INVESTOR BRIEFING NO. 23

MARCH 2016

Animal Welfare in Farmed Fish

Dr Martin Cooke

Finfish are globally the most numerous farmed animals. The world's leading food retailers and food brands include farmed finfish among their products, and they are a major source of affordable protein, especially in developing countries.

There is a huge biological diversity of farmed species and husbandry requirements for both freshwater and marine aquaculture. Finfish are sentient and deserve equivalent welfare considerations (i.e. in their breeding, feeding, husbandry, health, transport and slaughter) as terrestrial farmed species.

This briefing paper is intended to introduce users of the Business Benchmark on Farm Animal Welfare to animal welfare issues in aquaculture. It is not the objective to consider every possible welfare issue in all farmed species, but to highlight the more significant issues affecting commercially important species.

Background

At any given time, the number of finfish - that is, true fish as distinct from shellfish - being farmed in the world exceeds the total number of all terrestrial farm animals. Aquaculture output is almost equivalent on a global scale to that of capture fisheries, and in some regions it is higher. The World Bank estimates that 62% of all food fish will come from aquaculture by 2030[1].

According to the latest Food and Agriculture Organisation (FAO) statistics[2], in 2013 global aquaculture production was in excess of 97 million tonnes. Farmed finfish made up 47 million tonnes of this total (up from 44 million tonnes in 2012), while crustaceans, molluscs and other farmed aquatic food animal species accounted for 23 million tonnes. This compares to an estimated 308 million tonnes of red meat and poultry meat produced in the same year[3]. Finfish aquaculture was worth $94 billion in 2013 and is steadily increasing; between 2003 and 2013, global production

[1] World Bank (2013), *'Fish to 2030: Prospects for Fisheries and Aquaculture'* – available at: http://documents.worldbank.org/curated/en/2013/12/18882045/fish-2030-prospects-fisheries-aquaculture
[2] FAO (2015), Global Aquaculture Production statistic database (updated to 2013) – available at: http://www.fao.org/3/a-i4899e.pdf
[3] FAO (2014), 'Food Outlook: Biannual Report on Global Food Markets' – available at: http://www.fao.org/3/a-i4136e.pdf

doubled in volume and averaged a 9% year-on-year increase in value, in line with the growth over the same period in the global food price index.

China has by far the world's largest finfish aquaculture industry, responsible for over 55% of global output by volume in 2012, with three-quarters of production involving freshwater species. The next largest market is India, which is responsible for 9% of global output. In terms of marine aquaculture, Norway's Atlantic salmon (*Salmo salar*) industry makes it the world's largest marine aquaculture producer, although this accounts for just 3% of total world farmed finfish output.

Farmed finfish production by country (2012)

Producer	Inland Aquaculture		Marine Aquaculture		Farmed Finfish Total	
	tonnes	%	tonnes	%	tonnes	%
China	23,341,134	60.5%	1,028,399	18.5%	24,369,533	55.2%
India	3,812,420	9.9%	84,164	1.5%	3,896,584	8.8%
Indonesia	2,097,407	5.4%	582,077	10.5%	2,679,484	6.1%
Vietnam	2,091,200	5.4%	51,000	0.9%	2,142,200	4.9%
Bangladesh	1,525,672	4.0%	63,220	1.1%	1,588,892	3.6%
Norway	85	0.0%	1,319,033	23.8%	1,319,118	3.0%
Egypt	1,016,629	2.6%		0.0%	1,016,629	2.3%
Myanmar	822,589	2.1%	1,868	0.0%	824,457	1.9%
Chile	59,527	0.2%	758,587	13.7%	818,114	1.9%
Philippines	310,042	0.8%	361,722	6.5%	671,764	1.5%
Brazil	611,343	1.6%		0.0%	611,343	1.4%
Thailand	380,986	1.0%	19,994	0.4%	400,980	0.9%
Japan	33,957	0.1%	250,472	4.5%	284,429	0.6%
USA	185,598	0.5%	21,169	0.4%	206,767	0.5%
Rep. Korea	14,099	0.0%	76,307	1.4%	90,406	0.2%
Top 15 Sub-total	36,302,688	94.1%	4,618,012	83.2%	40,920,700	92.7%
Rest of World	2,296,562	5.9%	933,893	16.8%	3,230,455	7.3%
World	38,599,250	100.0%	5,551,905	100.0%	44,151,155	100.0%

Source: FAO

While more than 600 finfish species are farmed worldwide, the majority of global aquaculture relies on a few dozen species. Freshwater species account for 85% of global finfish aquaculture production volume (65% by value). Carp predominates in this group, representing 33% of global production by volume (64% by value). Diadromous species (i.e. species that can have marine and freshwater lifecycle phases, such as salmon and trout) account for only 10% of global production by volume, yet they represent 23% by value. Exclusively marine species, such as seabass and seabream, make up the remainder.

Patterns of production vary with location. For example, carp species are the most numerous farmed finfish in China, while, in the USA, catfish predominate. In the UK, Atlantic salmon from Norway and Chile is the main aquaculture species. In fact, within the UK retail sector, farmed salmon is the number one fresh fish (by volume and by value); it is also the UK's largest food export (worth over £500 million in 2014) to, principally, the USA, Europe and the Far East.

Finfish aquaculture (especially inland, fresh water aquaculture of herbivorous and omnivorous finfish species) is the primary source of affordable quality protein food in many developing countries. In 2012, aquaculture provided 9.41 kg of fish and other aquatic animal species for consumption per person in the world.[4]

Fish welfare

There is strong evidence that finfish, like other vertebrate animals, are sentient[5,6]. This means that fish are self-aware; they can feel pain and distress, they have long-term and short-term memory and, to some extent, they can experience emotions. Consideration of finfish welfare is based on the same principles as for terrestrial vertebrate species.

The World Organisation for Animal Health (OIE) defines animal welfare by the way in which an animal copes with the conditions in which it lives; an animal is in a good state of welfare if, as indicated by scientific evidence, it is healthy, comfortable, well nourished, safe, able to express innate behaviour, and not suffering from unpleasant states such as pain, fear, and distress. Thus, animal welfare refers to the state of the animal. The treatment that an animal receives is covered by other terms, such as animal care, animal husbandry, and humane handling.

A briefing paper published by Compassion in World Farming[7], indicates that intensive aquaculture practices frequently expose fish to a range of stressors (e.g. the stripping of broodfish, handling, vaccinations, crowding, grading, starvation, treatments, loading and transportation), which do not exist for wild fish.
Given the diversity of farmed finfish species and aquaculture systems, it is beyond the scope of this briefing to consider each in detail. Instead we focus on ten significant animal welfare factors, which have come to the attention of opinion formers, consumers and the wider public in the USA and Europe. These include issues relating to the selection of genetics and species for farming, feed, husbandry practices, health, transport and humane slaughter (see pages 7 to 14).

[4] FAO (2014), Global Aquaculture Production Volume and Value Statistics Database Updated to 2012 – FAO Fisheries and Aquaculture Department– available at: *ftp://ftp.fao.org/fi/stat/Overviews/AquacultureStatistics2012.pdf*

[5] For example, Chandroo, K.P, Duncan, I.J.H, Moccia, R.D. (2004). '*Can fish suffer? Perspectives on sentience, pain, fear and stress*', *Applied Animal Behaviour Science*, 86, 225–250

[6] Kittilsen. S. (2013) Functional aspects of emotions in fish. *Behavioural Processes*, 100, 153-159

[7] Compassion in World Farming (2009), '*The Welfare of Farmed Fish'* – available at: https://www.ciwf.org.uk/media/3818654/farmed-fish-briefing.pdf

Guidance and standards on finfish welfare

World Organisation for Animal Health (OIE)

The World Organization for Animal Health (OIE) defines the basic principles of animal welfare. The OIE has around180 Member Countries and is recognised as the reference organisation by the World Trade Organization (WTO) for standards relating to animal health and welfare. As such, OIE standards represent internationally agreed guiding principles for animal health and welfare. The OIE's Terrestrial Animal Health Code and Aquatic Animal Health Code exists to ensure the sanitary safety of international trade in terrestrial animals and aquatic animals and their products. Furthermore, its Aquatic Animal Health Code (the 'Aquatic Code') sets out standards for the improvement of aquatic animal health and welfare of farmed fish worldwide, including standards for safe international trade in aquatic animals (amphibians, crustaceans, fish and molluscs) and their products.

The OIE cites as guiding principles that:

- There is a critical relationship between fish health and fish welfare.
- The use of fish in harvest or capture fisheries, in research, and for recreation (e.g. ornamental and aquaria), is a major contribution to the wellbeing of people.
- The use of fish carries with it an ethical responsibility to ensure the welfare of such animals to the greatest extent practicable.
- Improvements in farmed fish welfare can often improve productivity and hence lead to economic benefits.
- The internationally recognised 'Five Freedoms'[8] provide valuable guidance in animal welfare.
- The scientific assessment of fish welfare involves both scientifically derived data and value-based assumptions that need to be considered together, and the process of making these assessments should be made as explicit as possible.
- Equivalent outcomes based on performance criteria, rather than identical systems based on design criteria, should be the basis for comparison of animal welfare standards and recommendations.

European Food Safety Authority (EFSA)

The European Food Safety Authority (EFSA) Scientific Panel on Animal Health and Welfare (AHAW) has issued various opinions on the welfare of fish. The Panel provides independent scientific advice on all aspects of animal diseases and animal welfare. Through its activities on fish welfare, EFSA aims to provide a science-based foundation for European policies and legislation, and to support risk managers in identifying methods to reduce unnecessary pain, distress and suffering for animals and to increase welfare where possible. EFSA is not mandated to give advice on ethical or cultural issues related to animal welfare.

[8] The OIE defines the Five Freedoms as: Freedom from hunger, thirst and malnutrition; Freedom from fear and distress; Freedom from physical and thermal discomfort; Freedom from pain, injury and disease; and Freedom to express normal patterns of behaviour.

In 2008, the EFSA was asked by the European Commission to assess welfare aspects of husbandry systems for the main farmed fish species within the EU. The AHAW Panel has adopted five species-specific[9] opinions in which potential risks[10] for welfare have been identified across different life stages. Furthermore, in 2009, the AHAW Panel adopted seven species-specific[11] opinions on the welfare aspects of stunning and killing methods for farmed fish.

Aquaculture Stewardship Council (ASC)

Founded in 2010 by WWF and IDH (Dutch Sustainable Trade Initiative), the Aquaculture Stewardship Council (ASC) is an independent not-for-profit organisation, which aims to be the world's leading certification and labelling programme for responsibly farmed seafood. Being consumer focused, products from certified farms may bear the ASC logo. Its standards cover salmon, *Tilapia* spp., *Pangasius* spp. (basa, river cobbler), *Seriola* spp. (amberjack) and cobia (black kingfish, *Rachycentron canadum*) and various farmed invertebrate species.

The focus of ASC standards is on the environmental and social impacts of aquaculture. Although animal welfare is not included explicitly, it is addressed indirectly in most of the individual ASC species standards (i.e. through water quality parameters, siting of production facilities, survival performance measures, and procedures for the treatment of sick fish and the use of medicated feed). Since the ASC standards do not effectively cover animal welfare, they cannot give reliable assurance of the welfare status of farmed finfish.

GLOBALGAP aquaculture standard

GLOBALGAP is a worldwide, business-to-business standard for safe and sustainable food production. It sets strict criteria for Good Agricultural Practices across a broad range of products, including traceability back to certified farms or production facilities, which farmers must comply with if they wish to sell their products to major retailers around the world.

The GLOBALGAP aquaculture standard covers legal compliance, food safety, worker welfare, environmental care, ecological care and animal welfare. It applies to salmon, trout, *Tilapia* spp. and *Pangasius* spp. as well as various invertebrates. It covers the entire production chain, from broodstock, seedlings and feed suppliers to farming, harvesting and processing. The inspection checklist comprehensively covers more than 100 control points relating to the management of animal welfare, including aspects such as staff training in animal welfare, predator control, biosecurity, transport and slaughter. While the inspection procedure does not include direct assessment of fish welfare (i.e. examination of fish), GLOBALGAP certification provides a reasonable level of assurance of finfish welfare.

[9] Species include: farmed Atlantic salmon, rainbow trout (*Oncorhyncus mykiss*) and brown trout (*Salmo trutta*), European eel (*Anguilla anguilla*), European seabass (*Dicentrarchus labrax*), gilthead seabream (*Sparus aurata*) and common carp (*Cyprinus carpio*)

[10] These include environmental conditions, feeding, husbandry practices, genetic make-up of stocks, disease and disease control measures.

[11] Species include: Atlantic bluefin tuna (*Thunnus thynnus*), common carp, European eel, Atlantic salmon, rainbow trout, European turbot (*Psetta maxima*), European seabass and gilthead seabream

Best Aquaculture Practices
A division of the Global Aquaculture Alliance (GAA), Best Aquaculture Practices (BAP) is an international certification programme based on achievable, science-based and continuously improved performance standards for the entire aquaculture supply chain - farms, hatcheries, processing plants and feed mills. BAP certification is based on independent audits, which evaluate compliance with the BAP standards developed by the Global Aquaculture Alliance (GAA). The BAP standards currently cover salmon, *Tilapia* spp., *Pangasius* spp. and channel catfish (*Ictalurus punctatus*), as well as carp and various other (primarily marine) species.
Although predominantly focusing on environmental responsibility, BAP certification standards cover the key elements of responsible aquaculture, including, social responsibility, food safety, animal health and welfare, and traceability. The animal welfare component is most comprehensively covered in the salmon standard, but it is less well covered in the general Finfish and Crustacean Farms standard, which is applicable to all other species.

RSPCA Assured (Freedom Food)
RSPCA Assured (previously Freedom Food) is the RSPCA's ethical food label dedicated to farm animal welfare. RSPCA Assured has two finfish aquaculture standards, covering Atlantic salmon (*Salmo salar*) and rainbow trout (*Oncorhynchus mykiss*). These are detailed in comprehensive assurance standards, which stipulate a high level of fish welfare. Although not strictly a global standard, RSPCA Assured is relevant to this briefing since farmed European salmon is significant in global trade. RSPCA Assured is recognised as the only scheme in Europe dedicated to farm animal welfare and has been acknowledged as a higher-level scheme by the UK government. Unlike other schemes, it is completely independent from the food and farming industries. The RSPCA's welfare standards are written by its team of scientific officers in the Farm Animals Department and are based on leading scientific, veterinary and practical industry expertise.

Animal welfare factors

Animal welfare concerns for all species, including finfish, are typically the consequence of a combination of adverse factors. For simplicity, this briefing focuses on some of the most consistently reported issues that affect animal welfare involving commercially important species. Given that signs of poor fish welfare may be the result of several coexisting causal factors, the management of finfish health and welfare should follow a broad approach, taking into account various processes along the value chain.

Factor 1 – Selection and breeding
Animal welfare can be improved by selecting for characteristics, such as good adaptation to local conditions and disease resistance. Typical practices include:

- Controlling the timing of breeding and egg production by manipulating day length and through the use of hormone treatments.
    - Eggs are normally harvested by manually stripping them from females in most species. Semen (milt) may also be obtained by stripping.

  - Given that these procedures involve intensive manual handling, are stressful for fish and may result in physical injury, broodfish should be anaesthetised. In species where eggs or milt can only be obtained surgically, fish should first be stunned prior to slaughter.
  - Heat treatment of the eggs of certain fish species (particularly salmon and trout) may be used to induce triploidy – a condition in which the fish has three copies of each chromosome instead of the normal two (diploid). All triploid fish are female and sterile, and they grow to a larger size than diploid fish.
  - Commercial tilapia production generally requires the use of male monosex populations. Male tilapia grow twice as fast as females. Mixed-sex populations develop a large size disparity among harvested fish, which affects marketability. The sex of female fry (i.e. pre-juvenile fish) may be reversed through administering a male sex hormone in their feed. Embryonic fish and fry are particularly sensitive to environmental changes such as temperature, pH and oxygen fluctuation. Consideration of fish welfare should always include aspects of broodfish and hatchery management.
- Eels are a significant farmed fish in Europe, particularly in the Netherlands, Italy and Denmark. Juvenile stock is obtained entirely by capture of eel larvae (glass eels) from the wild during their migration from the Sargasso Sea into European and Mediterranean freshwater systems. Since there is a strong market for the consumption of (dead) glass eels, there is little incentive to have regard for their welfare during capture and in post-capture storage.

Factor 2 – Feed and nutrition

Larval fish are generally fed on live zooplankton (e.g. rotifers). Larval first feeding is a particularly sensitive stage. Inadequate size or abundance of live feed at this stage can result in metabolic stress and may lead to cannibalism.

- Salmon, trout and other marine species require a significant proportion of fishmeal and fish oil in their diet, originating typically from huge industrial fisheries in South America. Although efforts have been made (for environmental and economic reasons) to reduce fishmeal and fish oil by using other protein sources such as soya, canola and poultry meal, more than 50% of the ration of growing fish may be fish-derived.
- Common carp can be produced in extensive systems in stagnant water ponds, using monoculture (single species) or polyculture (i.e. stocked with other carp species such as tilapia) systems. This enables a natural food and supplementary feed-based production method, in which fish that have different feeding habits and occupy different trophic niches are stocked in the same ponds. Artificial feed-based intensive monoculture production can be carried out in cages, irrigation reservoirs, and running water ponds and tanks, or in recirculation systems. Food supply is the main factor governing stocking density.

- Channel catfish are reared in ponds, cages, and circular tanks or linear raceways in the United States and China. Monoculture dominates in the United States, while in China, both monoculture and polyculture occurs with traditional species, such as carp. Formulated vegetable-based feeds are used. In pond based systems animal manures provide nutrients that stimulate the growth of protein-rich phytoplankton, which is consumed by filter feeding tilapia. In more intensive cage and raceway systems, supplementary feed, usually containing soybean meal and fish protein, is provided.

In all species, insufficient feed supply or poor quality feed will result in poor growth and low survival. Undernourished fish are stressed and less resilient to other problems, such as infectious disease, which may compromise welfare.

Factor 3 – Husbandry – water quality

Water quality is arguably one of the most critical factors affecting finfish welfare and should be closely monitored in all aquaculture systems. Some species (e.g. carp) are very tolerant of poor water quality, coping with a wide temperature range, low oxygen levels and high levels of suspended solids. Nevertheless rapid changes in water quality can cause welfare hazards. For example, algal blooms can affect pH balance and toxicity, and collapsed algal blooms can deplete oxygen levels and release ammonia. In marine and river species, poor water flows can result in localised oxygen depletion and carbon dioxide accumulation in sea pens and raceways, causing significant stress. Sea pens and raceways should be sited to ensure optimal water flow. Eutrophication of rivers (e.g. from fertiliser pollution) can reduce oxygen availability.

Factor 4 – Husbandry - stocking density

Stocking density is a major factor affecting fish welfare and is perhaps the easiest for fish farm managers to control. Stocking density influences fish health and welfare at all lifecycle stages and its effects interact with other aspects of fish welfare. Excessive stocking density can lead to fin damage and other injuries, increased aggression, behaviour alteration (including reduced feed intake) and increased vulnerability to infectious disease. All of these are significant welfare hazards.

Space requirements depend on each species' biology and growth stage. For some species, maximum stocking densities are defined in assurance standards and industry codes of practice. For organic production maximum stocking density may be defined in legislation. Crowding for management purposes, such as transport or vaccination, is stressful for all finfish, particularly so for solitary species. It should be avoided as far as possible and, when necessary, only imposed for the minimum feasible time. Finfish should be given enough space to avoid deterioration of water quality, to avoid aggressive encounters, to allow the expression of normal behaviour and to avoid abnormal behaviours associated with poor welfare.

Factor 5 – Husbandry - management procedures

Certain routine management procedures, such as size grading and transferring fish between tanks, ponds or cages can cause stress and injury to fish. Size grading is an important management tool that can enable the detection of diseased or injured fish and can be used ensure correct stocking density. In some systems fin tagging or fin clipping are used to identify broodfish. For example, in the United States, Pacific salmon are reared in commercial hatcheries and released into the wild as young fish (parr or smolts). Virtually all coho salmon (*Oncorhynchus kisutch*) and Chinook salmon (*Oncorhynchus tshawytscha*) produced in Washington state hatcheries are mass-marked by clipping the small adipose fin near their tail. Fishers subsequently catching these species are required to release any unclipped fish.

Wherever possible handling of fish should be avoided. Steps should be taken to avoid harm to fish and to reduce the stress caused by management activities.

Factor 6 – Husbandry - predator control

Finfish in farm pond environments and in sea pens are particularly vulnerable to the effects of predation. As well as the obvious effects of predation, the presence of birds (e.g. cormorants, ospreys and fish-eating eagles) or mammals (e.g. mink, otters and seals) in marine aquaculture, can induce significant stress to fish, manifested by behavioural changes and reduction in feeding. Therefore, protection fish farms from predators can help to safeguard animal welfare and productivity. However, regard should also be given to the welfare of the predatory animals themselves. Shooting seals and sea birds in an attempt to control the problem is unlikely to be very effective and is certainly controversial. In many places these creatures are themselves protected by law. The use of preventive measures is preferred. These include predator netting both above and in the water, acoustic devices (e.g. bird scarers and seal scrammers) and visual devices (e.g. decoys and flares).

In any aquaculture system where predation is likely to be an issue, risk assessment of the deployment of anti-predator measures should take account of the animal welfare impact on the farmed fish, on the predators themselves, and on any non-target species that may be affected, such as harbour porpoises.

Factor 7 – Finfish health

Farmed finfish are vulnerable to a range of infectious and non-infectious diseases. It is beyond the scope of this briefing note to cover these in any detail. The Aquatic Code provides guidance on the control of major infectious diseases (mostly affecting salmon and trout) in international trade in aquatic animal products. In trout and the freshwater phases of salmon, the fungus *Saprolegnia* can be a major problem. Salmon are also vulnerable to a range of viral and bacterial infections and to infestation with sea lice. In some salmon farms Ballan wrasse (*Labrus bergylta*) are used to control sea lice on the growing fish. In carp, environmental pathogens, often with low grade, chronic effects, are the major concern. Many of the most important infectious diseases of finfish may now be controlled by vaccination.

In common with terrestrial farming good practice, all aquaculture facilities should be registered with a suitably experienced veterinarian and should have a veterinary health plan covering the major preventive procedures, such as vaccinations, as well as outlining procedures for dealing with the most important disease risks. Where disease occurs, it must be promptly and appropriately treated to mitigate welfare impact.

Factor 8 – Antimicrobial agents

The OIE recognises the need for continued access to antimicrobial agents for treating and controlling infectious diseases in aquatic animals. The Aquatic Code (Section 6) provides guidance for the responsible and prudent use of antimicrobial agents in aquatic animals, with the aim of protecting both animal and human health. The OIE recognises that antimicrobial resistance is a global public and animal health concern that is influenced by the usage of antimicrobial agents in humans, animals and elsewhere.

Those working in the human, animal and plant sectors have a shared responsibility to address the risk factors for the selection and dissemination of antimicrobial resistance. This includes the responsible use of antimicrobial agents as well as the promotion of sound animal husbandry methods, hygiene procedures, vaccination and other alternative strategies to minimise the need for antimicrobial use in aquatic animals. Some antimicrobial agents (e.g. copper alloys) are used in marine aquaculture systems to control biofouling of nets and maintaining good water flow through sea pens. Certain antimicrobial agents, once widely used in aquaculture (e.g. malachite green, chloramphenicol, gentian violet, nitrofurans and fluoroquinolones) are banned in certain jurisdictions, because of concerns about the human health consequences of their use in animals. Antimicrobials and other medicines used in aquaculture should only be used under veterinary supervision, in compliance with legislation and in line with OIE guidance. Veterinarians or other aquatic animal health professionals authorised to prescribe veterinary medicines should only prescribe, dispense or administer a specific course of treatment with an antimicrobial agent for aquatic animals under their care.

Better husbandry techniques coupled with the development of vaccines against some of the major infectious diseases have considerably reduced the use of antimicrobial agents in aquaculture.

Factor 9 – Transport

The Aquatic Code (Chapter 7.2) describes the general principles for ensuring the welfare of farmed finfish during transport by air, sea or land. It covers the responsibilities of competent authorities (i.e. governments), owners and transporters in ensuring the fitness of the fish for transport; the competence of the personnel responsible for the fish at all stages; the design of vehicles and handling equipment; the maintenance of suitable water quality during transport; loading, transport and unloading procedures; and contingency planning in the case of emergencies. Food companies should regard the principles contained in the Aquatic Code as a minimum acceptable standard for the transport of farmed finfish.

It is the recommended practice with many species to starve the fish for several days prior to transport. In certain species, this practice can lower metabolic rate and reduce activity and is, therefore, considered to reduce handling stress. However excessive food deprivation can result in depletion of body fat reserves and loss of bodily condition, which is associated with poor welfare. Preparation for transport should include consideration of the fitness of the fish to be transported, the nature and duration of the transport, and the health and welfare implications for the fish being transported and the populations they are to join. Broodfish may be tranquilised prior to transportation. In many aquaculture systems, transport begins by crowding the fish using nets, then pumping them into the transport container or vehicle. Crowding can be particularly stressful for solitary and territorial species (e.g. halibut (*Hippoglossus* spp)), and it should not be performed to the extent that fish show signs of distress. Pumping and poor handling may result in physical injuries, particularly to the fins. Fish should, therefore, be monitored after pumping for signs of wounds or injuries.

During transport the principal concern is for maintenance of satisfactory water quality (e.g. oxygen, carbon dioxide and ammonia levels, pH, temperature and salinity) appropriate to the species being transported. Deterioration of water quality during transport is the most significant animal welfare issue for transporting live fish, especially the depletion of oxygen or accumulation of carbon dioxide and ammonia. Since this is likely to be related to journey time, some assurance standards specify maximum journey times. Some species are more tolerant of poor water quality than others (e.g. carp are remarkably tolerant of low oxygen levels, which would be fatal to other species). In general, fish fry are more vulnerable to poor water conditions than adult fish. Fish should be unloaded as soon as possible, although it may be necessary to acclimatise fish to new conditions if the water quality at the destination is significantly different (e.g. in terms of salinity, pH or temperature conditions) from that at the start.

Factor 10 – Humane slaughter

The Aquatic Code (Chapter 7.3) describes general principles that should be applied to ensure the welfare of farmed finfish during stunning and killing for human consumption. It notes that killing without prior stunning results in poor fish welfare and requires that stunning be used wherever feasible. It covers the competency of personnel as well as the design of holding, transfer and slaughtering facilities. Evisceration quickly follows stunning and killing, so it is imperative that fish are dead before this is done.

Since the technology now exists to slaughter all commercially important species in a humane way, food companies should regard the principles contained in the Aquatic Code as a minimum acceptable standard for the slaughter of farmed finfish. The sale to final consumers of live fish for human consumption is unacceptable. Where local cultural preferences demand that fish are offered for sale alive, competent personnel using recognised methods should conduct humane slaughtering.

The slaughtering process includes pre-slaughter handling, stunning to render the fish rapidly insensible and killing itself. It is common practice with many species to starve the fish for several days prior to slaughter. While the negative welfare effects on finfish are probably less than for warm-blooded animals, hunger is a major welfare issue for all animals. The most important animal welfare hazards in the pre-slaughter phase include crowding stress and mechanical injuries resulting from poor handling. In many commercial aquaculture systems, harvesting begins by crowding the fish using nets, then pumping them to the killing point. Crowding can be particularly stressful for solitary and territorial species. Crowding should not be performed to the extent that fish show signs of distress. Pumping and poor handling may result in physical injury to fish, particularly to the fins.

Fish are slaughtered in commercial aquaculture systems by a variety of methods, which, depending on the species and husbandry system, may or may not involve pre-slaughter stunning. In general, the larger species, such as salmon, are stunned, either by a blow to the head sufficient to damage the brain (percussion) or by electrical means. Both percussion and electrical stunning may be done manually or automatically. Welfare hazards associated with percussion stunning include hitting the fish in the wrong place or not hard enough, either because of inexperienced personnel or, in automated systems, because of poor placement of the fish or poor adjustment of equipment. Poor electrical stunning can occur for similar reasons. However the most frequent cause of poor electrical stunning is using too low electrical currents, resulting in temporary paralysis without complete loss of consciousness. Electrical stunning apparatus is available for group stunning of smaller species, but it is not widely used.

Very large species, such as tuna are killed by shooting (typically under water) or by coring (i.e. inserting a spike into the brain). In other large species, the major blood vessels in the gill arches are severed. Smaller species tend to be killed without stunning by asphyxia in ice slurry, by live chilling, by exposure to air or by carbon dioxide. These methods may also be used for larger species. Without stunning, all of these killing methods represent a significant welfare hazard.

In some markets the majority of farmed finfish are sold alive in food markets. This is particularly the case with carp, which may be exposed to air for extended periods before sale. This represents a significant animal welfare hazard. Retailers should be discouraged from selling live fish.

Taking action

What actions can companies take?

- Companies should explicitly acknowledge the welfare of finfish aquaculture as part of their animal welfare commitments.
- Companies should ensure compliance with the requirements of the OIE's Aquatic Animal Health Code (the 'Aquatic Code'), alongside national legislation and voluntary standards relating to animal welfare.
- Companies should formalise their commitment to ensuring the welfare of finfish in a policy statement or other suitable document.
- Companies should review their positions on key welfare issues (e.g. close confinement, routine mutilations, genetic modification and cloning, the use of antibiotics, pre-slaughter stunning and transportation) and indicate whether or not these stated positions include or exclude finfish aquaculture.
- Companies should ensure appropriate governance structures and management systems are in place to competently manage the welfare of finfish aquaculture internally and through supply chains.
- Companies should indicate the proportion of finfish aquaculture that is assured to basic farm assurance and higher welfare assurance standards.
- Companies should monitor and report on key welfare indicators for finfish.
- Companies should promote welfare aspects of finfish aquaculture to consumers, through labelling and other forms of communication.

What actions can investors take?

- As part of their company engagement activities, investors may ask companies how they are managing business risks and opportunities associated with the welfare of finfish aquaculture. (See 'Actions companies can take' above).
- Investors may refer to the company summary pages produced by the Business Benchmark on Farm Animal Welfare (available for download via www.bbfaw.com) to identify whether or not companies have published information on their management of welfare issues relating to finfish aquaculture.
- Investors may consider signing the BBFAW Investor Statement on Farm Animal Welfare. This will signal to companies that investors believe that the issue of farm animal welfare is potentially material to long-term investment value creation, and is a relevant consideration when forming views on the strategic positioning of companies in the food sector.
- Investors may consider joining the BBFAW Investor Collaboration on Farm Animal Welfare to actively engage with companies on their rankings in the Business Benchmark on Farm Animal Welfare.

About the author

Martin Cooke MRCVS

Martin Cooke is the International Head of Corporate Engagement at World Animal Protection. Martin leads on World Animal Protection's relationships with globally significant companies and helps colleagues to develop functional relationships with regionally and locally significant corporate partners aimed at protecting animals in farming, in disasters, in communities and in the wild. Martin is a member of the Royal College of Veterinary Surgeons and holds a masters degree in Wild Animal Health from the Institute of Zoology. Martin has been a Trustee of the Zoological Society of London (ZSL) since 2012, and has a keen professional interest in wildlife conservation and conservation science.

The **Business Benchmark on Farm Animal Welfare** is designed to help drive higher farm animal welfare standards in the world's leading food businesses. It is the first global measure of animal welfare standards in food companies and is designed for use by investors, companies, NGOs and other interested stakeholders.

For more information, go to www.bbfaw.com or contact the Programme Director, Nicky Amos: nicky@nicky-amos.co.uk.

Appendix 1

Additional reference sources and further reading

FAO Aquaculture resources: *http://www.fao.org/fishery/topic/13530/en*

FAO Fishery Statistics: *http://www.fao.org/fishery/statistics/global-aquaculture-production/query/en*

Farm Animal Welfare Committee – Opinion on the Welfare of Farmed Fish (2014): *https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/319323/Opinion_on_the_welfare_of_farmed_fish.pdf*

Scientific opinions on fish welfare – European Food Safety Authority (2008-2015): *http://www.efsa.europa.eu/en/topics/topic/fishwelfare.htm*

Sentience Mosaic: *http://www.animalmosaic.org/sentience/*

The fish site: *http://www.thefishsite.com*

Appendix 2

Finfish species referred to in this briefing

amberjack (*Seriola* spp.)

basa (*Pangasius* spp.) (*syn*.: river cobbler)

common **carp** (*Cyprinus carpio*)

channel **catfish** (*Ictalurus punctatus*)

Arctic **char** (*Salvelinus alpinus*)

cobia (*Rachycentron canadum*) (*syn*.: black kingfish)

European **eel** (*Anguilla anguilla*)

halibut (*Hippoglossus* spp.)

pintado (*Pseudoplatystoma fasciatum*) (*syn*.: barred sorubim)

Atlantic **salmon** (*Salmo salar*)

Chinook **salmon** (*Oncorhynchus tshawytscha*)

coho **salmon** (*Oncorhynchus kisutch*)

European **seabass** (*Dicentrarchus labrax*)

gilthead **seabream** (*Sparus aurata*)

tilapia (*Tilapia* spp.)

brown **trout** (*Salmo trutta*)

rainbow **trout** (*Oncorhyncus mykiss*)

Atlantic bluefin **tuna** (*Thunnus thynnus*)

European **turbot** (*Psetta maxima*)

Ballan **wrasse** (*Labrus bergylta*)