sizes occur. This can have negative consequences to the welfare of fish if operated by untrained staff as it can cause significant stress to the animals when removed from the water, or can cause damage to the scales or the skin of the fish.

Crowding

Handling and grading procedures usually require crowding of the fish. This process consists of confining the fish to a specific area of the tank at very high stocking densities, which has been shown to cause stress to the fish and can affect growth rates as well as increasing risks of damage and mortality, particularly if water quality is not maintained or the process is not carried out in a controlled manner.

Monitoring

Current fish production systems do not allow the monitoring of fish at the individual level, who are therefore generally treated as a group. This can cause serious welfare issues as, in salmon farming for example, the fish are transferred from freshwater to saltwater during smoltification regardless of the fact that some individuals may not be physiologically ready to be transferred into salt water. Those who are not ready will suffer major problems in salt water.

In addition, larger sea pens may not allow the catching of individual sick fish who therefore become a disease risk for the rest of the population. The presence of good stockpeople as well as the presence of underwater water systems can help monitoring fish welfare, however this is usually not enough to assess welfare at the individual level. Recent advances in video and AI technology has allowed improvements in monitoring of individuals but this is not widespread yet.

TRANSPORT

Transport

The transport of fish is usually carried out in specific transport tanks either by road, by air (helicopters), or by sea (wellboats). When transported by sea, fish are pumped into the wells of the boat, which are located in the hull. Usually the water is circulated through the wells using open valves to allow fresh seawater to enter. However modern wellboats have the ability to recirculate the water to maintain water quality and avoid discharging water near to other fish farms.

All transport, whether by road, boat or helicopter, can potentially be stressful for fish. Therefore, extra care must be practised during transport to minimise the negative impacts on the fish, particularly when loading and unloading the fish. The water conditions during transport must be monitored so that parameters such as oxygen and temperature do not change and impact the welfare of the fish.

Salmon farm on a freshwater loch

The transport of fish from freshwater systems to seawater also has the potential to negatively affect their welfare in addition to causing economic losses due to fish being injured and mortalities.

Finally, the level of competence of the operators is a very important aspect in transport. As transport is usually performed by third party organisations, this sometimes proves to be challenging to assess.

DISEASES

Sea lice

Sea lice infestation of farmed salmon has been the subject of much research and is considered to be one of the greatest challenges facing Scottish aquaculture. Sea lice can result in many health problems in fish and are detrimental to both the health and welfare of farmed salmon. Once attached to its host, the sea louse eats away at the skin of the salmon and causes physical damage, in the form of lesions. The site of the lesion is then susceptible to secondary infections. Sea lice can also stress the fish which, in turn, can negatively impact their immune system – increasing their susceptibility to other infections and diseases. There are a number of control strategies to reduce sea lice infestation, such as medicinal, biological or physical treatments (see our 'Sea lice control in farmed Atlantic Salmon' information sheet for more details).

Gill disease

The gills of fish are very sensitive and are continuously exposed to the external environment which makes them susceptible to damage from pathogens and parasites or other waterborne insults, as well as toxins in the water. Gill damage can be very detrimental to the welfare of fish and makes practices like handling much more hazardous. Maintaining appropriate water quality parameters and monitoring the water for plankton or pathogens is very important in ensuring the gills are kept in as good condition as possible.

USE OF CLEANER FISH

Cleaner fish, such as Wrasse and Lumpfish, have recently started to be farmed in the UK. As salmon can suffer from sea lice, cleaner fish are often introduced to salmon pens to feed on the sea lice, thereby reducing their impact on the salmon. Because the farming of wrasse and lumpfish is a relatively new industry, it is still in development. However, producers are attempting as best as possible to reflect the fish's natural life cycles and behaviours through their farming practices. For example, wrasse often seek out crevices and places to hide in the wild, therefore wrasse farmers often introduce environmental enrichment to their wrasse tanks. This often includes artificial kelps and hides, which aim to replicate the wrasse's natural environment and facilitate their natural behaviours.

Work of the RSPCA to improve fish welfare

RSPCA WELFARE STANDARDS

The RSPCA believes that fish have the mental capacity to feel pain and suffer, and that their welfare should be safeguarded in the same way as any other farmed animal. Each species of fish farmed in the UK exhibit different behaviours and preferences relating to their feeding, shoaling and the environments they prefer. The RSPCA would like all farmed fish to be reared in environments that enable them to perform their natural behaviours. Therefore, the RSPCA encourages fish producers to adopt the RSPCA welfare standards which have been developed to ensure that higher standards of animal welfare are met at all stages of the animals lives. The standards cover all key areas affecting fish welfare including water quality, stocking density, handling, health, slaughter and wider environmental impact.

The RSPCA is focusing on innovations around the aquaculture industry to assess the welfare impact on fish. Our welfare standards for the transportation of fish in wellboats, for example, resulted from over 2 years of research on the subject.

CAMPAIGN WORK

The RSPCA is calling for urgent amendments to the Agriculture Bill to ensure higher welfare protections for farm animals. In addition, the RSPCA is calling on the UK Government to recognise animal sentience in law.

FARMED FISH INFORMATION SHEET

ADVOCACY WORK

The RSPCA is working closely with the aquaculture industry in relation to the welfare of fish in finfish aquaculture, and salmon and trout in particular. This dynamic and collaborative way of working with the industry is helping to achieve welfare improvements for salmon and trout.

We take every opportunity to engage with decision makers and to put forward our views to encourage improvements for the welfare of farmed fish. We are members of the European Animal Welfare Platform (EAWP), which identifies best practice and looks into areas in which more research is needed into fish welfare. We are also members of the Marine Scotland technical working group looking at providing minimum technical definitions/industry standards for certain aspects of the fish farming process. We routinely contribute to national and international reviews and engagement processes relating to improving farmed fish welfare.

How you can help!

If you eat meat, eggs or dairy products and are concerned about welfare then look out for products carrying the RSPCA Assured logo. RSPCA Assured is the RSPCA's farm assurance and food labelling scheme that aims to ensure animals are reared, handled, transported and slaughtered/killed according to strict RSPCA welfare standards, developed by the RSPCA. The RSPCA welfare standards are informed by scientific evidence and practical experience.

If more consumers insist on higher welfare products, more supermarkets will want to stock them, which will encourage more farmers, hauliers and abattoirs to improve their practices and ultimately more farm animals will benefit.

Take part in the RSPCA's campaigns for farm animals by visiting www.rspca.org.uk/campaigns.

RESEARCH PROJECTS

We have conducted our own applied research looking at how freshwater stocking densities affect fish welfare and this has been incorporated into our salmon standards.

The Assurewel project was aimed to assess the effect of inputs (resources such as feed, space and bedding) on an animal's welfare. This joint project between the RSPCA, Bristol University and Soil Association came to an end in 2016, however we are continuing to look at developing a system for welfare outcome assessment for all major farmed animal species, including fish, for incorporation into farm assurance.

The RSPCA is also involved in a number of industry wide projects, including researching the impact of thermal delousing on fish health and welfare so that standards and recommendations can be made and implemented and looking at the risk factors involved in Saprolegnia infections in freshwater.

Recommended further information

- RSPCA website: https://www.rspca.org.uk/adviceandwelfare/farm/fish
- FAWC (2014) Opinion on the Welfare of Farmed Fish.
- EFSA (2008) Animal welfare aspects of husbandry systems for farmed Atlantic Salmon
- FAO Fisheries and Aquaculture resources – Salmo salar: http://www.fao.org/fishery/culturedspecies/Salmo_salar/en

References

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