Fish Welfare During Transport

25 October 2006
Thistle Hotel, Inverness

Forum organised by the Humane Slaughter Association

Speakers from:

Stirling University • Fish Vet Group • Scottish Sea Farms
Solway Transport • Nevis Marine • Freedom Foods/RSPCA • Defra

Introduction

For those of you who don't know the Humane Slaughter Association (HSA) too well, despite our name, the HSA remit is the welfare of food animals in markets, during transport and at slaughter. Our interest in the welare of terrestrial animals during transport extends back over the 95 years that the organisation has been in existence, but little consideration has been given to fish transport until more recently.

So far the HSA has produced two training videos concerning the transport of animals, both of which were designed to highlight the difficulties of moving livestock. The latter video - *The Road Ahead, Livestock Welfare in Transit* - has won training awards and has also been recognised by the EU being translated into eleven different languages to train hauliers across Europe.

This video has been successful, as it was produced in conjunction with the industry and was based on both practical knowledge and solid science.

However, as the HSA's involvement with fish transport has increased it is apparent that this kind of information is still being established and there are a number of parameters and ideas being tested. In addition, technology is changing and improving quickly as are standard aquaculture practices.

With this is mind, and the fact that new laws will come into effect in 2007 and 2008, the HSA has decided to hold this forum to bring together people involved in the transport of fish to discuss current practice and knowledge and help to identify if there are any knowledge gaps and if so how we can cover this either through research or practical development of current standards or a combination of both.

The range of delegates included transport operators, farming companies, vets, government, auditors, consultants, researchers and welfare groups, which represent most parties with an interest in fish transport.

The forum has provided a very good overview of the current state of the industry and has identified a number of possible ways forward to aid farming and transport companies as they strive for the highest welfare standards.

Aims of the Forum

- ✓ Gather industry representatives and scientists involved in the transport of live fish
- ✓ Review current knowledge and technology for the methods of transport available
- ✓ Establish possible research requirements and knowledge gaps
- ✓ Encourage information and technology transfer throughout the industry

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Acknowledgements

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Presentations

Introduction to welfare and water quality
Craig MacIntyre (University of Stirling)

This presentation was based on research carried out by Craig MacIntyre as part of his PhD. It was explained that his research is based on freshwater species but that the principles could be largely attributed to other species. He started by discussing the difficulty in defining animal welfare which reflects the largely abstract concepts of comfort and happiness. There are three different ways of viewing animal welfare:

- Function-based: reflecting the ability of the animal to perform in the farm environment, but this doesn't take into account the feelings of the fish.
- Feelings-based: reflecting whether the animal has what it wants and how it feels. The environment should be free from negative experiences and provide access to positive experiences.
- Nature-based: reflecting whether the animal can express its natural behaviour – is all natural behaviour good welfare - ie salmon migrating, is this a need to migrate or do they migrate because they need food, therefore in the farming environment when food is not an issue is the fact that they cannot migrate a welfare problem? We still do not know the answer.

These definitions tend to be exclusive. Different interest groups may not see welfare in the same way, which hampers interchange. A function-based view is adopted by many scientists, because it allows the relatively straightforward measurement of parameters representing health and condition, e.g. stress hormones and condition factor.

A feelings-based view assumes that animals (and fish) have mental experiences and that we can interpret these. Preference testing and behaviour are being used, but such methods are difficult to apply under farm conditions and during transport. How can this be tested in farming and transport systems? The nature-based view (held by animal rights groups) was questioned, as this is difficult to be quantifiable.

The presentation then focused on the issue of fish welfare, asking whether fish can experience pain and suffering. There are two components to pain - firstly the detection of the damaging stimulus and secondly an emotional component. We currently do not know whether fish have a conscious experience of events or circumstances as unpleasant, or the emotional capacity to suffer. Nevertheless, the welfare requirements of fish will ultimately be determined by society through consumers and retailers. Increasingly, a clearly-defined duty of care is being placed on farmers, transporters and processors.

Attention then focussed on water quality. Tables are available prescribing recommended limits for numerous water quality parameters. However, such limits can prove to be too simplistic. For example:

- the impact of suspended solids on fish health depends on the specifics of the particle size, shape and material, rather than just the concentration
- the toxicity of nitrite is highly dependent upon the chloride concentration

There are numerous interactions between the most significant water quality

parameters (oxygen, salinity, pH, carbon dioxide, ammonia, hardness, nitrite, suspended solids, temperature) that determine the impact on the fish. An example was given for ammonia: in typical Scottish loch water (10^{o}C, pH 6.5) with a total ammonia concentration of 3 mg/L, there would only be 0.0018 mg/L present as the toxic, un-ionised form (NH_3); in a typical English chalk fed river (15^{o}C, pH 7.8) the same amount of total ammonia would result in 20 times as much of the toxic form.

The talk finished by emphasising four take-home messages:

- Water quality interactions are complex and looking at one parameter individually is dangerous.
- It is very important to maintain oxygen levels in the water as fish are then far better able to cope with other challenges.
- Fish probably need time to adapt to changes in water chemistry so it is important to consider the implications of transporting fish between waters with different water chemistries.
- Disease is possibly the biggest threat to fish welfare and the susceptibility of fish is affected by water quality.

Statement: Comment made that animal welfare groups take into account that farming is an acceptable practice, rather than animal rights groups which are often underpinned by groups that do not agree with farming, and as such they should be looked at as separate groups with very different aims.

Question: Asked what is normal behaviour for fish during transport?

Answer: Craig responded that many of the behaviours are modelled on behaviours seen in farming systems and therefore there may be slight differences when transferring this information into transport systems.

Fitness to travel and its assessment
Pete Southgate (Fish Vet Group)

It is a legal requirement that fish have to be fit to travel under the Welfare of Animals Transport Order (1997), commonly termed WATO. There are two key paragraphs in this main piece of legislation, i.e.

> "No person shall cause or permit the transport of an animal that is unfit by reason of it being in the state of being newborn, diseased, infirm, ill, injured or fatigued or …for any other reason."
>
> "No person shall cause or permit an animal to be transported in a way which causes or is likely to cause injury or unnecessary suffering to the animal."

These requirements have been incorporated into codes of practice such as the Freedom Food standards, retailer standards and the industry code of practice.

The law requires that dead fish are not loaded, they are removed as soon as possible after being found, cause of death should be identified by a competent person and this should be recorded. Question to the audience does this happen? Are the records kept and who is a competent person?

The requirement of not transporting unfit fish is due to a variety of reasons: loading and transport are stressful procedures and unfit fish will not be able to cope so well; the high concentration of fish in transport tanks will facilitate the transmission of disease; transport presents a high risk of breaching biosecurity and introduction of disease to the destination.

So who is responsible for assessing fitness to travel, and how can it be done? Both the stockperson and the transporter have some measure of responsibility. The stockperson, as the person who has observed the fish through their growth period, will have the best idea of the condition and state of the fish and the transporter will have experience of fish in transport systems. Fitness to travel has to be assessed in a variety of ways:

- Visual inspection by a competent person a few days prior to transport. A variety of indicators can be used such as fish behaviour, the presence of moribund and dead fish, the condition of the fins and body, and the presence of lesions and damage. Visual inspection may be difficult in sea cages but is possible using a camera or diver. Further investigation for external skin and gill parasites can also be included.
- Assessing the recent disease history using veterinary reports, treatment records and mortality figures. If there has been a recent disease outbreak, then there is the risk of residual infection or fish acting as carriers.

Any obviously unfit individuals should be removed from the population, and if necessary the movement of suspect populations should be delayed pending further examination.

When should fish be observed and assessed? This should be done days before transport, helping to identify any changes in natural behaviour and looking for external parasites etc. Observation and assessment is just as important immediately prior to transport. This will allow sick or dead individuals to be removed. Again the planned movement should be stopped if judged necessary.

As a final point, if a checklist is made of all such observations and conclusions, this would provide a certificate for fitness to travel in case of inspection.

Statement: On the point that dead fish should be separated, the code referred to is being audited so this should be recorded.

Removal of dead fish should be balanced with the effect that this removal will have on the live fish.

Question: Are there any standards/simple systems for identifying scale loss/fin damage etc for highlighting which levels are acceptable/unacceptable for transport.

Answer: There is no such thing but it would be a useful tool.

The importance of transport management and contingency planning for fish welfare
John Barrington (Scottish Sea Farms -SSF)

Scottish Sea Farms (SSF) have three freshwater sites and numerous sea-cage farms on the west coast of Scotland and in Shetland. Each year SSF transport five million smolts to the marine sites, and a corresponding number of fish are harvested. Fish are transported in a variety of ways depending upon the stage – freshwater stage fish are moved in trucks and contracted helicopters, and smolts and harvest fish are transported in wellboats.

Transport involves feed withdrawal, physical handling and keeping fish in a modified environment during transport (due to potential differences in temperature, water quality, light, water flow, density). A modified environment has to be recognised as inevitable. The main aim in managing transport is to provide a safe environment and minimise unnecessary stress or discomfort to the fish before, during and after transport. Such management includes:

- Planning, risk assessment and contingency plans
- Ensuring training and competence
- Appropriate equipment design, maintenance and servicing
- Standard operating practices
- Biosecurity
- Specified supervisory responsibilities for each stage and overall
- Monitoring of water quality parameters and fish performance/behaviour
- Recording
- Communication

Planning involves identification of the method (truck, helicopter, wellboat) and route, stock details (numbers, weight, biomass, type), date and timing, the haulage contractor, and who will be responsible for each area. John emphasised that risk assessments are vital for each stage of operation. He provided an example of a risk assessment template for loading (e.g. fitness to travel, inadequately smoltified, experience of staff at crowding, etc). The likelihood of occurrence and the impact of each risk are scored on a scale of 1 to 10, and a subjective risk score is derived from the product. It is also important to note that planning is pointless if there is no communication from all people involved in the transport process.

Management of wellboat transport needs to include factors such as a route plan and an emergency plan in case of bad weather that includes suitable mooring sites and emergency contact numbers. All pumps and pipes used for loading and unloading must be suitable for the size of the fish, and their operation checked before use. Contingency plans for equipment must be in place with spare parts available. It is important to specify the levels of the water quality parameters which are going to be adhered to, with action levels. Wellboats have oxygenation systems and sensors enabling continuous monitoring of dissolved oxygen, temperature and carbon dioxide;

cameras are also used to monitor the fish throughout the trip. A moveable bulkhead is now commonly used in wellboats – this gathers the fish into a smaller volume, thereby avoiding the need to drain the well completely when removing the fish. The need for precise instructions to be provided to the wellboat about the cages intended to receive the smolts should also be stressed.

Management includes ensuring that staff are trained in basic fish health and welfare, and that personnel are competent to gauge the fitness of the fish and have the authority to stop the transport if necessary. Fitness is assessed from samples of 100 fish taken four weeks prior to transport and immediately prior to loading. Behaviour is noted on unloading and a further assessment is made 30 days after transport. All such monitoring is recorded and this enables a retrospective look at any effects of the transport. Any impacts identified are fed back into the risk assessment, which is revised and communicated to all relevant personnel.

Comments: Surprised at how many checks are made and the amount of paperwork that would be produced. Another delegate raised the point about cost.

Answer: There is significant paperwork produced and this takes a lot of time, it has not been costed as they see it as an essential part of the business.

Question: Are post transport deaths monitored and causes identified?
Answer: It is looked at and monitored, but the actual cause of death can be down to varying conditions.

Question: Smolts are delicate, easily lost to stress or disease therefore need to be looked after. Is the same concern afforded to harvest fish?

Answer: Fish quality is related to flesh quality, so yes they are looked after in the same way.

Specific requirements for road transport
Paul Armstrong-Wilson (Solway Transport)

Pre-transport preparation of the stock by the farmer is vital. The appropriate number /biomass of fish should be separated, they should have been able to recover from any handling, grading, or treatments, and they should have been starved. The haulier accepts the fish from the farmer in good faith and therefore needs to be made aware of any changes in behaviour and mortality that may affect his conclusion on fitness to travel. Paul also emphasised the need for the farmer to have the correct paperwork ready to accompany the fish.

The drivers of transport vehicles are a very important part of the transport process, and good drivers are difficult to come by. In addition to being conversant with basic HGV requirements such as the tachograph, drivers should be interested in the process of fish transportation. They also need to have a combination of attributes, being reliable, trustworthy, responsible, physically fit and practical. Drivers are given on-the-job training due to the lack of suitable courses.

Transporters need to have an operator's licence. Any vehicle must be suitable for the purpose, designed so that it can legally carry the weight of the fish and water. The transport vehicle must be well maintained, checked daily, and spares (e.g. fan belts) should be carried to minimise delays due to mechanical problems. Reliable breakdown cover should also be organised for all areas the vehicle is travelling through.

Transport tanks on the vehicles are commonly made of fibreglass, plastic or stainless steel. They should have smooth walls, free of chips that could harbour pathogens and be insulated to minimise temperature changes. The hatch should be large enough to prevent damage to the fish during loading, and lids should fit tightly so fish and water is not lost en route. The tanks should be supplied with oxygen and compressed air. The oxygen supply should have the capacity to sustain twice the nominal biomass of fish in the tank, so oxygen levels can be increased rapidly in the event of a problem, or if the actual number of fish is greater than intended due to weighing or counting errors. The additional aeration helps circulate the water within the tank and remove carbon dioxide. Any compressor for the air supply must be oil-free to avoid contaminating the water. The aeration rate will depend upon the type and size of fish.

The water in the tanks is the key to successful transport. It should be from the same source as the fish have been reared in, and be taken from the inlet rather than pond itself (or outlet) to ensure it is free from contamination and suspended solids. Water temperatures should be within the range 4–12^{o}C; any lower and the fish tend to settle on the bottom and smother each other; at higher temperatures there is too little dissolved oxygen, and the fish are more prone to stress.

Loading the fish into the transport tanks should be made as stress-free as possible. Stress on loading will cause the fish to shed mucus and faeces, compromising water quality. Ideally the fish should be pumped to avoid dry netting. The farm has a duty to ensure that sufficient staff are on hand to make loading a smooth and quick

operation, thereby minimising delays and the total time that the fish are in the tanks. There are no hard and fast rules for determining fish densities. The deterioration in water quality is the overriding factor, so the journey length, the size and species of fish, and the quality of the original water will determine density.

The route needs to have been planned beforehand, with consideration given to any potential traffic problems, road-works and the weather. Alternative routes and contingency plans need to be decided beforehand. During the journey, dissolved oxygen levels are typically monitored in the cab. The ideal is to aim for 100% oxygen saturation throughout the whole water column. It is important to monitor the whole water column, as fish tend to aggregate at the bottom. It is strongly advised against changing the water en route, due to biosecurity risks and the stress of the water change to the fish.

Once the vehicle arrives at the destination, unloading should be a smooth and quick operation, again with as little handling as possible. Preferably self-draining tanks should be used, with the caveat that the valves should be large enough for fish to easily pass through. It was also suggested that pumping water back into the tank during unloading should be considered if there is a risk of the tanks running dry. It is also important to facilitate the recovery of the fish by minimising any temperature change at unloading, and ensuring the fish are put into good quality water.

Finally, it is vital that systems are kept simple (so there is less to go wrong), and biosecurity is considered. The transport tanks themselves are routinely washed inside and out before disinfection, and vehicles should be disinfected on entering and leaving each farm.

Question: Presumably there is a trade-off between densities and economics of travel, are there any guidelines?
Answer: Short journeys could be 100kg/m^3 but longer journeys, such as those down to France would only be 60 kg/m^3.

Question: How often are drivers asked for Animal Transport Certificates?
Answer: Never, our company produce in-house certificates to be used on each journey, these have more information on them than required by the legislation for the company's benefit but we never have been asked for them.

Question: Have re circulation systems been considered?
Answer: Not sure if they are used, but would go back to final point – keep the system simple.

Question: Going back to the 30-day check mentioned earlier, is this information ever fed back to the haulier?
Answer: Only when things have gone wrong! Also made the point that they only know as much about the fish as the information they are given, so they don't always know the full story, which can have negative implications.

Specific requirements for wellboat transport
Ian Armstrong (Nevis Marine)

Started by highlighting the potentially devastating impact poor biosecurity during transport can have on the industry. Fish movements contributed to the spread of Infectious Salmon Anaemia (ISA) during the 1998/9 outbreak and, although the disease was eliminated in two years, there was a large human cost in terms of jobs and income. The outbreak precipitated the development of specialised harvest stations and significant changes in fish transport practices.

Seawater transport of fish in Scotland is currently dominated by Norwegian-based companies that lease wellboats to Scotland. These boats currently comprise the most modern wellboat fleet in the world. Purpose-built wellboats have the superstructure at the front to give a good view of the well. There is sophisticated remote monitoring on board with video camera observations of the wells, and dissolved oxygen sensors with alarms. Advanced water treatment including protein skimmers are incorporated to improve water quality, and there is a moveable bulkhead to improve unloading of fish.

Wellboats are used for transporting smolts to ongrowing sites and harvest fish to slaughter. The bulk (70%) of Scottish salmon production is now collected by direct harvest wellboats. These are closed-valve Refrigerated SeaWater (RSW) wellboats which enable the fish to be carefully chilled prior to slaughter. Once the fish are loaded, the valve is closed and the water is chilled. A code of good practice specifies that chilling should be from ambient, gradual (less than -1.5^{o} C/ hour) and steady, and stop before 4^{o}C. There are also guidelines on the density of fish (100–125 kg/m^{3}) in the well, which depends upon size of the fish (3.5 – 5 kg).

It should be emphasised that it is the quality of the wellboat journey that is important, rather than the duration. In Norway, smolts can be transported the entire length of coastline which takes 5–6 days. Preparation is vital to good transport practice and involves grading, ensuring a good health status, appropriate food deprivation, and a good crowding technique for loading. During unloading a suitable discharge facility is vital, as is an efficient working practice which includes communication between workers on the boat and cage.

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Specific requirements for helicopters and towing cages
Tony Wall (Fish Vet Group)

Helicopters.
Helicopters represent an expensive means of transport (around £650/hour) and are mainly used for moving smolts and broodstock to cages. The duration is typically short (maximum times approx 20 mins) and high densities are used (300-400 kg/m^3) to maximise the number of fish moved. To sustain the high density of fish, the water is supersaturated with oxygen before the fish are added and there is continuous oxygenation during transport. The "buckets" used for transporting the fish are specifically designed – when lowered into the water at the destination a spring-loaded float lever releases the hatch so the fish can swim out. They will be around 1m^3 in size and will be filled, first with two thirds water and the fish will be added to fill the bucket.

A major issue for helicopter transport is that good weather is needed, and it must be possible to abort any planned movements in the event of adverse weather conditions. The importance of good communication and planning is especially important with helicopter transport to ensure that the fish are released into the correct cage. Biosecurity was emphasised, with the need to ensure removal of biofilms from all parts of the bucket. A particular issue for helicopter transport, for which there is no information, is the potential effects on the fish of rapid changes in altitude, and the forces generated during sudden movements.

Risk areas for helicopter transport include physical damage at loading and during transport and this was illustrated by a photograph of a split cornea (Figure 1). Hypoxia during transport is a potential risk if there is insufficient oxygen, and conversely hyper-oxygenation may lead to gas bubble disease (illustrated with a photograph of bubbles formed behind the cornea, Figure 2). Technical problems can also occur, such as the bucket–opening mechanism not functioning or the helicopter being unable to fly.

Figure 1

Figure 2

Towing cages.
This method is usually used to move sea-cages from summer sites to inshore/sheltered sites for winter, and freshwater trout and salmon cages to shore for harvesting. It has clear advantages in that the fish are not handled and large numbers of fish can be moved at once. A major consideration is that the speed of the tow should not cause the cage net to deform and become "bagged" trapping the fish, or the fish to become exhausted and crowded and entrapped on the trailing wall. Towing

speed therefore depends upon the size and species of fish. Recommendations to reduce net deformation are that the nets are clean, net tensioning is considered, and directional currents are used. Other issues are that the propeller noise may cause fear in the fish, jellyfish swarms should be avoided, and large cages may become unwieldy if there is a significant current or high winds.
Finally the fitness to travel of fish with deformities was questioned – mouth and gill abnormalities could affect ventilation ability, and spinal deformities could affect the ability of fish to swim with the cage during towing.

Question: Has anyone looked at the rapid change in pressure and the effects it has on fish

Answer: No, but it has been done on frogs and they do have effects on the eyes by raising them 1000m, however fish don't get this high and it is not necessarily right to transfer this to fish.

Question: Has anybody looked at the mortality of fish been transported via the different methods and are there any significant findings?

Answer: The information should be there in the majority of fish companies' records of transfer, however it is not a simple task of just collecting data as there are a number of factors that affect the conditions and this information may not always be available.

Monitoring fish welfare during transport
John Avizienius (RSPCA) & Bob Waller (Freedom Food)

The distinction between the RSPCA and Freedom Foods was explained: the RSPCA develop standards which are then monitored by Freedom Foods through inspections. Monitoring requires an initial assessment of the relevant measures to appraise, and is necessary as it adds integrity to a scheme. Feedback from members is welcomed which goes to the authors of standards who, in consultation with an expert working group, make changes to standards as appropriate. The aim is always to have high standards, but these do need to be achievable. The development of scheme standards is therefore an interactive, evolutionary process.

The recent development of monitoring for fish transport is based upon the assumption that handling and journeys are stressful for the fish. Standards for monitoring are developed by breaking the transport process into stages (e.g. crowding, loading, recovery in wellboat, transport, unloading, stunning and bleeding), and then identifying a suitable set of indicators for each stage. The aim is to develop a checklist of fish-based indicators signifying whether conditions are good, bad or benign. Such indicators are based upon behaviour, morphology and physiology. Examples of indicators would include aggressive behaviour, non-aggressive behaviour, mouth gaping, rapid gill movements, obvious scale loss, mesh injuries to snouts, and visual observation of swimming pattern. A difficulty in applying such indicators is determining appropriate threshold levels to denote when remedial action is needed.

Emphasis was on the importance of challenging accepted practices and ensuring even the simple things are thought about so conditions are improved for the fish. For example, it is important to wait for the wellboat to arrive before starting to crowd the fish, and measuring oxygen in the corners of a crowd. Also using any novel indicators is welcomed, e.g. seagulls eating transferred smolt shows that the fish have been compromised.

In conclusion, why does such monitoring matter? There is always room for improvement and it enables problems to be identified, so that solutions can be found and the fish get a better deal. Product quality should also improve so producers also get a better deal with fewer downgrades and less loss to disease. Monitoring also provides a third party verification, and Freedom Foods is currently the only independent welfare venture in Europe, providing traceability and transparency for improved consumer confidence.

The role of Freedom Foods is to implement the RSPCA standards via inspection and monitoring. Monitoring is a three-stage process of observe, record and review. Observation allows identification of good and bad practices, recording provides documentation, and reviewing provides the opportunity to change practices. It was emphasised that members of the scheme need to

- Say what you do – i.e. have written procedures
- Do what you say – i.e. ensure protocols are communicated to staff who are aware of any revisions
- Be able to prove it – i.e. have records

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Implications of new regulations
Chris Elmer (Defra)

Currently the Welfare of Animals (Transport) Order 1997 implements Council Directive 91/628/EEC on the protection of animals during transport. This applies to the commercial movements of all vertebrate animals and cold-blooded animals (fish and crustaceans). From 5 January 2007, the new Welfare of Animals (Transport) Order 2006 comes into force, which applies Council Regulation 1/2005 on the protection of animals during transport to the transport of all vertebrates in connection with economic activity. Transport of fish in connection with food, sporting, ornamental, display aquaria, and research activity therefore all fall under the regulations. The conditions for fish transport are not detailed, and the relevant general provisions that apply to fish require that:

- No person shall transport or cause animals to be transported in a way likely to cause injury or undue suffering
- The fish are fit for transport.
- They are transported in accordance with any written instructions about feeding and watering, and any special care required is taken into account.
- The means of transport is designed, constructed, maintained and operated so as to avoid injury and suffering, and provides protection from extreme temperatures.

The new Order requires that road vehicles used to transport livestock for over eight hours are inspected and issued with an approval certificate. However, fish transport vehicles are believed to be exempt from this requirement, as fish tanks are not considered to be an integral part of the vehicle.

However, a new requirement is that transporter authorisation will be required by anyone transporting fish on journeys over 65 Km. These will be subject to:

- The transporter having no serious breaches of animal welfare legislation recorded against them.
- Being trained or entrusting the handling of the animals to personnel who have received training.
- Demonstrating that they have appropriate staff and equipment to transport animals in a proper way.

Authorisation will be issued free of charge (if applied for within this financial year), and will be valid for five years. It is difficult to relate the new regulations to transport by means other than road vehicle (e.g. wellboats, helicopters) because the legislation was primarily drafted for traditional farm livestock, horses and poultry. To summarise, the new rules require little change for most fish transport, other than the need to apply for an authorisation.

In conclusion, it was indicated that more conditions specific to fish could be introduced in the future. In March 2004 the European Food Standards Authority made recommendations on transport of fish that covered loading, transport management, space allowances, water temperatures, oxygen availability, and recovery after transport. These recommendations may be adopted by the Commission in future, but are not expected before 2011.

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Indicators of poor welfare following transport
Tony Wall (Fish Vet Group)

Dead or moribund fish could be caused by poor handling, exhaustion, suffocation, or poor water quality (low oxygen, high ammonia or carbon dioxide), depending upon when it is observed. Abnormal behaviour may indicate an aversive response (e.g. burrowing due to lights, noise, vibration) or may be a general, non-specific indicator that something is wrong (e.g. congregating in corners, surface swimming, porpoising, increased ventilation and gaping, exhaustion). Some abnormal behaviours may indicate specific problems: cod are susceptible to swimbladder inflation that results in them becoming trapped at the surface; "skittering" of salmon across the water surface is thought to indicate supersaturation. Skin colour changes may indicate stress. Physical damage (to the snout, jaw, eye, scales, fins) can occur during loading and unloading due to poor handling, excessive crowding, or burrowing behaviour. The nature of physical damage can be used to identify a problem, e.g. discrete areas of damage may indicate an obstruction in a pipe. Longer term indicators of poor welfare include an increased susceptibility to disease and poor performance.

Finally a personal view of the three major fish welfare problems associated with transport were highlighted:

- The transfer of smolt into seawater before physiological competence, resulting in poor osmoregulation. It was suggested that the industry needed to improve its ability to identify when fish were ready for this abrupt change in environment.
- The temperature changes that fish are exposed to during transport which includes wellboat chilling.
- Mechanical breakdowns, which result in significant mortalities during transport.

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Discussion and areas for further research

The meeting finished with a general discussion in which the audience and speakers debated various issues including:

- The maximum temperature drop during chilling in refrigerated seawater wellboats that should be permissible on welfare grounds.
- Appropriate periods for starvation prior to transport.
- The use of sedatives during transport.
- The implications of transporting fish between waters with different water chemistries.
- The effect on the fish of height differences (water-head) when using fish pumps.
- The potential to analyse the effects of transport conditions on fish by using the routine records of fitness 30 days after transport.

The aim of the day was to identify areas for futture work. As can be seen above a number of ideas were discussed and these included:

- Simple scales of acceptable/unacceptable standards ie photos of differing levels of fin damage, scale loss etc
- Development of benchmarks for post transport observations including mortality, feed conversion, abnormal behaviour etc.
- Research into maximum temperature drop/ rate of temperature drop.
- Developing ways of communicating between source farms/hauliers/destination sites to ensure smooth and easy transfer.
- Improved counting methods, to separate true loss of production from differences in counting/weighing methods.

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Overall impressions
Tim Ellis, Cefas

The meeting provided an excellent overview of fish transport in the UK, comprehensively covering the diverse methods that are used. It came across clearly that fish welfare is already an integral consideration for fish transport, being motivated by considerations of product quality, health and productivity, and adherence to welfare standards.

All fish transport involves far more than just shipment and numerous linked stages need to be considered: sorting of stock (separation / grading), feed withdrawal, crowding for loading, loading, transport within the tank/well/bucket/cage, unloading, introduction into a novel environment, and recovery. The quality of pre-transport husbandry, any sudden change in water chemistry on arrival, and the physical handling during loading and unloading are likely to be as significant to fish welfare as the transport itself. Several speakers mentioned avoidance of dry handling - this represents a significant shift from the historically accepted practice of netting that should have the welfare benefits of reduced stress, abrasion and physical damage. Nearly all speakers stressed that transport represents a major biosecurity risk for pathogen transfer, and that successful transport requires prior identification of risks and implementation of contingency plans in case things go wrong.

The key to good transport is maintaining good water quality. Water quality reflects numerous different parameters. Oxygen level is seen as the key factor because the transport tanks become "life support" systems. If things go wrong and oxygen levels drop too low, there can be catastrophic consequences. Nevertheless, oxygen levels in the water are easily monitored and readily maintained by bubbling the water with compressed pure oxygen. Water quality deterioration during transport is therefore typically due to parameters other than oxygen, and it is these that are perceived as determining transport duration and fish density. The closed nature of the transport units results in water quality problems that do not normally occur in open culture systems. Technology to deal with some of these problems is apparently being transferred from recirculation aquaculture (e.g. protein skimmers to reduce mucus and faecal contamination).

The practice of fish transport is apparently poorly supported by formal scientific research. The research conducted to date has presumably either not been communicated appropriately, or has been irrelevant, to the industry. There is a lack of knowledge on the behavioural and physiological responses of fish to transport. Nevertheless, it is commonly assumed that transport itself causes stress, fear and physical damage due to exposure to novel physical stimuli such as lights, noise, vibration, sudden water movements, and possibly rapid altitude changes. There appears to be a lack of standardised guidance on appropriate environmental conditions (densities, water quality limits, temperatures) and transport duration. Where guidelines are available, it is unclear as to how they were derived. There is a need to consolidate the research and practical information available to provide a best practice for fish transport. In the absence of such guidance, operators are working to their own guidelines arrived at by experience, which does allow adaptation for the

specifics of the journey, season, species, size and stage of the fish.

Fitness / welfare in relation to transport is being assessed using a variety of methods. However, these measures again do not appear to be standardised across the industry. Practical application of the methods for assessment and their interpretation appeared vague and therefore potentially dependent upon the individual operator. This is an area that could be tightened up, given the requirement to ensure fitness to travel.

No mortality data was presented during the forum, and there would appear to be a lack of quantitative information available for the fish transport industry. Within the broiler chicken industry, mortality levels during transport have been set at 0.5% per consignment[1], through contracts with retailers. Gathering and collation of such data for fish would allow open comparisons with other livestock industries, and would facilitate the setting of standards for fish transport. Defra is encouraging the development of measurable welfare outcome targets, and surveillance to allow benchmarking and identification of trends[1]. The forum highlighted that farmers are already routinely assessing fish stocks 30 days after transport, and these assessments represent an untapped resource of data.

1. Defra (2006). Delivering good animal welfare: a draft strategy under the Animal Health and Welfare Strategy. http://www.defra.gov.uk/corporate/consult/awelfare-strategy/aws-consultation.pdf

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Appendix 2 - New animal welfare during transport rules (England)

Currently the Welfare of Animals (Transport) Order 1997 implements Council Directive 91/628/EEC on the protection of animals during transport. This applies to commercial movements of all vertebrate animals and cold blooded animals (fish and crustaceans etc).

From 5 January 2007 a new Welfare of Animals (Transport) Order 2006 puts in place the procedures to comply with Council Regulation (EC) No 1/2005 on the protection of animals during transport. This will apply to:

- transport of all vertebrate animals in connection with an economic activity;
- this includes fish but not crustaceans etc;
- but we will retain existing basic protection for non vertebrates under national rules.

Conditions for road transport are set but for fish are not detailed. The relevant provisions require that they are:

- fit for transport;
- transported in accordance with any written instructions about feeding and watering and taking into account of any special care required.

Means of transport / container must:

- be designed, constructed, maintained and operated so as to avoid injury and suffering and to ensure safety;
- provide protection from extreme temperatures, and adverse changes in climatic conditions;
- if in a container carried loose in a vehicle this is marked indicating carriage of live animals and indicating the right way to be carried, and kept upright and sever jolts or shaking minimised.

Vehicles used to transport livestock over 8 hours require inspection and the issue of an approval certificate.

Defra has considered this requirement in relation to vehicles used to carry containers transporting animals, which are either free standing or permanently or temporarily secured to a vehicle and forming the sole means of containing them.

Defra believes that these are outside the scope of the requirement for vehicle inspection as it is the container the animal is transported in rather than the vehicle, which is critical to the welfare of the animal.

It is understood that fish are transported in containers which are either free standing or permanently or temporarily secured to a vehicle and forming the sole means of containing the fish.

Transporter authorisations are required by anyone transporting fish on journeys of over 65km. They will be subject to:

- the transporter having no serious breaches of animal welfare legislation recorded against them;
- being trained or entrusting the handling of the animals to personnel who have received training;
- demonstrating that they have appropriate staff and equipment to transport animals in a proper way.

Authorisations will be:

- issued free of charge if applied for within this financial year;
- valid for 5 years.

Transport by means other than road vehicles is hard to link to the Regulation which is primarily drafted for farmed livestock, horses and poultry:

- well boats - do not fit within specification for livestock vessels in the Regulation;
- helicopter transport - not the same as containerised transport in holds of aircraft;
- different sectors (food, sporting, ornamental) are accepted as requiring different treatment;

Defra needs to gain better knowledge of transport methods to apply rules in a practical and effective way.

To summarise, for most transporters (if not all):

- the only change is the need to apply for an authorisation;
- vehicle inspection and approval will not apply to this sector where fish are transported
- in containers which are free standing or permanently or temporarily secured to a vehicle and forming the sole means of containing the fish.

In the future more conditions specific to fish could be applied:

- A report from the European Food Safety Authority published in March 2004 makes recommendations on the transport of fish and covers loading, transport management, space allowances, water temperature, oxygen availability and recovery after transport;

- these are only recommendations have not been adopted by the Commission or discussed with member states;

- a formal proposal would be required to put detailed rules into place and these would be discussed between member states and the Commission and stakeholders would be consulted in this process.

Appendix 2 - Summary of welfare legislation applying to farmed fish (Scotland)

AQUACULTURE HEALTH JOINT WORKING GROUP WELFARE SUBGROUP

1. This note updates previous information provided to the AHJWG on how current animal welfare legislation applies to farmed fish.

2. There are now five main pieces of domestic legislation dealing with the welfare of farmed fish.

a. The Animal Health and Welfare (Scotland) Act 2006 (The Animal Welfare Act 2006 applies in England and Wales): Section 19 of this Act makes it an offence to cause or permit any unnecessary suffering to a protected animal. The Act defines a protected animal as a vertebrate animal other than man, which is commonly domesticated in the British Islands or under the control of man or not living in a wild state. This definition includes all farmed fish. Any act or omission which causes unnecessary suffering to farmed fish at any stage of production including slaughter is an offence under this legislation.

Section 24 of the Act also requires the person responsible for an animal to take such steps which are reasonable in the circumstances, to ensure that the needs of the animals are met. These needs include the animals' need for a suitable environment; a suitable diet; to be able to exhibit normal behaviour patterns; to be housed with, or apart from, other animals; and to be protected from suffering, injury and disease.

Section 47 of the Act excludes from the scope of the Act anything which occurs in the normal course of fishing, so excluding angling and commercial fishing from the legislation. This exclusion does not however apply to fish farming.

b. The Welfare of Farmed Animals (Scotland) Regulations 2000; these implement Council Directive 98/58/EC concerning the protection of animals kept for farming purposes. These Regulations require that owners and keepers of animals kept for farming purposes (defined to include fish) must take reasonable steps to "ensure the welfare of animals under their care" and "to ensure that the animals are not caused any unnecessary pain, suffering or injury". The Regulations also cover access to statutory welfare codes for employees and provide for the service of "improvement notices" by authorised persons under Regulation 11 where the authorised person considers that animals are being kept in a way which is likely to cause unnecessary pain, suffering or injury. However, as these Regulations are made under the Agriculture (Miscellaneous Provisions) Act 1968 and an "authorised person" means a person authorised under the Agriculture (Miscellaneous Provisions) Act they presumably would not apply to fish in the sea, although they would apply to farmed freshwater fish.

c. The Welfare of Animals (Transport) Order 1997; this Order requires that all animals, including fish, are transported in a way that does not, and is not likely to, cause injury or unnecessary suffering. This Order will be renewed in 2007 when EC Regulation 1/2005 is enforced. However, the provision to protect fish during transport will remain.

d. The Welfare of Animals (Slaughter or Killing) Regulations 1995; these regulations implement Council Directive 03/119/EC, Article 1.1 of which states that the Directive "shall

apply to the movement, lairaging, restraint, stunning, slaughter and killing of animals bred and kept for the production of meat, skin, fur or other products ……..".
This clearly includes fish. Article 4.1 of the Regulations state the "no person engaged in the movement, lairaging, restraint, stunning, slaughter or killing of animals shall":

(a) cause any avoidable excitement, pain or suffering to any animal; or
(b) permit any animal to sustain any avoidable excitement, pain, or suffering".

Furthermore, Regulation 4.2 states that: "no person shall engage in the movement, lairaging, restraint, stunning, slaughter or killing of any animal unless he has the knowledge and skill necessary to perform those tasks humanely and efficiently in accordance with these Regulations". The consequences of the above requirements are that fish should be slaughtered humanely by competent staff. Failure to do so would be an offence under these Regulations.

e) Council Directive 2006/88/EC of 24 October 2006 on animal health requirements for aquaculture animals and produts thereof, and on the prevention and control of certain diseases in aquatic animals. Of specific relevance are Article 8 (Recording obligations - traceability) and Article 13 (Disease prevention requirements in relation to transport).
Full details of this order can be found by the following link:
http://eur-lex.europa.eu/LexUriServ/site/en/oj/2006/l_328/l_32820061124en00140056.pdf
This Directive has to be transposed into national legsilation by 1 May 2008 and applied by the 1 August 2008.

Compiled by the Humane Slaughter Association, January 2007.

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