



**RSPCA welfare
standards for**

**farmed Atlantic
salmon**

July 2007



Certification Mark

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Introduction

The '*RSPCA Welfare Standards for farmed Atlantic salmon*' (*Salmo salar*) cover the two distinct phases of farming (freshwater and marine farming).

They take account of legislation, official codes of practice, scientific research, veterinary advice, recommendations of FAWC and the practical experience of the aquaculture industry. However, difficulties arise in specifying details in relation to several issues (for example, acceptable maximum stocking densities) due to the lack of scientific research examining fish welfare under different commercial systems. It is important to recognise therefore that the following requirements are made pending the relevant scientific research. To this end, the farmer is expected to maintain higher welfare standards at all times and demonstrate commitment to continual improvement as advances in knowledge and technology allow.

Scientific evidence from behavioural, physiological and anatomical studies shows that it is highly likely that fish feel pain. Fish also have a similar stress response system to mammals. It is essential that staff managing farmed fish are aware of the importance of welfare as an integral part of production.

A written Veterinary Health Plan (VHP) must be drawn up, which is regularly updated, in order to ensure higher standards of welfare. Each farm must have a designated fish veterinary surgeon available to advise on fish health matters and able to attend at short notice in case of disease. An Environmental Impact Management Plan must also be drawn up to closely monitor and minimise any effects of the operation on the wider environment.

Not all salmon farming companies are integrated and, therefore, there may be difficulties for seawater phase producers in obtaining smolts reared according to the RSPCA Welfare Standards. For this reason there is a derogation that smolts may be derived from sources where they have not been reared according to these standards for a period of two years after joining the scheme.

The 'Five Freedoms' as defined by FAWC are relevant to fish welfare and should be considered in relation to husbandry practice.

- ▶ Freedom from thirst, hunger and malnutrition
by access to an appropriate high quality diet and an environment in which fluid and electrolyte balance can be maintained.
- ▶ Freedom from discomfort
by maintaining the water at an appropriate temperature and chemical composition and providing well designed enclosures or tanks, with shading if necessary.
- ▶ Freedom from pain, injury or disease
by avoiding situations which are likely to cause pain, injury or disease, by rapid diagnosis and treatment of disease and humane killing.
- ▶ Freedom to express normal behaviour
by providing the appropriate space and environment for the species.
- ▶ Freedom from fear and distress
by minimising stressful situations such as handling or predator attack as far as possible, by making gradual changes to husbandry and water quality, and by humane slaughter.

These freedoms will be better provided for if those who have care of livestock practise:

- caring and responsible planning and management
- skilled, knowledgeable and conscientious stockmanship
- appropriate environmental design
- considerate handling and transport
- humane slaughter.

Guide to the use of the RSPCA welfare standards

- (i) At the head of each section the broad objectives of the standards are described.
- (ii) The numbered requirements are the standards, all of which must be complied with.
- (iii) Boxed sections (indicated by ①) give additional advice or may highlight areas where the standards will be reviewed in the future.

Freedom Food Ltd

Freedom Food is a wholly owned subsidiary of the RSPCA, formed to implement these standards. Upon satisfactory inspection farmers, hauliers, slaughterers, processors and retailers may subscribe to the scheme and use the Freedom Food trademark. All participants are regularly assessed by Freedom Food Ltd. A charge is levied to cover inspection, administration and marketing costs. Participants are also randomly monitored by members of the RSPCA Farm Animals Department, free of charge.

It is the intention of Freedom Food Ltd to establish sister, franchise organisations in other countries working to the RSPCA welfare standards and therefore, in time, establish a common and consistent message for consumers around the world.

Freedom Food Ltd is non-profit making. Any surplus income will be used to fund research into farm animal welfare.

Freshwater

The freshwater phase of the Atlantic Salmon lifecycle involves a number of separate stages. These stages range from the egg through to the fully smolted fish. All of them require detailed standards which ensure the welfare of the fish through the stages of the freshwater phase. These standards also need to ensure that the fish are fully prepared for the seawater phase of their lives. The welfare standards pertaining to the seawater phase are contained elsewhere in this document.



For the purposes of these standards the following definitions apply:

- Green eggs
Fertilised eggs that are water hardened up to the time that you can see the initial pigment of the fish eye with the naked human eye. This will be at approximately 220 degree days.
- Eyed eggs
Eggs that have reached the stage of development where the black spot of the eye is clearly visible.
- Alevins
Hatched eggs after 290 degree days and ready for first feeding.
- Fry
Starting from 0.2 grams up to 1 gram.
- Parr
Greater than 1 gram and up to 5 grams.
- Pre-smolt
From greater than 5 grams to signs of smolting.
- Smolts
Fully smolted.

These standards relate to both re-circulation and flow through systems.

General



There are areas of ongoing research which are designed to add to our knowledge about the welfare of the eggs and the fish at this stage of their lifecycle. If any new scientific evidence emanating from this research is shown to have a positive effect on the welfare of the eggs and fish involved, the RSPCA will seek to incorporate this information into subsequent versions of their standards. Some of this research may challenge what is at present deemed to be established practice. For example, if it is concluded that the production of a certain type of smolt is detrimental to its welfare, the RSPCA will not permit such fish to be produced as a part of the RSPCA welfare standards.

FW 1.1 Eggs and juvenile fish must be produced either in-house or obtained from another accredited supplier.

FW 1.2 All eggs must be tested for specified fish pathogens as required under the relevant European and national legislation.

Freshwater

- FW 1.3 Eggs and juvenile fish supplied by third parties must be accompanied by full health documentation and records of the parent stock as well as the eggs and juvenile fish themselves.
- FW 1.4 Supply water must:
- be of high quality
 - if necessary, be filtered or treated with ultra violet radiation.
- FW 1.5 Deterioration of water quality due to fouled nets or over feeding must be avoided.
- FW 1.6 The following maximum stocking densities must not be exceeded:

| | Maximum stocking density |
|-----------------------------------|--------------------------|
| Hatchery | 15000/m ² |
| First feeding tank | 10000/m ² |
| Freshwater production tank | 30kg/m ³ |
| Freshwater enclosure | 12kg/m ³ |
| Freshwater enclosure site maximum | 10kg/m ³ |

*

i Stocking densities are of central importance for fish welfare. High stocking densities in freshwater production tanks can cause poor water quality, increased disease transmission and physical damage. Low stocking densities do not necessarily equate to higher welfare states for the fish. Ensuring fish welfare is a multi-factorial process, taking into account factors such as stocking density, water temperature and water quality. Hence, making statements about fish welfare based on stocking density alone can be unhelpful. The RSPCA supports the view of the Farm Animal Welfare Council (FAWC) that the stocking density must allow fish to show most normal behaviour with minimal pain, stress and fear. However, good scientific information concerning the effects of freshwater stocking density on fish welfare is lacking.

The RSPCA is aware that some freshwater producers are currently rearing fish in production tanks at levels higher than the 30kg/m³ stated in the RSPCA welfare standards, with no apparent detrimental effects to fish welfare. Where this is the case, for a period of 2 years commencing 1 January 2007, the RSPCA will gather further information and compare the condition and welfare of fish reared under different commercial stocking densities and systems. During this period, a derogation may be granted if a producer can demonstrate, with reference to detailed health records and records relating to fish condition and physiology, that suitable stocking densities are being employed that optimise fish welfare.

The stocking densities in the table above will be reviewed in 2009, or sooner should scientific research or practical application suggest that this is necessary. However, if at any time during this 2-year period it becomes obvious that a particular stocking density is not conducive to good fish welfare, then it will not be permitted under the *RSPCA Welfare standards for farmed Atlantic salmon*.

If, at the end of this 2 year review period there is no evidence to show that stocking densities in freshwater production tanks above 30kg/m³ are beneficial for fish welfare, then the standard will not be amended and will stay at a maximum of 30kg/m³.

Freshwater

FW 1.7 * The table below shows water quality parameters that must be complied with:

| Parameter | Eggs | Alevins/fry | Parr/Smolts | Seawater |
|-----------------------------------|----------------|----------------|----------------|-----------|
| Oxygen (O ₂) | 7mg/litre | 7mg/litre | * 6mg/litre | 6mg/litre |
| Free ammonia (NH ₃) | N/A | <0.002mg/litre | <0.002mg/litre | N/A |
| Carbon dioxide (CO ₂) | N/A | <6mg/litre | <6mg/litre | N/A |
| Maximum temperature °C | 8 | 10 | 16 | * N/A |
| Minimum temperature °C | 1 | 1 | N/A | N/A |
| pH | 5.5 to 8 | 5.5 to 8 | 5.5 to 8 | N/A |
| Suspended solids (turbidity) | <25 parts/1000 | <25 parts/1000 | <25 parts/1000 | N/A |

i Super-saturated water can compromise fish welfare. Levels of oxygen, carbon dioxide and nitrogen should be regularly monitored in order to avoid this. As our knowledge of the water quality needs of the fish improves, it may be necessary to change and/or add to the constituents in the above table. For example the inclusion of parameters associated with the mineral content of the water may be appropriate as we get more information about their effect on the welfare of the fish.

In order to ensure due diligence with regard to the welfare of the fish, it is expected that all water quality parameters with the potential to affect welfare are measured.

FW 1.8 * All eggs must be sourced from IPN negative parents.

Green eggs

FW 2.1 All equipment must be:

- a) maintained in full working order
- b) serviced and repaired as required.

FW 2.2 Records must be kept of equipment services.

FW 2.3 The hatching environment must minimise movement of the eggs.

FW 2.4 Flow and/or oxygen alarms must be fitted to all water intakes to the unit.

FW 2.5 All alarms must be checked weekly and records kept.

FW 2.6 There must be a screen to prevent the blocking of inlet valves.

FW 2.6.1 Inlet valves must be regularly checked (at least daily).

FW 2.7 All eggs must be disinfected prior to entry to the on-growing facility.

FW 2.8 Eggs must be water-hardened before being exposed to disinfectant or transportation.

FW 2.9 Eggs being transported must be carried with twice the volume of water than eggs.

FW 2.10 Water flow and tank design must be such that 'dead spots' within the tank/tray do not occur, i.e. it must be sufficient to provide oxygen and remove waste products.

FW 2.11 Eggs must be placed into the hatching environment to ensure maximum survival rates and be accessible for picking.

Freshwater

- FW 2.12 Conditions in the hatching environment must be hygienic and free from any rough edges that could cause damage to the eggs.
- FW 2.13 Where trays are used there must be a single layer of eggs in the tray to allow for hand picking of unviable eggs.
- FW 2.13.1* Where multi-layer systems such as buckets are used, it must be demonstrated that water hygiene and the integrity of the eggs are maintained.
- FW 2.14 To prevent the spread of disease there must be no cross contamination of water from one tank to another.
- FW 2.15 After placement, green eggs must remain undisturbed (other than for picking) for 250 degree days.
- FW 2.16 Where picking is practised, dead/unviable eggs must be removed daily with minimum disturbance.
- FW 2.17 Full darkness must be maintained other than for inspection.
- FW 2.18 Regular inspections must be made to ensure the earliest detection of fungal infections.

Eyed eggs

- FW 3.1 Eggs must not be shocked before 250 degree days or after 370 degree days.
- FW 3.2 The shocking method must be identified and must not be such that it causes excessive mortalities.
- FW 3.3 Training records must be available which identify those who are competent to perform shocking.
- FW 3.4 Shocking onto a dry surface is prohibited.
- FW 3.5 A suitable substrate must be in place before hatching.
- FW 3.6 The transportation of eyed eggs must be done using purpose built boxes.
- FW 3.7 Eggs must not be transported at a depth greater than 4cm.



Ice can be used above the eggs to allow cooling water to drip through to maintain moisture levels.

Alevins


- FW 4.1 The hatching substrate must provide a secure environment for the alevins without encouraging bunching.
- FW 4.2 All alevins must be inspected daily and any dead ones removed.
- FW 4.3 The siphoning of alevins is allowed, but nets must not be used to transfer them when they weigh under 0.5 grams.
- FW 4.4 Full darkness must be maintained other than for inspection.

Freshwater

- FW 4.5 Where water temperature manipulation is practised, fluctuation in temperature and temperature gradient must be kept to a minimum.
- FW 4.6 Feeding must start before the yolk sac disappears in more than 10% of the alevins.

Fry

- FW 5.1 Fish must have access to sufficient food to maintain them in full health and vigour.
- FW 5.2 Feed must be:
- available to appetite
 - spread at regular intervals.
- FW 5.3 Light levels must be such that they allow all fish in the water column to see the feed at all times.

 **The RSPCA is investigating whether supplying a dark period is of benefit to the welfare of the fish.**

- FW 5.4 Water flow rates must be such that the fry can hold and adjust their position in the water easily.
- FW 5.5 All tanks must have individual nets/cleaning equipment.
- FW 5.6 There must not be any grading before the majority of fish weigh a minimum of 1.3 grams.
- FW 5.7 The load of suspended solids must allow visibility to the bottom of the tank.
- FW 5.8 Tanks over 5 metres in diameter must have both oxygen and out-flow alarms fitted.
- FW 5.9 The water depth must be appropriate to the tank being used in order to be able to maintain optimum water quality levels.
- FW 5.10 As the fish leave the bottom of the tank, the water depth must be adjusted to allow natural behaviour.
- FW 5.11 To ensure the welfare of the fish, they must be inspected at regular intervals, at least twice daily.

Parr

- FW 6.1 The water temperature must not be manipulated above 16°C unless required by a veterinary surgeon.
- FW 6.2 Feed withdrawal prior to grading must not exceed 24 hours.
- FW 6.3 Parr must only be crowded for a maximum of 2 hours.
- FW 6.4 Grading must only start when the majority of fish weigh in excess of 1.3 grams.
- FW 6.5 The grader must be suitable for the size and type of fish.
- FW 6.6 All staff must be fully trained and competent to use the chosen grading system.
- FW 6.7 Parr must be able to hold and adjust their position in the water easily.

Freshwater

- FW 6.8 Very small individual fish must not be left to die in air.
- FW 6.9 When dealing with more than individual fish below 5 grams in weight, that require culling, they must be put into an anaesthetic mixture as prescribed by a vet.
- FW 6.10 Individual smolts over 5 grams in weight that require culling must be dispatched using a percussive blow.
- FW 6.11 Measures must be in place to prevent fish escaping.

Freshwater lochs

- FW 7.1 In some adverse environmental conditions it may be necessary to temporarily withdraw feed to avoid compromising the welfare of the fish through the increased risk of de-oxygenated conditions arising, for example, during an algal bloom. This withdrawal period must be kept to a minimum.
- FW 7.2 Nets used in freshwater lochs must be managed hygienically.

Pre-smolt

- FW 8.1 Visual checks and observations must be made for several weeks during the period prior to smolting (silvering, swim pattern, shape).

i As a guide, the RSPCA recommends the use of the smolt scoring system as amended, of C. Findlay, of the Fish Vet Group Inverness.

Smolt score

| Score | Appearance |
|-------|--------------------------------------------------------------------------------------------------------------|
| 1 | Parr marks clear, light coloured back, flanks green, belly yellow, no silvering. |
| 2 | Parr marks fading, back and fins light, flanks starting to silver, belly yellow. |
| 3 | Parr marks faint, back and fins darkening, flanks silver, belly whitening. |
| 4 | Parr marks very faint, dark back, yellow only around fin bases and operculum, flanks silver. |
| 5 | Parr marks gone, back dark, dark margin to fin edges, flanks silver, belly white, silvering colour dominant. |

- FW 8.2 The smoltification process must be closely monitored for several weeks as detailed in the Veterinary Health Plan (see H 1.1).
- FW 8.3 The use of hypertonic water for smolt survival testing is prohibited (water above 35 parts/1000).
- FW 8.4 Feed withdrawal prior to transfer to sea must be no greater than 48 hours.

Vaccination

- FW 9.1 Vaccination at 1 gram liveweight must be by the immersion method only.
- FW 9.2 Hand vaccination is the only other permitted procedure.
- FW 9.3 Vaccines must be used according to manufacturers' instructions.

Freshwater


- FW 9.4 Anaesthetic must be used according to manufacturers' instructions.
- FW 9.5 Following vaccination, any gradients from the vaccination table to the recovery tank must be such that the fish are not at risk of hitting the bottom of the tank or other fish.
- FW 9.6 The depth and flow of water must be closely monitored to ensure that returning fish are not returned to water that is either too shallow, or at an incorrect flow rate, depth or quality.
- FW 9.7 Water temperature for vaccination must be according to manufacturers' instructions.
- FW 9.8 Care must be taken when returning to the recovery tank following vaccination.
- FW 9.9 Oxygen levels in the recovery tank must be:
- a) monitored regularly
 - b) maintained at a minimum of 6 mg/litre.
- FW 9.10 Fish must be checked at regular intervals to ensure that vaccinations are being performed correctly and consistently.
- FW 9.11 The vaccination procedure must be subject to an annual third party audit.
- FW 9.12 All of those involved in vaccinating fish must be trained and competent to do so.
- FW 9.13 If mechanical vaccination is to be used, this will be regarded as a novel system and must therefore be referred to the RSPCA Farm Animals Department before it can be considered for accreditation to the Freedom Food scheme.

Management and stockmanship

The attitudes and competence of staff are a vital factor determining whether high standards of fish welfare can be achieved. It is the responsibility of management to ensure there is a welfare ethos among staff. It is essential that stock-keepers are suitably trained and experienced, and are able to recognise indicators of poor welfare at an early stage. They must have a good working knowledge of the husbandry system used and the animals under their care.

- M 1.1 * All records, checklists, health plans, contingency plans, written standard operating and emergency procedures, policies and publications that the RSPCA welfare standards for farmed Atlantic salmon require the producer to keep and maintain, must be made available to the Freedom Food Assessor and RSPCA Farm Livestock Officer.

Managers and stock-keepers

- M 2.1 Managers must ensure that all stock-keepers:
- have a copy of the current version of the RSPCA Welfare standards for farmed Atlantic salmon at each site
 - are familiar with its content
 - understand and apply its content.
- M 2.2 Managers must ensure that all staff working with stock are trained and competent in aspects of fish husbandry and welfare, relevant to their duties.
- M 2.3 Written records of staff training must be maintained.
- M 2.4 An adequate number of experienced staff must be available to deal sufficiently quickly with any problems that arise.
- M 2.5 Managers must:
- develop and implement plans and precautions to cope with emergencies such as fire, leaks, problems with transportation, etc.
 - provide an emergency action board, sited in a prominent position, which must include:
 - the procedures to be followed by those discovering such an emergency
 - the location of water sources for use by the fire brigade
 - a map grid reference and postcode for the location of the unit.
- M 2.6 Stock-keepers must be able to demonstrate their proficiency in procedures that have the potential to cause pain or distress including netting or other handling, crowding and euthanasia.
- M 2.7 Stock-keepers must be able to recognise indicators of poor welfare in fish including abnormal behaviour, physical injury and symptoms of disease.
-  Staff with responsibility for fish should be able to satisfy auditors, on questioning, of their knowledge of fish husbandry and welfare, their competence in a range of practical circumstances, and their ability to identify and rectify problems.**
- M 2.8 Managers must ensure the Veterinary Health Plan (VHP) is drawn up (see H 1.1), implemented and regularly updated.

Inspection and records

- M 3.1 Any welfare problems seen during an inspection by the producer must be dealt with appropriately and without delay.

i Welfare problems of sufficient severity that they should have been noticed on previous inspections and dealt with, shall be taken by the Freedom Food Assessor or RSPCA Farm Livestock Officer as evidence of negligence of duties by the stock-keeper.

- M 3.2 Fish must be inspected at least once a day, unless exceptional weather conditions make this impossible.

i It is the responsibility of the person caring for the fish to ensure that suitably regular and thorough inspections are being made.

- M 3.3 Full records must be maintained of inspections, including:

- a) the time and date of inspection
- b) the name(s) and signature(s) of the person(s) conducting the inspection for each group of animals
- c) details of any problems identified and any action taken.

- M 3.4 If problems are identified during an inspection, the stock-keeper must act promptly to discover the cause and take remedial action, in consultation with a veterinary surgeon when necessary.

- M 3.5 High standards of biosecurity must be maintained to avoid the spread of diseases between different populations of fish, as specified in a written policy.

- M 3.6 Removal of dead fish must occur frequently, and at least twice a week, except when adverse weather conditions mean this would involve danger to personnel.

- M 3.7 The cause of death of all fish must be classified using the categories developed in the VHP (see H 1.1).

i Veterinary advice should be sought if the cause of death is not clear according to the criteria identified in the VHP (see H 1.1).

- M 3.8 Relevant staff must demonstrate competence in interpretation of mortality records.

- M 3.9 When removing dead fish, appropriate precautions must be taken to prevent the spread of disease.

- M 3.10 Dead fish must be disposed of through outlets or methods approved by the appropriate statutory authority.

- M 3.11 Inspections and other routine practices must be conducted in ways that do not unnecessarily stress the fish.

- M 3.12 All equipment used on a daily basis, including automatic and emergency back up equipment, must be inspected daily to check for defects.

Management and stockmanship

M 3.12.1 Records of inspections relating to M 3.12 must be kept.

M 3.13 Any equipment defects must be immediately rectified or, if this is not possible, alternative measures must be taken to safeguard fish welfare as necessary.

M 3.14 Stock-keepers must be able to recognise:

- a) visual indicators of poor water
- b) behavioural indicators of poor water quality.

M 3.15 The following accurate and up-to-date records must be maintained:

- Details of origin of stock, allowing traceability
- Age of fish
- Pest control/predator control
- Crowding and grading records
- Calibration records
- Numbers and weights of fish in each tank/enclosure
- Estimated current stocking densities in each tank/enclosure
- Where appropriate, target age and weight at which fish will be transferred to sea or slaughtered (in order to predict final stocking densities)
- Details of fish and equipment inspections
- Daily and cumulative mortality (reasons stated)
- Daily and cumulative culling (reasons stated)
- Feed consumption
- Details of any health problems
- Details of any medication/vaccinations applied
- Records of smoltification monitoring
- SEPA correspondence
- Records of water quality tests as appropriate to the system (see E 4.1)
- Records of net inspections and maintenance
- Training records
- Full details of fish movements

Husbandry practices

High standards of husbandry must be maintained at all times with the welfare of stock being considered as a priority. Animals must be handled in a considerate and skilled manner. Caring and responsible planning and management must be employed to safeguard welfare during essential procedures.

Handling

- HP 1.1 Removal from water and handling must only be carried out when absolutely necessary.
- HP 1.2 If fish must be handled:
- a) adequate support must be given to the body
 - b) live fish must never be held by the tail only or thrown on solid objects.
- HP 1.3 Time out of water must:
- a) be kept to the minimum possible
 - b) never exceed 15 seconds for a live fish (unless anaesthetised).
- HP 1.4 Where pumps and pipes are used these must not injure or unnecessarily stress fish.
- HP 1.5 When hand nets are used they must be:
- a) of a suitable size
 - b) designed to avoid the occurrence of physical damage
 - c) kept clean, disinfected and in good repair.
- HP 1.6 A different net must be used for handling fish from different populations to reduce the risk of disease transmission.

Crowding and grading

i **Crowding is stressful to fish and should be kept to the absolute minimum necessary. Where appropriate, crowding a small population with a clean seine net is generally preferable to crowding a whole enclosure/tank. Careful monitoring of the fish is essential during crowding. It is essential that the persons responsible are able to recognise if a welfare problem is arising and have the experience to take action as appropriate. Limited grading is likely to be advantageous to welfare by preventing aggression and reducing feeding competition. However, the grading process will cause stress to fish and should be kept to the minimum necessary. Prevention of injury and stress to fish should be the main consideration when deciding on which method of grading to use.**

- HP 2.1 Crowding must be kept to the minimum necessary and no enclosure/tank must be crowded more than twice in any week or 3 times in any month, unless this is required by the designated veterinary surgeon for fish welfare reasons.
- HP 2.2 The period for which fish are crowded on any one occasion must not exceed 2 hours.
- HP 2.3 Enclosure nets must be kept clean in order to avoid water quality problems during crowding.

Husbandry practices

- HP 2.4 If fish show signs of undue stress during crowding, immediate action must be taken as appropriate, for example by increasing the volume available to fish or by addition of supplementary oxygen.
- HP 2.5 Oxygen level must be monitored throughout crowding and must not fall below 6mg/litre. If it does, corrective action must be taken.
- HP 2.6 Grading equipment must be designed so as not to cause damage to fish and must be regularly maintained.

* **i** Grading can be a stressful process for the fish. If this process is carried out where the size of grader and pump(s) is inappropriate for the size of the fish then mortalities and injuries can occur. The RSPCA is examining this process with a view to reducing the potential for compromising fish welfare.

Pests and predators

- HP 3.1 Humane precautions must be taken to protect fish from predators and prevent pest infestations on the farm.

Genetic selection and modification

i Compared to most other farm animals, salmon have been farmed intensively for a short time and less alteration has been achieved by genetic selection. The RSPCA is opposed to any breeding procedures that adversely affect welfare.

- HP 4.1 Genetic modification techniques are prohibited.
- HP 4.2 Fish must not have been produced by breeding techniques that result in health or welfare problems for any of the animals involved.

Equipment and environmental quality

The equipment in which fish are kept must be designed with full consideration of their welfare needs, and must protect them from physical or physiological discomfort, distress and injury, and allow them to perform natural behaviours. The stock-keeper is responsible for providing the life support system for farmed fish and must maintain the highest environmental quality at all times.

Enclosure/tank construction, situation and maintenance

- E 1.1 The siting of tanks and enclosures must be carefully considered with regard to fish welfare, personnel safety and minimising adverse affects upon the environment as detailed in the Environmental Impact Management Plan.

Tanks

- E 2.1 Tanks must be designed with fish welfare as a major consideration, with no sharp protrusions which may be injurious to the fish.
- E 2.2 Inlets and outlets must be designed to prevent fish escape, and ingress of wild stock.
- E 2.3 Tanks must be provided with lids or covered in net to prevent fish escaping.
- E 2.4 Flow rate must be suitable for fish to be able to hold their position.

Enclosures

- E 3.1 The location of enclosures must allow an adequate flux of clean water but must be protected from exposure to extreme conditions that may damage enclosures.
- E 3.2 The current must not be too strong for fish to be able to hold their position.
- E 3.3 There must be easy access from the shore so that adequate inspections can be made.
- E 3.4 The minimum depth of the enclosure must be 5m (apart from fry in freshwater loch enclosures).
- E 3.5 Netting used in the construction of enclosures must present a smooth, non-abrasive surface to limit injuries to the snout, fins and scales of fish.
- E 3.6 Biofouling must not be allowed to build up on enclosure nets.
- E 3.7 Enclosure nets must be regularly checked for holes and fouling and maintained accordingly.
- E 3.8 Nets must be adequately tensioned and weighted to prevent distortion.

Water quality

i In contrast to most other forms of livestock farming, the life support system for the fish, in the form of a continuous flow of well-oxygenated water, must be provided by the farmer. All staff involved in caring for fish must recognise the importance of this responsibility and the highest water quality must be maintained at all times.

- E 4.1 Water quality composition must be monitored sufficiently frequently, if necessary daily, depending on the system, time of year and stage of stock (as specified in the VHP - see H 1.1).
- E 4.2 If water quality departs from the acceptable range, steps must be taken immediately to identify the source of the problems and rectify the situation as quickly as possible.

Stocking density

- E 5.1 The following maximum stocking densities must not be exceeded:

| | Maximum stocking density |
|---------------------------------|---------------------------------|
| Seawater enclosure | 17kg/m ³ |
| Seawater enclosure site maximum | 15kg/m ³ |

- E 5.2 The maximum stocking density must be calculated on the weight of fish/m³ of water volume. For enclosures deeper than 15m, a depth of 15m must be used in calculation of volume for the purpose of planning stocking levels.

i Total enclosure depth must not be used when calculating stocking rates for enclosures deeper than 15m because water currents and tidal flow may distort nets at depth, reducing the volume available to fish. Also, with deep enclosures it is more difficult to ensure fish near the bottom of the enclosure receive adequate food. This policy will be reviewed as more is known about the relationships between enclosure design, stocking density and fish behaviour.

Lighting

- E 6.1 Lighting must be maintained at a level suitable for each stage of development (as detailed in the VHP - see H 1.1).
- E 6.2 Fish must be protected from distress caused by high levels of UV light or sudden changes in lighting levels (see E 6.3 to E 6.6).
- E 6.3 Developing eggs and young fry must be maintained in dim light or darkness to reduce mortality.
- E 6.4 Rearing tanks must:
- have dimmers fitted which are used at lights on and off
 - be protected from strong sunlight
 - have at least 50% of the tank surface covered.

Equipment and environmental quality

- E 6.5 Tank covers must be removed or lights provided before transfer to sea in order to habituate fish to brighter light.
- E 6.6 Enclosures must be of adequate depth to prevent damage from ultraviolet radiation.

i The RSPCA is considering the welfare implications of using artificial lighting patterns (photoperiods) to alter fish development and growth. Currently there appear to be potential welfare advantages in some cases. For example, providing artificial lighting in sea enclosures can reduce early maturing. However, little research has been conducted examining the effects of photoperiod on welfare and the Society will therefore continue to gather information in this area and amend these standards as appropriate. In the meantime, the optimum lighting patterns for fish welfare on each site, as determined by practical experience and veterinary advice, should be implemented.

Environmental enrichment

i The requirements of salmon for environmental stimulation are not understood. Environmental enrichment is not therefore necessary at present. This policy will be reviewed in 5 years from January 2007.

Feeding

Fish must have freedom from hunger and malnutrition by ready access to a high quality diet that is appropriate to their species, and allows full health to be maintained. Food must be distributed in such a way that fish can eat without undue competition.

- F 1.1 Feeding must be such that the quality, quantity and frequency are optimal for the fish's stage of development.

Food content

- F 2.1 All feed must be manufactured from constituents that are free from active parasites and known fish pathogens and contamination.
- F 2.2 All feeds used must be produced strictly to the standards laid down by all the relevant UK and EU legislation.
- F 2.3 No feedstuffs containing growth regulators or hormones are permitted.
- F 2.4 The use of veterinary medicinal products in food is prohibited except for essential therapeutic use (a disease outbreak or where welfare will otherwise be compromised as advised by a veterinary surgeon).

Feeding methods

- F 3.1 Food must be dispensed and distributed in such a way that fish can eat without undue competition.
- F 3.2 Observation of fish must take place during feeding.
- F 3.3 The person feeding must check that fish on the periphery of the tank or enclosure receive adequate amounts of food.
- F 3.4 Overfeeding must be avoided.

i Feedback systems to prevent overfeeding are encouraged in seawater enclosures.

Fasting

i Although salmon may not feed for long periods in the wild, depriving a farmed fish that has previously been fed regularly will usually have an adverse effect on welfare. Therefore, salmon must not be deprived of food, except for a period before slaughter for food hygiene reasons, or where the overall effect of food deprivation is an improvement in fish health. It is unacceptable to deprive salmon of food for perceived flesh quality reasons.

- F 4.1 Fasting time must be kept to the minimum possible and must not exceed 72 hours (unless directed by the designated veterinary surgeon for fish welfare reasons).

Fish must be protected from pain, injury and disease, through good management and husbandry practice, and by rapid detection and treatment of disease. All producers must develop a health plan in consultation with a designated veterinary surgeon. Disease is a major cause of poor welfare and mortality in farmed salmon. Further, wild fish may be susceptible to disease agents carried by farmed fish. Therefore it is essential to take all reasonable steps to minimise the likelihood of disease outbreaks in the farmed stock.

- H 1.1 A Veterinary Health Plan (VHP) must be drawn up and updated regularly, and at least annually, following a visit from the designated veterinary surgeon (see Appendix 1).
- H 1.2 The VHP (see H 1.1) must include future husbandry plans, risk assessment, monitoring and control of fish health and diseases.

i **The Veterinary Health Plan (VHP) forms a vitally important part of the RSPCA Welfare standards with regard to maintaining the health and welfare of livestock on farm. The written VHP is agreed between a named veterinary surgeon and the producer and is then frequently updated following regular visits from the veterinary surgeon to the farm.**

The RSPCA has developed guidance notes for producers and veterinary surgeons as to how the VHP should be formulated to ensure high standards of health are maintained. These guidance notes are available in Appendix 1 (p. 45).

Should you or your veterinary surgeon require assistance with the formulation of your VHP, please refer to these guidance notes or talk to an RSPCA Farm Livestock Officer.

- H 1.3 All relevant legislation regarding notifiable diseases must be understood and adhered to.
- H 1.4 There must be no recurring physical damage occurring on fish attributable to features of their environment, husbandry procedures or unrecognised disease challenge.

i **Recurring physical damage is that seen on a number of fish, with sufficient similarity to suggest a common cause, for example poor tank or enclosure design, methods of handling or a husbandry procedure. Different types of physical damage may also suggest a common cause.**

- H 1.5 Fish condition must be continuously monitored for signs of disease or problems with the environment or handling practices.
- H 1.6 If a problem is identified, the VHP (see H 1.1) must be revised to include a programme of remedial action.
- H 1.7 Any fish suffering from overt physical damage, or disease symptoms, must be segregated and treated without delay.
- H 1.8 If necessary, a veterinary surgeon must be consulted to determine the most appropriate action relating to H 1.7 (however, this must not delay euthanasia of a severely distressed fish).

Health

- H 1.9 If the mortality level is above 0.5% a week (excluding pre-swim up fry) the designated vet must be notified and an investigation made as appropriate.

Casualty slaughter

- H 2.1 Any seriously sick or injured fish, or fish found not to be recovering, must be humanely killed without delay.
- H 2.2 Overdose of a suitable anaesthetic (as specified in the Veterinary Health Plan) using immersion in a solution of the agent, must be used for culling fish during the freshwater stage, including pre-swim up fry.
- H 2.2.1 For fish during the seawater stage, a non-recoverable percussive blow to the head, using a priest or mechanical percussive device, of sufficient force to render the fish immediately insensible, can be used for emergency killing instead of anaesthetic overdose.
- H 2.3 Under no circumstances must seriously injured or sick fish be left to die in air.
- H 2.4 Culling of sick or injured fish must only be conducted by suitably trained and competent people.

Medicinal products

- H 3.1 High quality management and husbandry standards must be employed in order to minimise the need for therapeutants.
- H 3.2 Treatment must only be given when the welfare of the stock may otherwise be threatened (as advised by a veterinary surgeon).
- H 3.3 Prophylactic use of veterinary medicinal products, where no known disease problems exist, is prohibited (except vaccines as agreed with the veterinary surgeon).
- H 3.4 In cases where medication is required for welfare reasons, treatments must be used in accordance with current legislation and the designated veterinary surgeon's recommendations.

i It is recommended that producers obtain, read and where appropriate, apply the advice contained with the latest version of the '*Guidelines on Responsible Use of Antimicrobials in Fish Production*' issued by the Responsible Use of Medicines in Agriculture (RUMA) alliance (RUMA, Acorn House, 25 Mardley Hill, Welwyn, Hertfordshire, AL6 0TT; www.ruma.org.uk).

- H 3.5 Any veterinary medicines used must be licensed in the UK for use in Atlantic salmon or authorised under an Animal Test Certificate or an Animal Test Exemption Certificate issue.

i The RSPCA recognises that the welfare of farmed fish may be adversely affected by the limited availability of vaccines or therapeutic medicines approved for the treatment of fish. In exceptional circumstances, on the advice of the designated veterinary surgeon, specific products licensed in the UK for use in other food producing species can be administered (following the requirements of the cascade principle) as detailed in the Veterinary Health Plan (see H 1.1), providing that a valid discharge consent is held from the appropriate Government body. All proven medications should be made available to aid disease treatment as advised by the designated veterinary surgeon.

Health

- H 3.6 The medication must only be administered to fish:
- a) by suitably trained staff
 - b) strictly in accordance with the instructions prescribed.
- H 3.7 The potential for therapeutic agents to affect the environment, both locally and more widely, must be given full consideration, and all relevant legislation and Codes of Practice must be adhered to.
- H 3.8 A valid discharge consent must be held, prior to commencement of treatment, for all medicines administered.
- H 3.8.1 Veterinary medicine withdrawal periods must be strictly adhered to.
- H 3.9 Veterinary products must be properly labelled and stored appropriately.
- H 3.10 All farms must have a written pharmaceutical waste policy.

Sea lice


i The problems involved with availability of effective treatments for sea lice infestations are recognised. The welfare and environmental impact of treatments must be given full consideration. The RSPCA will monitor the situation, and review new technology and research as it develops.

- H 4.1 Farms must take all reasonable steps to minimise the gravid lice population.
- H 4.2 Stock-keepers must be able to recognise symptoms of lice infestation.
- H 4.3 Separation of year classes and fallowing of sites must be practised to help control sea lice populations as detailed in the Environmental Impact Management Plan (see ENV 1.1).
- H 4.4 The producer must, through documented evidence, demonstrate that any co-operative management schemes between operations in the same loch/area aimed at reducing sea lice populations have been entered.
- H 4.5 Sea lice prevention and treatment programmes must be drawn-up with the designated veterinary surgeon and fully detailed in the Veterinary Health Plan (see H 1.1).
- H 4.6 Biological control using cleaner fish (wrasse) is prohibited.

i The RSPCA is reviewing current research associated with using wrasse as cleaner fish, in order to establish whether a change to Standard H 4.6 is warranted.

Vaccination

- H 5.1 The VHP (see H 1.1) must incorporate a vaccination programme to protect fish from diseases for which an effective vaccine is available and which may represent a risk to the fish.

 If effective oral vaccines are developed these should be the preferred method of vaccination.

- H 5.2 Records must be made of all vaccination procedures including:
- a) the date of vaccination
 - b) identification of the groups of fish vaccinated
 - c) the vaccine used (including batch numbers)
 - d) details of dosage and the names of personnel involved.
- H 5.3 Vaccination must only be carried out by named competent persons.
- H 5.4 Vaccines must be used in accordance with the manufacturers' recommendations.
- H 5.5 All vaccines must be stored in an appropriate container and must not be used after their expiry date.
- H 5.6 Equipment used in vaccination must be maintained in a hygienic manner.
- H 5.7 All vaccination procedures must be conducted with care and with the minimum possible distress caused to the fish.

Mutilations

- H 6.1 Mutilations involving the removal of sensitive tissue are prohibited.
- H 6.2 Marking methods that cause distress or injury to fish must not be used.

Transport

Transport systems must be designed and operated in such a way that ensures fish are not caused unnecessary distress or discomfort. The transport and handling of fish must be kept to an absolute minimum. Persons involved in transport must be thoroughly trained and competent to carry out the required tasks.

- T 1.1 All journeys must have an up to date transport plan, which covers important aspects of the journey, such as journey times, water qualities, contingency plans and those responsible for fish welfare throughout the journey.
- T 1.2 Any catching and handling of fish prior to transport must be kept to a minimum and conducted in such a way as to prevent any unnecessary distress to the fish.
- T 1.3 A written policy on catching and handling must be in place.
- T 1.4 Fish in transit must be inspected regularly (and at least once every 4 hours 30 minutes).
- T 1.5 Delays in transport must be reduced to the absolute minimum possible.
- T 1.6 Supplementary oxygen or aeration must be available during all transportation, which is sufficient to last at least 50% longer than the anticipated journey length.
- T 1.7 Oxygen levels must be maintained at a minimum of 6mg/litre.
- T 1.8 Excessive changes in water temperature and pH during transportation must be avoided.
- T 1.9 Care must be taken to ensure dead fish are not loaded for transport.
- T 1.10 Sick or seriously injured fish must:
 - a) not be transported
 - b) be humanely destroyed.
- T 1.11 Any fish which die during transportation must be separated from live fish as soon as possible after arrival.
- T 1.12 Records must be kept of any deaths or injuries that occur during transportation.
- T 1.13 Transport containers must be cleaned and disinfected after each consignment of fish is transported to prevent spread of disease.
- T 1.14 All persons involved in transportation of fish must be familiar with, and transport fish in accordance with, all relevant legislation.

* Smolt transport

These smolt transport standards are to be considered in conjunction with, and as a supplement to, existing transport and well boat standards.

Smolt transport - general

- ST 1.1 * There must be a named member of staff responsible for monitoring the welfare of the fish during loading and unloading.
- ST 1.2 * Records of procedures relating to ST 1.1 must:
- a) be maintained
 - b) include details of any casualties or compromises to the welfare of the fish.
- ST 1.3 * There must be a pre-transport plan in place that identifies all areas of risk associated with the journey.
- ST 1.4 * Should a journey require the use of a ro-ro ferry, procedures must be in place to ensure the welfare of the fish during this stationary time.
- ST 1.5 * The ferry must be booked prior to sailing.
- ST 1.6 * Drivers must be able to gain access below deck during the journey, to be able to check on the welfare of the fish.
- ST 1.7 * Fish must be checked at least every 2 hours.
- ST 1.8 * The following records must be kept:
- Time since last handling
 - Time since vaccination
 - Time since last treatment (including anaesthetic)
 - Feed withdrawal time
 - Date of full smoltification
 - Any clinical signs of disease
 - Crowding records (how often/duration etc.)
 - Oxygen levels during crowding
 - Numbers of fish in each tank to be transported
 - Stocking densities of tanks being used for transport
 - Numbers of fish to be put in each receiving enclosure
- ST 1.9 * All fish must be fully smoltified at the time of placement at sea.
- ST 1.10 * Only healthy, undamaged smolts must be transported.
- ST 1.11 * Pre-transport fasting must never exceed 48 hours, unless specified by a veterinary surgeon/senior production manager.
- ST 1.12 * Any bath treatment must be completed a minimum of 14 days before transport.
- ST 1.13 * Records of treatments relating to ST 1.12 must be kept.

Smolt transport

ST 1.14 * All staff working with, or handling the fish must be:

- a) trained and competent
- b) aware of their duties
- c) aware of any risks involved.

ST 1.15 * Records of training relating to ST 1.14 must be kept.

ST 1.16 * All equipment must be:

- a) cleansed and disinfected prior to use
- b) fit and suitable for the purpose that it was intended for.

ST 1.17 * To minimise thermal shock and to avoid the inhibition of oxygen release into the water, the water temperature used for transportation must be as close as possible to that from which the fish came.

i As a guide, we would not expect more than 3 or 4°C difference.

ST 1.18 * Fish must not be transported above 16°C.

ST 1.19 * No fish must be out of water for more than 15 seconds.

ST 1.20 * There must be at least 50% more oxygen available than is needed for the journey.

ST 1.21 * Water must be free from contaminants which may be detrimental to the welfare of the fish.

ST 1.22 * If fish pumps are to be used, they must be suitable for the size of fish being pumped.

ST 1.23 * To avoid physical injury to the fish, any bends or joins in the pipes must be kept to a minimum, or ideally avoided altogether.

ST 1.24 * There must be no joints, kinks or rough internal edges on, or in the pipes which may cause physical injury to the fish.

ST 1.25 * There must be a procedure in place to ensure that all fish are removed from any pipes or other equipment used at the end of loading and unloading.

ST 1.26 * The drop from the end of any pipe must be such that it:

- a) avoids injuring the fish
- b) allows them to disperse without others landing on top of them.

i Poor netting technique can compromise the welfare of the fish, and for this reason, the RSPCA would prefer the use pumps to move fish because, in our view, it minimises the risk of compromising fish welfare.

ST 1.27 * If fish are to be netted, the nets must be of a suitable size and design for the size of fish to be handled.

ST 1.28 * Handnets must not be overfilled.

Smolt transport

- ST 1.29 * Fish must not be netted before they are ready to be received at the transport tanks/helicopter buckets.
- ST 1.30 * The netting of the last fish in any tank must be undertaken with a great deal of caution and care so as not to injure any fish.

Towing enclosures

- ST 2.1 * The speed of towing must be suitable for the size of the fish.
- ST 2.2 * Nets must be tensioned to avoid the problems associated with the nets bagging, which could compromise fish welfare.
- ST 2.3 * Nets must be clean before they are considered for towing.
- ST 2.4 * There must be a person on the enclosure monitoring the behaviour of the fish to ensure their welfare.
- ST 2.5 * There must be clear communication between the skipper and the person on the enclosure.
- ST 2.6 * The speed of the tow must not be faster than the speed of the swimming fish.
- ST 2.7 * Extreme care must be taken to avoiding towing the enclosure through a fluther of jellyfish or algal blooms.

Road transport

- ST 3.1 * The driver of the vehicle must:
- be fully aware of the transport regulations relating to fish
 - understand the needs of the fish being transported
 - drive in a manner which will not adversely compromise the welfare of the fish.
- ST 3.2 * Tank insulation must be such that it allows the water to remain at a constant temperature +/- 0.5°C from the start of the journey.
- ST 3.3 * Before leaving the site, the driver must:
- perform a visual check of the oxygen levels and rates of aeration into the tanks
 - record the oxygen levels on the record sheet.
- ST 3.4 * All transport tanks and life support systems must:
- be fit for the purpose of transporting fish
 - be without leaks, chips or cracks.
- ST 3.5 * Fish must be allowed to settle before departure.
- ST 3.6 * After the required stocking density has been reached, all tanks must be filled to the top with good quality water from a known source.

Smolt transport

ST 3.7 * Maximum stocking densities must be set so that water quality can be maintained over the length of the journey.

i Maximum stocking density will depend on the distance travelled, but as a general guide it should be within 60 to 100 kg/m³.

ST 3.8 * Oxygen levels must be:

- a) continuously monitored
- b) maintained at a minimum of 6mg/litre.

ST 3.9 * Diffused oxygen must be spread around the water column by the use of an oil free compressor.

ST 3.10 * There must be sufficient aeration to avoid deadspots.

ST 3.11 * All lids, outlets and any other openings must be fully secured before departure.

ST 3.12 * During the journey, if oxygen levels become unstable, the driver must:

- a) be able to visually check the fish for signs of stress
- b) be able to identify the reasons for the oxygen instability
- c) take appropriate action to ensure the welfare of the fish.

ST 3.13 * Fish must be checked at least every 2 hours.

ST 3.14 * When arriving at the discharge site, the driver must:

- a) ensure compliance with any biosecurity requirements
- b) have been aware of these before arrival on site.

ST 3.15 * After arrival at the site, discharge must take place without undue delay.

ST 3.16 * The lorry must be sited to ensure that all tanks can be fully emptied, taking into account any camber which may be in the ground.

ST 3.17 * Valves must be suitable for more than one fish to pass through at any one time.

ST 3.18 * All pipes must be securely attached to prevent fish from escaping during the unloading process.

ST 3.19 * All unloading must be through mucon valves, rather than netting fish from the tanks.

ST 3.20 * Any pipes used for unloading must be able to be adjusted to account for any rise and fall in the tide.

ST 3.21 * Water must always be in the tanks during unloading in order to avoid the last fish from becoming dry.

ST 3.22 * There must be a system for flushing the tanks at the end of unloading to ensure that the last fish is removed.

ST 3.23 * Tank design must facilitate the discharge of the last fish by having sloping floors which guide the fish to the outlet.

Well boat transport

- ST 4.1 * The journey must be planned to ensure that arrivals at the loading and unloading sites are such that they avoid delays in moving the fish.
- ST 4.2 * There must be staff available at the site that is to receive smolts.
- ST 4.3 * The well boat must have water in the well before loading commences.
- ST 4.4 * The water in the well must be from as near to the delivery site as is practicable.
- ST 4.5 * Maximum stocking densities must:
- a) be within 40 to 50 kg/m³
 - b) be set so that water quality can be maintained over the length of the journey.
- ST 4.6 * Oxygen levels must be:
- a) continuously monitored
 - b) maintained at a minimum of 6mg/litre.
- ST 4.7 * If fish counting equipment is in place, it must:
- a) use wet counting
 - b) be fully maintained
 - c) be regularly calibrated to maintain accuracy
 - d) be of a design not likely to cause damage or injury to the fish.
- ST 4.8 * The number of fish to be loaded must be known in order to be able to verify compliance with the stocking density.
- ST 4.9 * There must be enough light in the well to enable easy inspection of the fish.
- ST 4.10 * Pumps and pipes used for unloading must be positioned to minimise the height and distance that the fish have to be pumped.
- ST 4.11 * Pumps and pipes must be free of any rough edges which might damage the fish.
- ST 4.12 * Extreme care must be taken when removing the last fish(es) from the well.
- ST 4.13 * Adjustments must be made to the trim/balance of the well boat to ensure fish are aligned with the discharge point.
- ST 4.14 * Water flow through the wells at discharge must:
- a) be sufficient to facilitate movement of the fish
 - b) not be so strong as to cause the fish injury.
- ST 4.15 * The pipe layout angle and drop must:
- a) lead to good distribution into the enclosure
 - b) minimise the risk of collisions between fish.

Smolt transport

ST 4.16 * The nets at the reception enclosure must:

- a) be set at sufficient depth to permit inspection
- b) not be so shallow that fish are stressed by strong sunlight.

ST 4.17 * The fish must be given humane protection from birds and marine predators.

ST 4.18 * The unloading of fish must not take place if adverse weather conditions are likely to compromise the welfare of the fish.

ST 4.19 * Dead and moribund fish must be disposed of humanely and hygienically.

ST 4.20 * Records of all dead and moribund fish must:

- a) be kept
- b) include the cause of death where possible and any other information relating to the health and welfare of the fish
- c) be available for inspection by the Freedom Food assessor or RSPCA Farm Livestock Officer for a least 1 year.

Helicopter transfer

ST 5.1 * Pilots and ground crew must be aware of the welfare consequences of how they handle the fish.

ST 5.2 * Pilots and ground crew must:


- a) have a copy of the current version of the RSPCA Welfare standards for farmed Atlantic salmon
- b) be familiar with its content
- c) understand and apply its content.

ST 5.3 * There must be staff available at each site receiving smolts.

ST 5.4 * All receiving enclosures must be clearly identified, for example, marked with buoys.

ST 5.5 * Staff must be able to communicate with the loading site and the helicopter.

ST 5.6 * The fish must be netted from the tanks/rearing enclosures to the helicopter bucket with extreme care.

 **The RSPCA would prefer that pumps are used to transfer fish for this mode of transport, as it believes that it is better for the welfare of the fish. It will investigate the advantages of such a method, and if appropriate, introduce it as the method to use.**

ST 5.7 * Helicopter buckets and other ancillary equipment must be:

- a) fully maintained
- b) clean
- c) suitable for the job.

ST 5.8 * There must be sufficient buckets to ensure that the time that fish have to wait for transportation is minimised.

ST 5.9 * Fish must not be placed into buckets until the imminent arrival of the helicopter.

Smolt transport

ST 5.10 * The helicopter bucket must contain approximately two-thirds water before any fish are loaded into it.

ST 5.11 * The life support system of the bucket must be switched on and working before the fish are put in.

ST 5.12 * A sample weight of fish must be known before loading commences.

ST 5.13 * Helicopter buckets must have their own independent supply of oxygen.

ST 5.14 * The oxygen levels in the bucket must be:

- a) the same as that of the tanks from whence the fish came
- b) maintained at a minimum of 6mg/litre.

ST 5.15 * The helicopter bucket must be lowered gently into the water.

ST 5.16 * The helicopter bucket must be allowed to empty completely before moving off.

ST 5.17 * The planned maximum journey time to the discharge site with fish on board must be no longer than 15 minutes.

ST 5.18 * Maximum stocking density in the bucket must be no greater than 400 kg/m³.

ST 5.19 * There must be contingency plans in place for:

- a) bad weather
- b) if a bucket will not open.

Well boats

These well boat standards are to be considered in conjunction with, and as a supplement to, existing transport standards. At present these standards do not apply to well boat grading, only for transfer to slaughter.

General

- W 1.1 All vessels must be appropriately certificated and operated by qualified personnel.
- W 1.1.1 All crew members must have attended a recognised fish welfare course within 12 months after joining the scheme
- W 1.2 * All personnel must:
- a) have access to a copy of the current version of the RSPCA Welfare standards for farmed Atlantic salmon
 - b) be familiar with its content
 - c) understand and apply its content.
- W 1.3 Multi-site collections are prohibited (collections of fish from different sites from different disease control areas are prohibited.)
- W 1.4 Intra-site collections and collections from neighbouring sites of the same year class are allowed, but must be recorded.
- W 1.5 The well boat must be fitted with moveable bulkheads.
- W 1.6 The well boat must be fitted with video cameras in each well in order to monitor the fish during transportation, loading and unloading.
- W 1.7 The well boat must be equipped with water quality monitoring and maintenance equipment such as oxygen and pH probes, carbon dioxide and ammonia strippers.
- W 1.8 The well boat must be able to monitor and record the numbers of fish loaded in each well.
- W 1.9 There must be sufficient natural or artificial lighting to enable continual inspection/monitoring of the fish throughout the well.
- W 1.10 Where systems are reliant on automatic monitoring equipment, this equipment must be alarmed and underpinned by fully operational manual back-up systems. This includes water quality control methods, such as oxygenators/aerators and carbon dioxide strippers.
- W 1.11 Boats must have the facility to close valves and re-circulate water.
- W 1.12 Journeys must be planned between the producer, the well boat skipper and the slaughter site.
- W 1.13 There must be written contingency plans to accommodate unforeseen circumstances associated with the journey.

Fish pumps

- W 2.1 Well boats must have siphon vacuum pumping equipment for loading.
- W 2.2 Pumps must be operated in accordance with manufacturers' instructions.
- W 2.3 Pressure relief valves must operate efficiently.

Water quality

- W 3.1 Water must be chilled at a maximum of 1.5°C per hour.
- W 3.2 The minimum temperature of the water at the end of chilling must be no lower than 4°C.
- W 3.3 Oxygen levels must be:
- a) continuously monitored
 - b) maintained at a minimum of 6mg/litre.
- W 3.4 The carbon dioxide levels of the water must not be detrimental to fish welfare.

i There are at present recommendations being developed by the Council of Europe for water quality. At present the recommendation is 20 mg/litre for carbon dioxide. This issue will be kept under review by the RSPCA, to ascertain the optimum levels of carbon dioxide from an animal welfare perspective.

- W 3.5 The pH of the water in the well must always be between 7.5 and 8.
- W 3.6 The total suspended solids content of the water must not be detrimental to fish welfare.

i There are few, if any, recommendations concerning suspended solids in the water. This will be kept under review by the RSPCA, to ascertain the optimum levels of suspended solids in the water from an animal welfare perspective.

- W 3.7 The upper limit for ammonia must be 0.0125 mg/litre or less (unionised form).
- W 3.8 The water temperature must remain within the range of 4 to 16°C.
- W 3.9 Salinity levels must be within the range of 28 to 35 parts/1000.

i The RSPCA recognises that many of the issues relating to water quality in the well boat are inter-linked, and simplistic assumptions relating to them can be unhelpful. The values given above are based on both practical experience and scientific evidence where it is available. It is intended to review the figures regularly in order to ensure that the welfare of the fish is optimised during transportation. Similarly, values will have to be adjusted should any legislation relating to them be introduced.

Loading

- W 4.1 The crowding of the fish in the enclosure must coincide with the arrival of the well boat.
- W 4.2 The duration of the crowding in the enclosure must not exceed 2 hours.
- W 4.3 At the start of loading, the wells must contain sufficient water to prevent fish suffering injury from hitting each other, the walls or sides of the well.
- W 4.4 The maximum stocking density in the well must be based on the liveweight of the fish:

| Liveweight | Maximum stocking density |
|-------------------|---------------------------------|
| 5kg | 125kg/m ³ |
| 4kg | 110kg/m ³ |
| 3.5kg | 100kg/m ³ |

i These stocking densities will be under constant review. If there are obvious signs of physical injury to the fish, then the stocking density should be lowered accordingly, in increments of 10 kg/m³.

- W 4.5 A counting/weighing device such as a 'Bioscanner' must be fitted on the inlet pipes in order to calculate fish numbers and stocking density.
- W 4.6 Loading speed of the water must be based on the largest fish and must always be in the range of 3 metres/second.
- W 4.7 Pipes must be free from sharp protrusions, kinks and bends which may injure the fish.
- W 4.8 Pipe diameters and flap doors must be appropriate to the size of the fish being moved. In any case the minimum internal diameter of the pipe must be not less than 12 inches/315mm.
- W 4.9 There must be a system in place which ensures that the last fish is removed from the pipe at the end of unloading, or during any pause in unloading.
- W 4.10 Maximum dwell time in the pipe must not exceed 1 minute during loading.

Journey time

- W 5.1 Water quality parameters must be monitored throughout the journey.
- W 5.2 Visual appraisal of the welfare of the fish must be carried out throughout the journey.
- W 5.3 Journey times and holding times under conditions of closed valves must not exceed a planned time of 14 hours with capacity to carry on to a maximum of 21 hours in emergencies only, whilst still retaining water quality specifications.

Unloading

- W 6.1 In order to avoid unnecessary delays, the docking of the well boat and the end of break time at the slaughter plant, must coincide.

Well boats

- W 6.2 Pumping of the fish out of the wells to the slaughter plant must be done in a way which ensures that the slaughter personnel can maintain an efficient stunning procedure, thus ensuring that fish do not miss the stunner.
- W 6.3 Water at the outflow pipe must be sampled and tested on a regular basis for oxygen, temperature and pH.
- W 6.3.1 If the water quality falls below a 20% threshold of the well water, then immediate remedial action must be taken to make the necessary improvements.
- W 6.4 There must be a system in place which ensures that the last fish is removed from the pipe at the end of unloading. This system must not be injurious to the fish.
- W 6.5 The maximum dwell time in the pipe must be no more than 10 minutes.

i This can be worked out by the time it takes to empty the well and pipe and the number of fish in the well.

- W 6.6 Unloading speed must not exceed 3 metres per second.

Biosecurity

- W 7.1 Well boats arriving in the United Kingdom (UK) to work within UK waters must carry a valid veterinary certificate of disinfection from the country of origin.
- W 7.2 Inter-site movement of vessels must be kept to a minimum.
- W 7.3 Any visible surface mortalities or obviously moribund fish on the surface must be removed before unloading.
- W 7.4 Well boats transporting live fish must travel closed when located within 5 kilometres of any fin fish farm site.
- W 7.5 The cleaning and disinfectant procedures for well boats as set out in the FRS Marine Laboratory's '*Disinfection Guide*' with regard to the ISA Virus: Version II, must be adhered to. The checklist must be signed by the skipper on completion.
- W 7.6 All equipment must be checked regularly and maintained in accordance with manufacturers' or in-house maintenance schedules.
- W 7.7 All equipment must be maintained in clean, hygienic conditions and must be thoroughly disinfected and rinsed after use.
- W 7.8 All storage facilities must be bunded, wind and water tight, and pest proof.
- W 7.9 All solid and liquid waste materials must be stored and disposed of appropriately and in accordance with relevant legislation.

Records

- W 8.1 The following records must be kept for inspection:
- Well boat movements
 - Fish movements
 - Times of fish movements – loading and unloading
 - Disinfection logs
 - Numbers of fish loaded/stocking density/fish size distribution
 - Mortalities
 - Water quality parameters as set out in the standards
 - Route covered during transport
 - Timing of open and closed valve operation
 - Calibration of equipment used for automatic recording

Slaughter

Fish must be killed humanely without any unnecessary distress or discomfort. Pre-slaughter crowding and handling must be kept to an absolute minimum. Personnel involved in slaughter must be thoroughly trained and competent to carry out the required tasks.

- S 1.1 Prior to slaughter, fish must:
 - a) only be fasted for the absolute minimum period required to meet food hygiene requirements
 - b) not be fasted for more than 72 hours, unless fasting is beneficial for welfare.
- S 1.2 Crowding and handling prior to slaughter must be kept to an absolute minimum.
- S 1.3 Farmed fish must be humanely slaughtered.
- S 1.4 The method of slaughter used must rapidly, and without pain and distress, render the fish insensible, until death supervenes.
 - S 1.4.1 An efficiently applied percussive blow is the only permitted slaughter method at present.
 - S 1.4.2 Humane mechanical devices must be used in preference to a manual percussive blow (except for emergency slaughter).
 - S 1.4.3 The use of mechanical devices must be monitored to ensure that they are working properly and that they are delivering the stun at the correct location.
- S 1.5 One blow must be delivered to the top of the head just behind the eyes, of sufficient force to cause immediate loss of consciousness that lasts until death.
 - S 1.5.1 A priest must be available throughout the slaughter process to allow a manual percussive blow to be administered in an emergency.
- S 1.6 Bleeding must follow within 10 seconds.
- S 1.7 All staff involved with the slaughter process must have received full training to ensure they have the knowledge and skill to perform their task humanely and efficiently.
- S 1.8 There must be a named person responsible for fish welfare throughout the slaughter process who has attended a recognised training course in humane slaughter of fish.
- S 1.9 Slaughter efficiency must be continuously monitored to ensure that every fish is effectively stunned and does not regain consciousness prior to death.

i **Methods for monitoring fish slaughtering operations are outlined in the Veterinary Health Plan guidelines (see H 1.1).**

Slaughter

S 1.10 All blood and mucus from slaughter operations must be contained and disposed of ashore.

i The RSPCA is examining all new developments associated with the slaughter and killing of farmed fish. If any of these methods are shown not to compromise the welfare of the fish involved, then consideration will be given to incorporating them into the RSPCA welfare standards in the future.

Wider environmental impact

The farm must be operated with respect for the natural environment and employees must recognise their duty to care for the wider environment. All reasonable steps must be taken to minimise the ecological impact of the farming system. Producers must draw up an Environmental Impact Management Plan within two years.

- ENV 1.1 An Environmental Impact Plan must be drawn up and complied with.
- ENV 1.2 All relevant legislation, official guidelines and Codes of Practice must be strictly adhered to and understood.

i These standards are primarily aimed at the welfare of farmed fish. However, the potential for aquaculture to have wider environmental effects must also be considered. In addition to fully complying with all relevant legislation and recommendations, the farmer must demonstrably and positively review environmental protection policies as developments in research and technology allow. An Environmental Impact Management Plan must be drawn up according to the guidelines provided. It is the responsibility of the management to ensure that all employees recognise their duty to care for the natural environment and monitor possible impacts on it.

Predators

- ENV 2.1 Farmed fish must be protected from predation by denying predators access to tanks and enclosures.
- ENV 2.2 Enclosures must be adequately tensioned and of a suitable net size to reduce the risk of predators becoming entangled.

i The RSPCA recognises that predator activity can cause welfare problems on fish farms.

- ENV 2.3 The farmer must take all reasonable non-lethal, humane methods of control to prevent predation of stocks as detailed in the Environmental Impact Management Plan; the primary means of achieving this must be physical exclusion.

Escapees

- ENV 3.1 Every reasonable step must be taken to prevent the escape of farmed fish.
- ENV 3.2 Enclosures must be designed and sited in such a way that they are not likely to be damaged by adverse weather conditions.
- ENV 3.3 Fish farms must have a containment plan in place with the aim of preventing fish escaping.

i Farmed fish which escape may have an adverse ecological impact and are also likely to experience welfare problems. It is therefore essential that all possible reasonable measures are being taken to prevent farmed fish escaping.

Wider environmental impact

- ENV 3.3.1 The contingency plan, as referred to in Standard M 2.5, must contain a section on actions to be taken in the event of fish escaping.

Extraneous species

- ENV 4.1 Extraneous species must be returned to the wild, or humanely culled, as advised by the designated veterinary surgeon.

Fallowing

- ENV 5.1 Enclosures must be fallowed as detailed in the Environmental Impact Management Plan to allow recovery of the benthos and help reduce sea lice populations.

Aesthetic

- ENV 6.1 Sites must be kept tidy and all waste must be disposed of by an approved method; burning of plastics is prohibited.

Appendix 1 - RSPCA veterinary health plan guidance notes

This document provides complimentary notes to the RSPCA's welfare standards for farmed Atlantic salmon, and is intended as guidance for producers and their veterinary surgeons during the formulation of their written Veterinary Health Plan (VHP). All farms are different and, therefore, these notes are not intended to be prescriptive but to offer guidance regarding the main areas which should be considered. In places, some of the requirements of RSPCA welfare standards are highlighted. However, these are just relevant examples and the RSPCA welfare standards must be consulted in full for the detailed requirements.

The RSPCA is grateful to those who assisted in formulating these guidance notes – particularly Pete Southgate BvetMed MSc MRCVS of the Fish Vet Group veterinary surgeons, and Steve Kestin BSc PhD of the University of Bristol, for their invaluable contribution. The Society would also like to thank members of the RSPCA/Freedom Food Salmon Working Group for their advice.

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The written Veterinary Health Plan (VHP) should be agreed between the vet and the producer and, where appropriate, the stock-keeper. It should involve regular visits on-site by the farm's own vet.

It would be preferable if the visits could be carried out by the same vet to give continuity and consistency of advice. This vet should be named and be responsible for overseeing the drawing up of the health plan on the first visit as well as an annual review.

Part A) VHP guidelines on fish health

Pete Southgate BvetMed MSc MRCVS, Fish Vet Group veterinary surgeons

The VHP is a document which is developed by the farm personnel and their veterinary surgeons to encompass all areas of fish health and welfare. It attempts to identify and define areas of management and husbandry where agreed activities and protocols are aimed at best practice for the maintenance and improvement of the stock health status and welfare. It should set out objectives and aspirations which are regularly reviewed and updated.

See RSPCA welfare standard - H 1.1

The VHP must cover six key areas:

- 1. Biosecurity.**
- 2. General management.**
- 3. Disease and physical injury – control and monitoring.**
- 4. Training.**
- 5. Major common diseases.**
- 6. Classification of causes of death.**

Maximising fish health and welfare is the overall aspiration of the VHP.

1. Biosecurity

See RSPCA welfare standard - M 3.5

Appropriate and effective biosecurity measures must be in place to minimise the introduction of new infectious agents into the farm. These measures should address the following areas:

- . disease examination and certification of ova and fish prior to stocking
- . visitors and vehicle movements
- . staff sanitation
- . movement of equipment and staff between sites
- . stock separation, isolation, sanitary and hygiene procedures between working areas
- . sanitation of fixed and movable equipment
- . day-to-day cleaning/disinfection and terminal disinfection of buildings, equipment, enclosures and nets.

Fish movements

It is recognised that biosecurity may be difficult in some cases e.g. open sea enclosure sites, where isolation of stocks from potential pathogens from the environment is impossible, but these risks must be recognised and minimised as far as possible e.g. by separation of year class stocks, appropriate fallowing and site selection.

2. General management

The farmer is expected to maintain the highest possible welfare standards at all times. It is essential that staff managing farmed fish are aware of the importance of welfare as an integral part of production. Physical health and injury scoring should be used by the farmer as a management tool to improve welfare (see Part C) and this system should be used to provide feedback to the VHP.

The VHP shall establish procedures which identify areas of welfare risk and methods of monitoring and

Appendix 1 - veterinary health plan guidance notes

minimising risk. Monitoring will determine whether the procedures are appropriate and successful. Procedures shall be regularly reviewed and the VHP changed to account for any corrective actions identified.

The VHP will include reference to a 'chain of command' detailing responsibilities for specific procedures, supervisors, reporting responsibilities and the provision of suitably trained deputies.

See RSPCA welfare standards - M 2.4 to M 2.6

Management activities to be addressed:

- . routine inspection of fish and equipment and method of recording
- . methods of handling fish
- . procedures for crowding fish
- . procedures for grading fish
- . procedures for monitoring smoltification by sea water tolerance testing and condition scoring
- . agreed maximum stocking density for each system
- . lighting levels for each stage of development
- . methods for monitoring fish slaughtering operations (see Part B).

Humane culling

The VHP must cover appropriate action when dealing with the humane destruction of seriously sick or injured fish. This should include guidelines on recognising fish that require culling. Fish which are unlikely to recover from a condition or are likely to be experiencing pain or distress must be humanely killed without delay. It is unacceptable to leave such fish to suffer when it is possible to catch and remove them. For example, if a seriously injured fish is noticed during crowding, which can be caught without distressing the remaining fish, it must be removed immediately, rather than subjected to further procedures such as pumping.

Consideration must also be given in the VHP to situations in which mass culling maybe required for emergency reasons such as a major disease outbreak. In such situations prompt identification and action can prevent considerable suffering, and producers must outline measures to ensure this is achieved as part of an Emergency Procedures Action Plan. Due attention must be paid to welfare in such circumstances as advised by the attending veterinary surgeon.

See RSPCA welfare standards - H 2.1 to H 2.2.1

3. Disease and physical damage – control and monitoring

Fish must be protected from pain, injury and disease, through good management and husbandry practice, and by rapid detection and treatment of disease.

See RSPCA welfare standards - M 2.7, M 3.2, M 3.6, M 3.7, H 1.4

The VHP shall include future husbandry plans and an assessment of risks to the health and survival of fish stocks.

The VHP must be regularly updated following visits from the veterinary surgeon.

The VHP must detail methods of removal and disposal of dead fish. The cause of death must be classified (see PART A, 6. Classification of causes of disease). Any culling should be carried out by an agreed procedure. An agreed recording procedure shall be established including cause of death (or reason for culling), dates and times of inspections and signature. Appropriate biosecurity arrangements must be in

place for the disposal of dead fish, including sanitation of equipment used.

The VHP shall detail evidence of physical damage e.g. fin damage, descaling, wounds, lice damage, eye damage etc. Incidence of physical injury and deformity must be regularly monitored (see PART C) and a programme established to identify and rectify the cause of recurring damage on a number of fish. A system of physical health scoring shall be established in conjunction with the VHP.

Farms must benchmark the physical health and damage of their fish at entry to the scheme, using accepted protocols, and monitor fish at regular intervals. As time progresses, it is expected that fish condition will progressively improve. If deterioration in fish condition occurs, this must be investigated with the site veterinary surgeon and remedial action agreed and updated into the VHP. The log detailing fish physical health and damage must be available for inspection by RSPCA farm livestock officer and Freedom Food Assessor.

Disease surveillance

Early identification of developing health problems is an important component of a VHP, allowing prompt action to be taken. Good stockmanship is therefore crucial for the early recognition of disease symptoms.

See RSPCA welfare standards - H 1.5, H 1.8

It is essential that stock-keepers are suitably trained and experienced and are able to recognise indicators of disease at an early stage.

Every effort should be made to establish procedures to give early warning of disease or health problems by appropriate monitoring techniques, on-site observations, use of cameras and laboratory tests as necessary. The exact nature of these should be determined in discussion with the veterinary surgeon and may include regular on-site monitoring and sampling and laboratory examination such as routine microscopic examination for the presence of parasites and the establishment of lice monitoring as detailed above. The requirements of third party auditing of purchased stocks and the use of tests for detecting covert disease should also be considered.

Procedures must be established for actions taken on suspicion of a disease outbreak or health problem. This must include:

- . personnel responsible for on-farm investigation
- . appropriate on-farm sampling procedures
- . involvement of the veterinary surgeon and diagnostic laboratories
- . submission of appropriate material for investigation
- . notification of disease incidence to appropriate bodies if deemed necessary.

Staff must be aware of the requirements regarding notifiable diseases. All reasonable steps must be taken to facilitate prompt identification, confirmation and response should a notifiable disease be present.

See RSPCA welfare standard - H 1.3

Supply and application of appropriate therapeutic compounds must be included in the VHP including procedures for the proper administration of medicated feeds and bath treatments.

Recording

It is essential that accurate health and production records are kept on the farm. In addition to their use as part of the day to day monitoring of the health and condition of the stocks, they should also be part of the preventative medicine plan and used in conjunction with improving health control and biosecurity measures. Review procedures should be in place to monitor trends and highlight areas of concern which may indicate changes to systems and adjustments to the VHP. The success or failure of any treatment or changes in management/husbandry procedures should also be recorded and reviewed.

See RSPCA welfare standards - H 1.6, H 1.9

Medicinal products

The use of medicinal products must be detailed in the VHP. Use must be minimised by high standards of management and husbandry and treatments restricted to occasions when the welfare of the stocks is threatened. The VHP shall detail currently available veterinary medicines licensed for fish and their use in accordance with current legislation, including withdrawal periods and discharge consents. Under exceptional circumstances the use of compounds under the prescribing cascade may be advised by the veterinary surgeon; the details of the cascade principle will be set out in the VHP.

See RSPCA welfare standards - H 3.1, H 3.3

The use of all medicinal products will be recorded in full in an appropriate medicines book. All veterinary products must be properly labelled and stored in an appropriate locked cabinet. An up-to-date stock record must be maintained and no out-of-date product retained.

Vaccination

See RSPCA welfare standards - H 5.1, H 5.7

A vaccination policy must be agreed with the farm's veterinary surgeon establishing potential risks and the organisms against which the fish can and will be vaccinated.

Full records must be maintained of all vaccination procedures.

Protocols for effective and hygienic vaccination must be in place, including appropriate fish health assessment prior to vaccination and monitoring during and following the vaccination procedure. Procedures must be conducted with care and with the minimum possible distress to the fish.

All vaccinators must be trained and competent in vaccinating technique, including biosecurity, hygienic practices, health and safety and fish handling procedures.

Appropriate procedures must be in place for third party vaccinators and the vaccination of purchased stock, including monitoring of third party vaccination and supplied vaccinated stocks. These procedures must detail biosecurity precautions in place.

At present vaccines are available for the following bacterial diseases:

- . Furunculosis (*Aeromonas salmonicida*).
- . *Vibrio anguillarum* – usually two serotypes.
- . Winter sore (*Morotella viscosus*).
- . Hitra disease (*Vibrio salmonicida*).
- . Enteric redmouth (*Yersinia ruckeri*).

In the future, effective Infectious Pancreatic Necrosis (IPN), Rickettsial and Pancreas Disease (PD) vaccines may be available.

Choice of vaccine depends on level of threat and assessment of 'side effects' such as post vaccine fungal infection and the level of abdominal adhesions, both of which may have a greater fish welfare implication than the disease against which the fish is being protected.

4. Training

A programme of training relevant to the requirements of the VHP should be detailed. This should include procedures for identifying and monitoring training needs and progress by means of regular reviews and management observations. The establishment of induction training for new personnel and a system of recording training requirements, provision and performance.

Although the majority of management and husbandry procedures have some impact on the health and welfare of the fish, some specific areas of training requirements are relevant to the demands of the VHP:

- . recognition of signs of poor welfare or disease symptoms
- . investigation of health and welfare problems
- . administration and recording use of medicinal products
- . vaccination
- . sea lice monitoring
- . monitoring fish health
- . handling, crowding, grading fish
- . culling
- . humane slaughter.

See RSPCA welfare standard - M 2.2

Written records of staff training must be maintained and be available to the Freedom Food assessor and RSPCA farm livestock officer.

5. Major common diseases

Sea lice

See RSPCA welfare standards - H 4.1 to H 4.5

Due to severe welfare problems caused by sea lice infestation, and the possible risk to wild salmonids, farms must take all reasonable steps to maintain a minimal ovigerous lice population. Farms must develop an integrated pest management policy based on stocking/fallowing times, strategic treatment regimen and area management agreements. A sea lice prevention and treatment programme shall be drawn up in conjunction with the veterinary surgeon; this shall include frequency of monitoring, sampling and monitoring protocols and threshold lice levels triggering treatments. The programme shall include agreed treatment regimes, treatment monitoring to ensure fish welfare, critical control and post-treatment monitoring.

Sea lice infestation must be monitored on a weekly basis by sampling a minimum of five fish from a representative number of pens (depending on the size of the farm). To enable appropriate choice and timing of treatments, *Lepeoptheirus* species must be classified into mobile, attached and gravid female stages; *Caligus* species are counted but not grouped. A strategic treatment regime must be implemented to avoid the 'spring settlement' of high numbers of copepodid stages. Treatment regimes and choice of treatment must at all times consider the welfare of the fish and preference must be given to more 'welfare friendly' treatments whenever possible, e.g. in-feed treatments are preferred to bath treatments; some bath treatments may be considered by the veterinary surgeon to be less damaging to fish than other bath treatments. Consideration must be given to treatment strategies to avoid the potential development of resistant lice.

Infectious Pancreatic Necrosis (IPN) virus

IPN can cause serious losses of fish in freshwater and following sea transfer of smolts. Losses can be as high as 50% with affected fish often showing few presenting symptoms. This is a notifiable disease and any suspected outbreak should be reported to the appropriate authority. Outbreaks of clinical IPN are frequently related to levels of stress to which fish are subjected, particularly at seawater transfer. Every effort must be made to ensure that stress is minimised and particular attention should be paid to the following:

- . adequate and continuing biosecurity and hygiene
- . avoiding putting infected fish to sea
- . consideration of stock selection and possible susceptibility to IPN
- . correct timing of vaccination
- . size, health, condition and nutritional status of presmolts
- . use of nutraceuticals, particularly around sea transfer
- . timing of sea water transfer, judgement of smoltification and the utilisation of sea water tolerance tests
- . minimising stress during transport and keeping transport times to a minimum
- . frequent removal of dead and dying fish
- . fallowing and area management agreements
- . controlling other disease conditions such as lice (which can carry IPN virus).

There is no treatment for IPN and control is based upon avoidance and paying attention to the above factors. The practice of starving the fish at the first sign of the disease is not thought to be an effective control measure.

Fungal infection

Infection with *Saprolegnia* fungus can result in serious disease conditions in fresh water stages of salmon production, including the egg. Infection can be particularly severe at times when the fish's resistance to the infection is low e.g. following vaccination, at low temperatures, and when maturing. Damaged fish are particularly vulnerable when even very minor damage – removal of areas of mucus, scale loss, minor fin erosion – allows the germination of fungal spores (which are ubiquitous in the fresh water environment), which can lead to the development of serious skin, fin and tail lesions. The risk of fungal infection varies between water sources, depending on the nature of the water body, water chemistry etc. and it is essential that farmers are aware of the extent of the risk posed. There are no very effective treatments for established fungal infection, and control must rest with minimising the risk of infection. Strict attention must be paid to hygienic practices and the cleanliness and sanitation of equipment; accumulations of dirt, build up of biofilms, waste feed, faeces, and dead fish all act as reservoirs for fungus. Dead, damaged and grossly infected fish and eggs must be removed from the water. All equipment and management procedures, such as crowding and grading, must aim to minimise any damage. Priority should be given to farming practices which are aimed at minimising handling the fish, including stocking policies, grading, moving and transportation. Vaccination protocols must include methods of minimising subsequent fungal infection including hygiene, vaccination technique, consideration of choice of vaccine, netting and handling, and the use of 'wet' vaccination technique. Consideration should also be given to the use of nutraceuticals prior to vaccination, and the prophylactic use of available anti-fungal agents post-vaccination.

Algae/Jellyfish blooms

Blooms of marine (and occasionally freshwater) phytoplankton (algae) and jellyfish (e.g. *Solmaris corona*) have the potential for causing severe damage and heavy losses of farmed salmon. Algae may affect the fish by producing toxins, by reducing oxygen levels at night and when they die off, and by being directly irritant to the gills and skin. Similarly, jellyfish can be directly damaging by stinging, irritating and accumulating within the gills, and by reducing water flows and oxygen levels. Indirect damage to fish can occur as a result of stress and escape responses. Affected fish appear irritated, may 'porpoise' in the

water, go off their feed and show lethargy, skin damage and pale/damaged gills. Acute losses can occur due to the toxic and/or oxygen depleting properties of the algae. Monitoring for these blooms must be carried out, particularly during the period April-October, when blooms commonly occur. Monitoring should be carried out using secci discs, dissolved oxygen logging, and by taking and preserving water samples for examination. Appropriate procedures must be established to deal with a suspect algal/jellyfish bloom, including stopping feeding, avoiding any stress to the fish, and the use of aeration systems/skirts. Monitoring, area management agreements, early warning, and response must be integral to the long-term management of blooms.

Deformity

Various deformities can occur in stocks of farmed salmon, many of these may not show grossly until the fish are on-growing in the sea, although the problem may have been initiated at a much earlier stage. A number of deformities have been identified including spinal, jaw, operculum and heart, often in combination. The cause is often uncertain although genetic, hatchery, handling and nutritional factors have been suggested. The deformed fish may be more vulnerable to handling, stress, and be particularly susceptible to loss during bath treatments. The presence and extent of any deformities should be monitored from as early stage as possible and any possible causes investigated. Factors in the hatchery which have been implicated, such as high and fluctuating temperatures, high carbon dioxide levels etc., must be avoided and due consideration must be given to the management and handling of affected fish, including possible grading out and culling.

6. Classification of causes of death

Often it is difficult to assign a specific cause of death. It is usually only possible in relatively recently dead fish and frequent removal of dead fish from pens helps this. If there is any doubt as to cause, it is better initially to classify as 'unspecified', to carry out some diagnostic investigation and to reclassify subsequently if a cause has been more clearly ascertained.

See RSPCA welfare standards - M 3.6 to M 3.8

Classifications:

- . unspecified
- . runt
- . predator damage
- . other damage (handling, grading, net)
- . bacterial disease (furunculosis, Vibrio, winter lesion, Rickettsia
- . may wish to categorise separately)
- . lice
- . parasites (freshwater)
- . fungus
- . IPN
- . PD
- . the presence of feed in the gut (express faeces from gut for testing).

Part B) VHP guidelines on ensuring fish welfare at slaughter

Steve Kestin BSc PhD, University of Bristol

1. Introduction

It is now widely accepted that fish experience suffering if they are stressed or injured. During slaughter, stress and pain can all too easily be caused to fish unless the process is carried out carefully. This is because stress can occur during the preslaughter crowd, when fish can panic and injure themselves, and when oxygen levels can become depleted. During the slaughter process injury and pain can be caused if the process is not correctly carried out.

The purpose of this section is to provide guidelines on how to prevent fish becoming stressed and to identify whether the fish are being stunned effectively. This allows people involved in fish slaughtering operations to check that the process is being carried out humanely. Improving fish welfare at slaughter is not the only reason to carry out the process carefully. There are also commercial benefits to reducing stress and injury at slaughter. These will also be briefly covered.

2. What is humane slaughter?

The same requirements for humane slaughter must apply to farmed fish as to other farmed animals. Methods used should either cause death instantly or render fish insensible to pain and distress until dead. In order to ensure that fish are being humanely killed, we need to be able to check that they are not experiencing distress or pain.

3. What parts of the operation do we need to examine?

There are two basic operations in slaughtering fish that need to be considered:

- . crowding the fish and delivering them to the slaughter table
- . killing them.

We need different techniques to assess each part but it is important to view the operation as a whole. The welfare and commercial benefits of a humane killing operation will only occur if both parts are carefully handled.

4. Assessing the pre-slaughter crowd

During the pre-slaughter crowding we need to make sure the fish are not stressed or injured.

Typically, during the crowd, the density of fish will be increased near the intake of a fish pump or so that they can be netted out. This crowding may be done using a sweep net or by reducing the depth of the enclosure net, or by a combination of both.

Crowding a small population with a seine net is generally preferable to crowding a whole enclosure.

See RSPCA welfare standard - HP 2.3

Increasing the density of fish is necessary for the operation to be efficient, but it is important that the fish are not frightened into vigorous activity like fast swimming, escape attempts, or 'burrowing' into the net. Fast swimming, escape attempts and burrowing are clear signs that fish are stressed.

5. The 'feed-back loop'

In a pre-slaughter crowd, if fish are frightened or panicked into swimming fast, several things happen:

- . they use up oxygen in the water faster. This in turn will cause further panic as the fish try to find better quality water
- . the fish injure themselves on the enclosure net and on each other, leading to further panic (and increased downgrading from scale loss, injury and bruising)
- . the more the fish swim fast, the more muscle glycogen they use up. This will mean that the carcasses will be prone to gaping and could have paler flesh.

In a pre-slaughter crowd, once fish start to panic and swim vigorously the situation can easily get out of hand and result in mortality and downgrading. Crowding must be done gently and carefully so that fish do not panic, or years of care rearing top quality fish can be undone in a few minutes.

6. Signs to watch out for

In a carefully crowded enclosure, the fish will look calm. Fish will be swimming leisurely. Obviously they will be encountering other fish frequently but they will avoid them with a flick of the tail. Fish will slide along the net and turn casually when they reach an obstruction. No fish will be burrowing into the enclosure net trying to escape. Only the odd dorsal fin of fish will be breaking the surface.

See RSPCA welfare standard - HP 2.4

When fish are stressed in a preslaughter crowd, fish will be swimming fast and could be trying to burrow into the bottom, sides or corners of the net trying to escape. If parts of the back of any fish, in addition to the dorsal fin, are exposed when they swim close to the surface or over each other, then they are almost certainly crowded too much. Fish scales seen suspended in the water column down stream from crowded fish are a clear sign that the crowd is too dense and fish are damaging themselves. Snout damage in the form of sore or bleeding snouts seen on fish after slaughter is also a clear sign that fish have been burrowing into the net. If any of the signs of stressed fish are seen, the fish need to be given more room quickly. Dissolved oxygen in the water must be monitored during the crowd but monitoring oxygen is not a substitute for observing the fish for signs of stress.

See RSPCA welfare standard - HP 2.5

7. Maintaining a good crowd

It is important to realise that fish will be stressed even in a well-crowded enclosure. Therefore, it is important that the maximum crowd duration is not too long. Generally, two hours should be regarded as a maximum crowd duration.

See RSPCA welfare standards - HP 2.1, HP 2.2

There is a fine line between a crowd that is too dense, causing excessive activity in the fish, and a crowd that is not dense enough to maintain an adequate flow of fish to the killing table. The best way to achieve an adequate but not excessive density of fish is to reduce the volume available gradually as fish are removed. As a guide, in a good crowd the net will be reduced at approximately 15-minute intervals, and at more frequent intervals when there are few fish remaining.

When pulling the enclosure nets or sweep net to crowd the fish, try to avoid areas where the net is shallow just below the surface, or folds causing pockets in the net. These will cause fish to panic if they become trapped.

To manage the crowd carefully, it should be the responsibility of one person to ensure the fish are carefully crowded and this person should have no other responsibilities or tasks to perform to distract him.

8. Methods for conveying fish to the slaughter table

The transfer operation should not injure or stress fish. It should be carried out quickly using equipment specifically designed for the job. Pipe lines should be kept short (no more than 10 meters), so that fish are not being stressed in the pipe for too long. Obviously, there must be a method for quickly getting fish out of the pipe in the event of equipment breakdown as fish can die in a pipe from lack of oxygen in only a few minutes. Fish should exit the pipe onto the slaughtering table in a way that does not lead to injury, meaning that they must not have to drop down onto a de-waterer or the table.

Air-lift pumps, venturi pumps, vacuum pumps and crane operated brailles are all used to transfer fish to killing operations. Generally, air-lift and venturi pumps are preferred as they damage and stress fish less.

Examine a sample of about 50 fish immediately after slaughter for evidence of scale or skin loss or injury caused by handling equipment like pipes and pumps. As a guide, if any of the fish have areas of recent scale loss etc. larger than a two pence coin, the equipment needs to be examined and improved.

See RSPCA welfare standard - HP 1.4

The whole crowding and pumping operation should deliver fish to the killing table in a steady stream and at a pace that the slaughter team can cope with. The killing team should be able to adjust the flow of fish from the table easily.

Stunners should be positioned on the table in such a way that handling of fish prior to stunning is reduced to an absolute minimum. On a well-designed killing table, fish can be gently guided into the stunner without struggling.

When fish arrive on the table, to minimise stress and injury, they must be stunned immediately. As a guide, operators should aim to stun fish within five seconds of arrival on the table.

9. Managing a good stunning operation

First, the stunning machines should be set up and maintained regularly according to the manufacturer manuals. The pressure of the air delivered to the machines should be clearly visible and checked against the machine manufacturer recommendations, and logged at least twice per shift. A record of checks and maintenance should be kept.

Second, operators should be familiar with the operation of the machine. During training they should practice with a dead fish to perfect their technique of capture and presentation for stunning before killing any live fish.

It is critically important for fish welfare that the machine hits the fish accurately and hard.

If stunning is correctly carried out, the fish will not recover from the blow, even if it is not bled. If fish are not hit hard or accurately, they will be injured or could recover consciousness and will suffer.

Because poor stunning could cause so much suffering, we need to ensure that all fish are being stunned effectively.

See RSPCA welfare standard - S 1.4 to S 1.5.1

10. Assessing the effectiveness of stunning

First, watch fish arriving at the stunning table from the fish pump. Time how long it is between a particular fish arriving and it being stunned. Note down the time and then repeat for about ten fish. Work out the average. As a guide, if the average 'arrival to stunning time' is more than five seconds then the operation needs to be improved.

Reduce the flow of fish to the table by slowing the fish pump and/or reducing the crowd density. Then look at the ergonomics of the killing table. Could fish delivery, presentation or handling be improved by modifying the table with dividers or higher/lower edges or rubber mats, placing the stunners in a different position or are more stunning machines needed? It is surprising how many killing tables are ergonomically not well laid out. Try modifications to the table with temporary wood partitions etc and evaluate the effectiveness of these modifications before having the table modified by professionals.

Second, observe the stunning operation. Count how many stunning blows are needed to stun a particular fish. Note down the number and then repeat for about ten fish. If fish require more than one stunning blow, then the operation and/or set up of the stunner needs to be improved. Check that the operator is presenting fish correctly, that sufficient air pressure is available and that the machines have been maintained and are not obstructed in any way. Re-evaluate the stunning process. If fish require more than one stunning blow, then the operation must be stopped and the manufacturers of the machine need to be contacted.

Note that the unconsciousness induced by percussive stunning should be immediate and permanent i.e. the fish should not recover from the blow, even if it is not bled. Bleeding is not part of the killing operation but is done for flesh quality reasons.

11. Determining whether fish are adequately stunned

Observe fish immediately after stunning. In a properly stunned fish a reflex shudder or tail flap will usually occur for a few seconds after stunning. Do not be worried about this reflex movement if it lasts for up to four seconds. But if movement lasts for much more than four seconds, it is not a reflex and stunning is not being done effectively.

If there is no overt movement in fish after four seconds, pick the fish up and examine it. Look for signs of rhythmic breathing and eye roll. These are the best signs to look for to determine if the fish is properly stunned. This is because rhythmic breathing and eye roll are both signs of brain stem activity – if they are absent it is safe to conclude that the fish is deeply unconscious.

- . Rhythmic breathing appears as rhythmic movements of the operculum (gill cover) (and sometimes the mouth). Note that occasionally fish that have been properly stunned will flare their gills a few minutes after stunning. This is a reflex action and, provided it is not repeated more than a couple of times, can be ignored.
- . To observe eye roll, with the fish lying on its side, look at the movement of the eye when the fish is rolled upright and then back again. In a stunned or dead fish the eye will remain flat and fixed in the skull. In a conscious fish or one that has not been properly stunned (i.e. with brain function), the eye will appear to move in the eye socket, trying to remain upright when the fish is rolled onto its side.

If there is no sign of rhythmic breathing or eye roll then the fish is properly stunned. If rhythmic breathing or eye roll can be observed, then the fish is not adequately stunned. Practice observing rhythmic breathing and eye roll on a few fish before they are stunned so that you know what to look for.

Make sure that all people involved in stunning and bleeding fish know that if a fish is fighting or responding to handling in any way it is not unconscious and must be stunned before anything else is done to it. If a fish responds to handling or the cut of the knife when exsanguinated then it is definitely not stunned.

12. Assessing the stunning operation

See RSPCA welfare standard - S 1.9

Use the simple indicators of brain function to estimate the efficacy of the stunning operation at least once each day fish are killed and particularly when new equipment or operators are used. Examine at least 50 fish picked at random and stunned by all operators and machines. As a guide, if any of these fish respond to handling or show any signs of rhythmic breathing or eye roll they are inadequately stunned and the causes need to be identified and rectified. Make a note of the results of each assessment and any action taken in the killing log.

13. Exsanguination (bleeding)

Remember that properly carried out, percussive stunning is permanent. Bleeding is carried out to improve the flesh quality of fish. In most cases, bleeding is done by cutting all the gills arches on one side of the fish. This should be done reasonably soon after stunning. But, contrary to popular belief, a beating heart is not necessary for effective bleed out.

14. Finally

See RSPCA welfare standard - S 1.7

Each person involved in killing should be aware of the importance of good killing practice. This means minimised stress or injury before slaughter, and rapid and effectively applied stunning. The signs to look for are leisurely swimming fish in the crowd pen, and still carcasses after stunning. In particular, there should be no movement in the bleeding/icing tub.

The overall stress of a slaughter operation can easily be assessed if the pattern of rigor onset and resolution is measured. Salmon killed without stress enter rigor after approximately 40 hours. When salmon are stressed before they are killed, they can enter rigor very rapidly, typically in less than 15 hours.

15. Summary of observations and measurements to make during fish slaughter

Observe the behaviour of fish in the pre-slaughter crowd pen

Look for the following signs of low stress:

- . fish swimming leisurely
- . fish sliding along net, turning casually when obstructed
- . only the odd dorsal fin of fish breaks the surface.

Look for the following signs of high stress:

- . fish trying to burrow into the bottom, sides or corners of the net
- . fish trying to escape from folds in the net or shallow areas
- . parts of the back of fish exposed when fish swim close to the surface or over each other
- . fish scales suspended in the water column down stream from enclosure
- . oxygen levels below 5.5 mg/l.

Check the killing equipment and staff

Check:

Appendix 1 - veterinary health plan guidance notes

- . pressure of the air delivered to the stunning machines
- . maintenance log of stunning machines
- . operators are familiar with the operation of the machine
- . operators, technique of capture and presentation for stunning is good.

Watch the stunning operation

- . work out the average 'arrival on table to stun' interval. If more than five seconds the operation needs to be improved
- . observe the number of blows needed to stun fish. If more than one blow is needed the operation needs to be improved.

Examine a sample of 50 fish immediately after slaughter

Look for:

- . carcass movement lasting more than four seconds in any fish, stunning is not being done effectively
- . signs of rhythmic breathing and eye roll – if either present, stunning is not being done effectively
- . snout damage in the form of sore or bleeding snouts – sign of poor preslaughter crowd
- . scale or skin loss or injury – signs of poor handling equipment (pumps and pipes etc).

Part C) Development of a programme for monitoring physical injury and deformity

Introduction

Regular monitoring of fish for signs of physical damage or deformity is an important part of management so that welfare problems do not go undetected. However, it can be difficult to observe individual fish clearly due to the large number of animals and the size of enclosures. Whenever husbandry procedures allow closer proximity to fish, the opportunity should be taken for more detailed observation. In addition there should be detailed monitoring of fish health at slaughter where careful examinations of individuals for disease, injury and deformity can be made.

The RSPCA welfare standards require that there is no recurring physical damage occurring on fish attributable to features of their environment, husbandry procedures or unrecognised disease challenge. Incidence of physical damage must be regularly monitored at slaughter according to a programme specified in the VHP (see Part A for more details). This programme must include keeping records to show that physical health scoring has been regularly conducted on a sample of fish at slaughter. The records must also give details of the levels of physical damage observed during monitoring, for example, the percentage of fish with fin damage, descaling, wounds etc. Records should be discussed with the veterinary surgeon, and the VHP must be regularly updated to identify and rectify the causes of any physical health problems that become evident during monitoring.

There follows a guide for a possible monitoring programme which could be used at slaughter. Examples are given of the types of condition which should be monitored. The proportion of fish affected should be recorded. Some photographic scales (see pages 62 to 63) are also presented to demonstrate how the severity of some types of damage could be assessed.

Possible monitoring programme

The conditions which are to be monitored must be specified in the VHP. It is suggested these include:

- . eye damage/loss
- . snout injuries
- . fin damage (dorsal, pectoral, pelvic, tail)
- . deformities (jaw, operculum, spine)
- . scale/skin damage (due to abrasion, sea lice etc).

Examples are given below of scales that could be used to record the severity of the condition for each fish assessed. Each fish is given a score of 0,1 or 2 for each condition. Score 0 indicates the fish is completely normal, Score 1 is used for fish that are mildly affected, Score 2 is used for severely affected fish.

Photographic scales are also given to suggest examples of different scores. These photographs illustrate the type of damage which may be seen, but are not intended to be exhaustive. For some conditions, the severity, age, and extent of damage can vary considerably. Scoring will be somewhat subjective. The important factor is for the person assessing fish to be consistent when scoring in order to be able to monitor any changes in damage levels.

When drawing up a monitoring programme there should be an initial trial of the scoring system, with a sample of fish being removed from the slaughter line after killing and transferred to an examination bench. The process is easier if two people are involved. Each of the conditions should be carefully examined on each fish, by one observer, and a score assigned.

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Once a method of using the scales has been established and scoring can be conducted consistently, assessments can be started on a random sample of fish. A recorder should stand behind the assessor and write down the scores as they were called out. A random sample of 150 fish on the slaughter line should be assessed (trials have shown approximately 150 fish can be assessed in one hour by an experienced team).

Use of the scales in the Freedom Food scheme







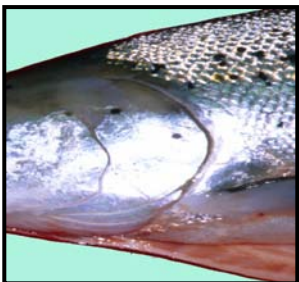
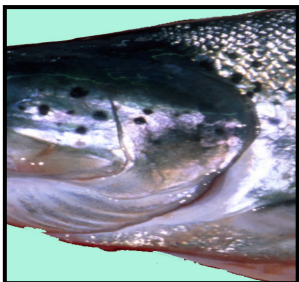






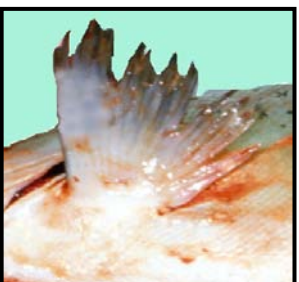
The results from this assessment should be used to identify areas where welfare can be improved on the farm, by identifying causes of physical damage and taking action to rectify the situation. Records of physical damage scale assessment must be kept and made available to the Freedom Food Assessor and RSPCA farm livestock officer, along with details of any action taken as a result of the assessment. It is expected that the VHP will be regularly updated, in consultation with the veterinary surgeon, to reflect the results of the physical damage scoring assessment.

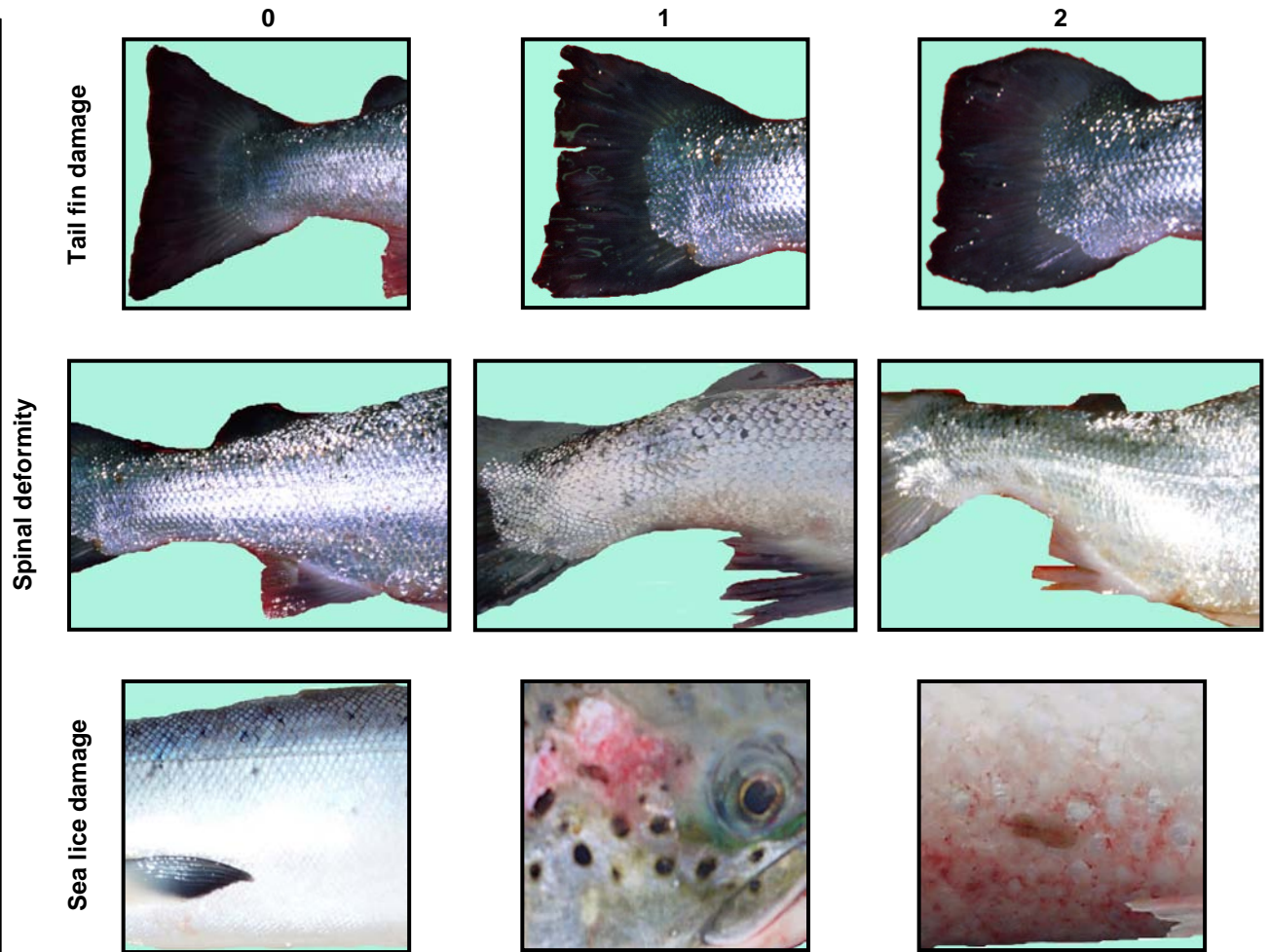
Suggested scoring system

The table below shows the score given to a fish for each condition depending on the severity of damage.

| | | Score given to fish | | | Also note: |
|---------------------------------|--------------------------------------------|---------------------|---------------------------------|-----------------------------------------|----------------|
| | | 0 | 1 | 2 | |
| type and level of damage | Eye loss/damage | None | One eye | Both eyes | Type of damage |
| | Snout injury | None | Mild | Severe | |
| | Jaw deformity | None | Mild | Severe | |
| | Operculum deformity | None | Mild | Severe and/or both sides | |
| | Dorsal fin damage Type and level of damage | None | Mild | Severe | |
| | Pectoral fin damage | None | Mild | Severe and/or both sides | |
| | Tail fin damage | None | Mild | Severe | |
| | Spine deformity | None | Mild | Severe | |
| | Scale loss/skin damage | None | < 10% each side and superficial | > 10% each side and/or deep skin damage | |
| | Sea lice damage | None | Mild | Severe | |

Suggested examples of normal, mild and severe for conditions classified in this way (note: eye loss/damage and scale loss have a different classification and no examples are given).

| | 0 | 1 | 2 |
|---------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Snout injury |  |  |  |
| Jaw deformity |  |  |  |
| Operculum deformity |  |  |  |
| Dorsal fin damage |  |  |  |
| Pectoral fin damage |  |  |  |



These photographs are part of a larger set of photographic scales which have been developed by the University of Bristol for use during on-farm assessment of farmed fish welfare. The copyright for these images belongs to the University of Bristol.

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