



# **Welfare of farmed fish: Common practices during transport and at slaughter**

Executive Summary

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## Executive Summary

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## Introduction

The aim of this study was to gather information on current animal welfare practices in European aquaculture as regards the transport and slaughter of farmed fish, and to analyse the extent that fish welfare issues remain unresolved. The costs of adhering to good welfare practices, the economic situation, effects on competitiveness and other factors were taken into account. The reference period was 2009-2013.

The study focused on the five main farmed fish species to provide a general presentation of the current situation in European aquaculture: Atlantic salmon (cold-water marine); common carp and rainbow trout (freshwater), and; European sea bass and gilthead sea bream (Mediterranean marine).

The international standards of the World Organisation for Animal Health (OIE) on animal welfare during transport and stunning and killing of farmed fish for human consumption were used as a benchmark for assessment of welfare practices. EFSA recommendations on slaughter were also taken into account.

## Review of current fish welfare practices

The main methods of transporting live fish in the EU are by road and sea (well-boat). Transportation methods were reviewed for two stages of production: transport of fry, fingerlings or juvenile fish to on-growing facilities (for Atlantic salmon, European sea bass and gilthead sea bream), and; transport of marketable fish for slaughter (for Atlantic salmon, common carp and rainbow trout). It was agreed that the study would not assess transport for on-growing for common carp and rainbow trout; and it is not relevant for marketable sea bream and sea bass as these species are slaughtered on-farm without transport between facilities.

Impaired welfare and stress during transport may be caused by many factors including changes in stocking density, handling, water movement and poor water quality. Different fish species have different requirements regarding oxygen, pH, salinity and temperature, and they have different abilities to cope with variances of these parameters.

Slaughter activities include handling, restraining, stunning and killing. Stunning should cause loss of consciousness and sensibility without avoidable stress, discomfort or pain. In some methods, it may also cause death. When the stunning method is reversible or does not cause death, it should be followed by a killing method. The OIE advises the use of electrical or mechanical stunning and killing methods, although these have not yet been developed or applied in practice for all fish species. Other stunning and killing methods – such as live chilling followed by electrical stunning, live chilling with carbon dioxide (CO<sub>2</sub>), carbon dioxide stunning, and asphyxia in ice – are considered to result in poor fish welfare and do not meet OIE standards.

The most common methods for slaughtering Atlantic salmon are percussion, and electrical stunning followed by a killing method. In most cases Atlantic salmon are removed from water before electrical stunning, which may however be more stressful than electrical stunning in water, as the fish are exposed to air. Live chilling with CO<sub>2</sub> is used to a limited extent in Norway. In Ireland, CO<sub>2</sub> stunning is still used to a limited extent, although its use is declining.

Common carp are stunned and killed by a manual blow to the head, with a period of prior exposure to air. Exposure to air for 10 minutes, as is common practice, is stressful. Electrical stunning in water is also used. For rainbow trout, electrical stunning and asphyxia in ice are the most common methods, although manual percussion, CO<sub>2</sub> stunning, and chilling in ice slurry followed by electrical stunning are also used to a limited extent in France. Asphyxia in ice is still the most common slaughter method for

European sea bass and gilthead sea bream; electrical stunning is still in an experimental stage in Greece for these species.

The impact of improved animal welfare practices on product quality is complex, because the effects may vary between welfare practices and between the fish species under consideration. Improved welfare practices such as percussion and electrical stunning can lead to carcass damage, but this can be avoided or minimised by drawing up specifications to ensure little or no detriment to product quality. As fish welfare becomes more widely acknowledged as a factor in product quality, it can be expected that more attention will be given to identifying practices that improve both welfare and product quality.

### **OIE and national standards on farmed fish welfare**

The study found that OIE standards are likely to be achieved with regard to the transport of smolts and marketable Atlantic salmon, marketable rainbow trout, and fry/fingerling/juvenile European sea bass and gilthead sea bream in the case-study countries. It was found that transport of marketable common carp for slaughter in Poland and Germany only partly meets OIE standards, although it does meet Council Regulation 1/2005. In the Czech Republic, transport of common carp for slaughter meets OIE standards.

The achievement of OIE standards at slaughter was found to depend on the species. In Norway, the UK and Ireland the standards are met for percussion of Atlantic salmon. In Norway 25-30 % of fish are oriented (i.e. they are positioned so they enter the stunner head-first) prior to electrical stunning after dewatering, though this percentage is increasing. With orientation, the OIE standards are met for electrical stunning after dewatering. However, electrical stunning should be followed by decapitation or percussion as a killing method to meet OIE standards. Live chilling with CO<sub>2</sub> is still used in Norway to a limited extent. This method, which will be phased out, does not meet OIE standards. Carbon dioxide levels for live chilling with CO<sub>2</sub> are substantially lower than used for CO<sub>2</sub> stunning. In Ireland, CO<sub>2</sub> stunning is still used to a limited extent, although its use is declining. Carbon dioxide stunning does not meet OIE standards.

For common carp, the achievement of OIE standards for electrical stunning in Poland, the Czech Republic and Germany depends on the construction of the equipment. Information about the construction is scarce. Manual percussion (a blow to the head) is common practice in Poland and Germany and, when applied correctly and instantaneously after exposure to air, meets OIE standards.

Similarly, the achievement of OIE standards for electrical stunning of freshwater rainbow trout in Denmark and Italy depends on the design and construction of the equipment. Asphyxia in ice is still practised on about 30 % of production in Denmark. In Poland asphyxia in ice is also used. Manual percussion of trout in France meets OIE standards provided it is performed instantaneously after exposure of the fish to air. However, in France both CO<sub>2</sub> stunning and chilling in ice water followed by electrical stunning do not meet OIE standards.

Asphyxia in ice of sea bass and sea bream is still practised in Greece, Spain and Italy. OIE standards at slaughter are therefore not achieved for these species.

National legislation and guidelines are not as well developed in the EEA states as for terrestrial farm animals, although the situation is improving due to growing attention on fish welfare. For the five species covered by the study, private standards that include welfare during transport and slaughter are predominately implemented in the salmon sector, to a lesser extent for trout, and on a limited scale for sea bass and sea bream. A very limited number of carp farms are covered by private welfare standards.

## Socio-economic aspects

EU aquaculture can be classified into four main types according to environment and species: shellfish, with a production of 653 000 tonnes in 2010; freshwater species (332 000 tonnes); Mediterranean marine species (213 000 tonnes), and; cold-water marine species (190 000 tonnes). The total production volume of 1 388 000 tonnes in 2010 is forecast to grow by 56 % to 2 161 000 tonnes in 2030 .

The study focused on five finfish species and did not address shellfish.

The key investment to achieve good welfare practices in the EEA states for fish during transport was identified as water quality equipment. As the use of this equipment is already widespread, no further investments are required to meet OIE standards during transport, and transport was not considered further in the economic analysis.

It should be noted that the economic aspects associated with specific welfare practices are based on limited available data from a specific reference period, 2009-2013. While the analysis gives an indication of costs and prices at the time of survey, it may not reflect trends over a longer period, or over the period since. Wider extrapolation to other years, volumes and species should not be considered on the basis of the data in this study alone.

Atlantic salmon – The top five world salmon producers are Norway (56 % of world production in 2013), Chile (24 %), United Kingdom (8 %), Canada (5 %) and the Faroe Islands (4%). Ireland produces 0.4%. Production in Norway increased by 35 % between 2009 and 2013. In the United Kingdom it increased by 13 % and in Ireland it decreased by 25 % over the reference period.

The STECF database indicated substantial differences in efficiency between the EEA states: in 2012, the cost price of Atlantic salmon in Norway, the United Kingdom and Ireland was calculated to be 2.66, 3.19 and 6.34 euros/kg respectively. Sales prices also varied substantially between the states. In Ireland in 2012 the cost price was higher than the sales price; this can be attributed to the average enterprise in Ireland being relatively small with relatively more employees and higher value of assets. It should be noted that the economic performance of the sector is likely to have evolved since the reference period.

Two methods to improve the welfare of salmon at slaughter were considered: 1) electrical stunning before dewatering, and; 2) stunning by percussion after dewatering. The annual costs of these investments – taking into account labour savings – are about 2 euro cents/kg or 0.5 % of the sales price in UK, and no more than 9 euro cents/kg or less than 1.5 % of the sales price in Ireland. Large-scale producers, as in Norway, would even see a net reduction in the unit production cost of about one euro cent/kg of fish as the labour savings outweigh the investment costs.

As there is already a high level of implementation of fish welfare practices in the salmon industry in EEA states, relatively few enterprises will need to invest to meet OIE standards. Small-scale producers will benefit less from economies of scale, unless they share facilities with other producers. The impact on competitiveness will therefore be small for Norway and the United Kingdom. A substantial part of the Irish production is exported at premium prices (organic production); therefore the effect on international competitiveness is likely to be small.

Common carp – Poland, the Czech Republic, Hungary and Germany together produced 1.3 % of world carp volume in 2013. Whilst world production, dominated by China, grew 26 % between 2009 and 2013, production in the four EEA states declined by 8 %.

Without subsidies, carp farming was generally not a profitable activity in the EEA between 2009 and 2013. This holds true between countries despite large variations in production costs. In 2012, the production cost in Germany, Poland and Romania (the countries where the most reliable data were available) was 3.38, 2.08 and 1.31 euros/kg respectively. The main factors contributing to this variation are differences in production volume. In all three countries, the cost price exceeded the sales price (excluding subsidies and other income). Poland is a larger volume producer, but does not appear to benefit from economies of scale. EEA production costs are approximately double those in China.

The methods that were considered to improve the welfare of common carp at slaughter in line with OIE standards were electrical stunning – either before or after dewatering – followed by decapitation. Electrical stunning after dewatering is more expensive with 17 % higher annual costs.

The additional unit cost of production varied significantly according to the scale of the enterprises. For the cheaper of the two methods – electrical stunning before dewatering – the extra cost was 6 euro cents/kg in Poland, 41 euro cents/kg in Romania, and 58 euro cents/kg in Germany. As a percentage of the sales price, the figures were 2.8 %, 24.4 % and 24.0% respectively.

Investment to improve welfare at slaughter would be difficult for enterprises that are already unprofitable, although collaboration between small-scale producers would give economies of scale. Most farmed carp (98 % in 2012-2013) is consumed in the country of production and therefore the effect of improved welfare practices on international competitiveness will be limited. In Europe, sales prices in domestic markets are higher than those for export.

Rainbow trout – The major EEA producers – Norway, Italy, Denmark, France and Poland – account for 22 % of world production of rainbow trout. Chile is the largest producer and the largest exporter, although its output has fallen markedly since 2012. After Chile with a 31 % share of exports, six EEA States make up the top seven exporters: Norway (26 %), Denmark (8.5 %), Italy (3.7 %), Sweden (3.7 %), Spain (3.3 %) and France (2.7 %). China and the Russian Federation are major producers, but not major exporters.

Trout farms in Italy, Denmark and France show a varying picture regarding profitability. Italy has the largest enterprises, followed by Denmark and France. Italian farms also had the lowest unit cost of production at 1.90 euros/kg in 2012 and were profitable without subsidies. Unit production costs in Denmark and France were higher at 2.9 and 3.1 euros/kg, and both were, on average, unprofitable without subsidies. It should be noted that the economic performance of the sector is likely to have evolved since the reference period. Insufficient economic data was available for analysis of trout farming in Poland.

Chile has a considerably higher production cost than the EEA states, and the cost price per kg exceeds the export price, making it difficult for Chile to compete in the export market.

OIE standards at slaughter for trout are only partly achieved and further investment in the slaughter process is required to meet them, particularly in Denmark and France. One method was considered: electrical stunning before dewatering, followed by manual gill cutting. This investment results in labour savings and therefore particularly benefits large-scale producers and those with high salary levels.

Investment in electrical stunning before dewatering on Italian trout farms was calculated to reduce production cost by 6 euro cents/kg as a result of labour savings. In Denmark and France, there was an additional cost of 4 euro cents/kg and 24 euro cents/kg respectively.



The cost of implementing improved welfare at slaughter for trout is relatively small for large-scale producers and may even result in cost savings. In contrast, the cost for small-scale producers, as in France where CO<sub>2</sub> is still used as a stunning method, is notably high – up to 30 euro cents/kg. Sharing of facilities by enterprises to achieve economies of scale would help to mitigate the extra costs.

European sea bass and gilthead sea bream – Four countries accounted for 85 % of world production of European sea bass in 2013: Turkey (46 %), Greece (24 %), Spain (10 %) and Italy (5 %). The same four countries accounted for 75 % of world production of gilthead sea bream: Greece (36 %), Turkey (23 %), Spain (12 %) and Italy (3.4 %). About 50 % of world production of both species is exported (including re export).

The finances of sea bass and sea bream aquaculture were analysed together in each of the three case study countries (Greece, Spain and Italy) as information sources provide composite data.

The production of sea bass and sea bream was generally not profitable in Greece, Spain and Italy over the reference period (2009-2013) and only survived with subsidies and other sources of income. The unit production cost in these states varied between 5.36 and 6.71 euros/kg over the period. Spain has the largest enterprises, followed by Greece and Italy. However, Spanish enterprises have relatively high numbers of employees and therefore no economies of scale were evident. It should be noted that the economic performance of the sector is likely to have evolved since the reference period

The overall sales price in the EEA states varied around 5.50 euros/kg. The export price was lower at roughly 4.50 euros/kg. In Turkey – the main competitor country – the sales and export prices were lower at around 3.80 and 3.60 euros/kg respectively.

Two methods to improve fish welfare at slaughter in order to meet OIE standards were considered: 1) electrical stunning before dewatering, and; 2) electrical stunning after dewatering, both followed by chilling in a slurry of ice and sea water. Electrical stunning before dewatering is the more expensive option with 25 % higher annual costs.

The additional unit cost varies slightly between the methods, but it varies to a greater extent between countries according to the size of enterprises. In Spain – with the largest enterprises – the additional unit cost was 4 euro cents/kg for both methods. In Greece, it was 5-6 euro cents/kg depending on the method, and in Italy – with the smallest enterprises – it was 11-13 euro cents/kg. As a percentage of the sales price, the additional cost was 0.6-0.7 % in Spain, 0.9-1.1 % in Greece and 1.5-1.9 % in Italy.

Although the extra costs are relatively modest as a proportion of the sales price, they may cause difficulties for enterprises that are already unprofitable without subsidies. There is a considerable variation in profitability between producers, mainly related to the scale of production.

## Conclusions

OIE standards for transport are largely achieved in the case-study countries for Atlantic salmon, rainbow trout, European sea bass and gilthead sea bream. Some shortcomings were identified regarding the transport of common carp for slaughter.

The level of achievement of OIE standards at slaughter varies with the species. For Atlantic salmon, best practices are mostly achieved, with a few exceptions. For common carp and rainbow trout, the level of achievement varies between methods used. For European sea bass and gilthead sea bream, OIE standards are not achieved.

The economic analysis shows that differences in production cost are mainly caused by the structure of the industry, with particular benefits from economies of scale. Improving welfare practices is likely to have only a very small impact on the cost price. Other factors, such as feed, labour and operating costs are responsible for larger variations between enterprises and countries. The effect of implementing improved welfare practices is greatest on smaller farms.

On salmon and trout farms, investment in improving welfare leads to labour savings and may outweigh the investment cost on larger farms.

Carp is mainly consumed in the country of production and was generally not profitable without subsidies between 2009 and 2013 in typical EEA production systems. Small farms are likely to have most difficulty in investing to improve animal welfare and may experience a competitive disadvantage. However, the export position of the country is unlikely to be affected.

Production of sea bass and sea bream was generally not profitable between 2009 and 2013 without subsidies in the major EEA states. It should be noted that the economic performance of the sector is likely to have evolved since the reference period. It may therefore be difficult for producers to make the necessary investment to improve welfare standards. Turkey has been increasing production and exports, but lower export value indicates that Turkey is unable to achieve the same market prices as the EEA States.

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