

## **Welfare of farmed fish**

Review of Chapters 7.2.. 'Welfare of farmed fish during transport', 7.3.. 'Welfare aspects of stunning and killing of farmed fish for human consumption' and 7.4.. 'Killing of farmed fish for disease control purposes' of the *Aquatic Code*

***A report for the Aquatic Animal Commission of the World Organisation for Animal Health***

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## Executive summary

The main objectives of this report are to assess the current *Aquatic Code* Chapter (7.2., 7.3. and 7.4.) to determine whether all relevant welfare hazards had been identified and the appropriate mitigation recommended. This report uses as a key source previously completed work which reviewed the science around fish sentience and their capacity to experience pain and stress (Peeler, 2025). Recommendations (listed in [Appendix 1](#)) are made for revisions to the current chapters to ensure clearer alignment with the current scientific consensus, address previously unidentified welfare hazards and improve their applicability.

It is suggested that definitions for stunning, killing and culling are added to the Glossary of the *Aquatic Code* to align with the *Terrestrial Code*. Chapter 7.2. (transport) covers the important welfare hazards including crowding, water quality, risk of physical injury. Recommended revisions aim primarily to provide more detailed guidance to support to consistent and effective implementation of standards. A number of revisions provide extended guidance to minimise the impact of crowding and ensure good conditions during transport. It is recommended that transport mode specific guidance is given for towing cages, helicopters, air freight and well-boats. Hazards are associated with these modes of transport require mitigation that cannot be captured under the current generic guidance.

Chapter 7.3. (stunning and killing) addresses all the hazards associated with the design of holding facilities and fish handling associated with slaughter. Recommended revisions focus on clarifying responsibilities, training and record keeping. Current guidance on methods of stunning and killing is generic and brief. Methods not considered appropriate due to poor welfare are listed. Clearer instruction that stunning should always precede killing is recommended. Additional text to address killing by exsanguination and the possibility of mis-cuts is proposed. It is recommended that the chapter provides additional descriptive information on mechanical and electrical stunning.

Chapter 7.4. (killing for disease control purposes) addresses all the hazards identified by Peeler (2025). Suggested revisions strengthen the existing guidance by clarifying the role of the Competent Authority (CA), the operational team and requiring standard operating procedures (SOPs) to be a condition of authorisation. Maceration is currently recommended as a method for destruction of newly hatched fish. To fully align with current scientific consensus, take a precautionary position, and provide more explicit guidance it is recommended that maceration is only used on fish up to, but not including, the larval stage.

A few cross-cutting issues were identified. It was noted that SOPs are only referenced in chapter 7.4. In chapter 7.2. and 7.3. SOPs for activities associated with transport, handling, stunning and killing could be recommended. These SOPs would help ensure that tasks are consistently completed correctly, thus contributing to improved fish welfare. There are several recommendations around record keeping which should be structured in a consistent format between chapters.

The purpose of Section 7 is to provide guidance to support Members ensure good welfare of fish are evidence based and clear scientific justification. The existing standards largely address the welfare hazards identified by Peeler (2025). However, new guidance has been recommended to mitigate hazards not previously identified (e.g. noise and mis-cuts). The revisions proposed aim to strengthen the standards by providing additional information, and additional requirements, for example, around training and record keeping. Maintaining records of water quality, injury and death during handling and transport allows those involved in the handling, transporting and slaughter of fish to assess welfare during these periods, and to identify when problems arise. Similarly record keeping of hazards at time of killing (e.g. mis-stuns) will allow facilities to monitor fish welfare. Recording keeping is essential for the Competent Authority and others to audit compliance with legislation or Codes of Good Practice.

## Table of Contents

Executive summary .....	ii
Table of Contents .....	iii
List of Tables .....	v
1. Objectives .....	1
2. Introduction .....	1
3. Glossary .....	2
4. Chapter 7.1. Introduction .....	2
5. Chapter 7.2. Transport of live fish.....	3
5.1. Overview .....	3
5.2. Scientific evidence underpinning current guidance .....	3
5.3. Welfare hazards and impacts: fish transport and handling .....	3
5.4. Recommended revisions: current guidance .....	5
5.4.1. Competent Authorities .....	5
5.4.2. Responsibilities.....	5
5.4.3. Competence and training .....	5
5.4.4. Pre-transport fasting .....	5
5.4.5. Contingency planning .....	5
5.4.6. Loading the fish .....	6
5.4.7. Conditions during transport .....	6
5.4.8. Monitoring during transport.....	6
5.4.9. Post transport activities .....	7
5.5. Recommended revisions: new guidance .....	7
5.5.1. General considerations.....	7
5.5.2. Draining ponds .....	7
5.5.3. Removal from water .....	7
5.5.4. Brailing.....	8
5.5.5. Pumps and pipes.....	8
5.5.6. Noise.....	8
5.5.7. Transport mode specific recommendations .....	8
6. Chapter 7.3. Stunning and killing of farmed fish.....	9
6.1. Overview .....	9
6.2. Welfare hazards: holding facilities, loading and unloading (articles 7.3.1. -7.3.5) .....	9
6.3. Recommended revisions to Articles 7.3.1 to 7.3.5 .....	11
6.3.1. Article 7.3.1 Scope .....	11
6.3.2. Article 7.3.2. Personnel .....	11
6.3.3. Article 7.3.3. Transport .....	11
6.3.4. Article 7.3.4. Design of holding facilities .....	11
6.3.5. Article 7.3.5. Unloading, transferring and loading .....	11

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6.4.	Welfare hazards: stunning and killing (Articles 7.3.6. – 7.3.8.) .....	12
6.5.	Recommended revisions to article 7.3.6. ....	13
6.5.	Comparison of stunning and killing methods .....	14
7.	Chapter 7.4. Killing fish for disease control purposes .....	14
7.1.	Overview .....	14
7.2.	Welfare hazards.....	15
7.3.	Recommended revisions .....	15
8.	Cross cutting issues.....	16
9.	Summary of recommendations.....	17
10.	Discussion.....	18
11.	Conclusion .....	19
12.	References.....	20
13.	Appendices .....	21

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## List of Tables

Table 2	Welfare hazards associated with stunning and killing method identified by Peeler (2025) ...	10
Table 3	Welfare hazards associated with pharmacological methods of killing (from Peeler, 2025)...	15
Table 4	Activities for which SOPS could be developed for Chapters 7.2. and 7.3. ....	17
Table 5	Recommendation categorised by Chapter.....	18
Table 6	Welfare hazards associated with fish handling (taken from Peeler, 2025).....	26
Table 7	Welfare hazards by impacts associated with transport (taken from Peeler, 2025) .....	26
Table 8	Welfare impacts associated with transport method (taken from Peeler, 2025) .....	27

## List of Appendices

Appendix 1	Summary of recommended revisions to section 7 of the <i>Aquatic Code</i> . ....	21
Appendix 2	Welfare hazards associated with handling and transport (extracted from Peeler, 2025) ..	26
Appendix 3	Revised Article 7.2.8.: Unloading (incorporating guidance from the current article 7.3.5.)	28

## Acronyms

BTA	British Trout Association
CA	Competent Authority
DO	dissolved oxygen
EFSA	European Food standards Authority
EU	European Union
FAWC	Farm Animal Welfare Council
GS	Google Scholar
HSA	Humane slaughter association
RSPCA	Royal Society for the Protection of Cruelty against Animals
SOP	standard operating procedure
SSPO	Scottish Salmon Producers Organisation
WoS	Web of Science
WOAH	World Organisation for Animal Health

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## 1. Objectives

- Assess chapters 7.2., 7.3. and 7.4. against welfare hazards identified in *Welfare of farmed fish: Review of the relevant scientific evidence on the welfare aspects of farmed fish during transport, the stunning and killing of farmed fish for human consumption and the killing of farmed fish for disease control purposes* (Peeler, 2025).
- For chapter 7.2.
  - determine whether all relevant welfare hazards were identified and guidance for mitigation provided.
  - assess scientific evidence underpinning current guidance
  - make recommendations for revision of current guidance and additional guidance for previously unidentified hazards
- For chapters 7.3. and 7.4. review guidance on the design of holding facilities and unloading, loading, and transferring fish to determine whether
  - determine whether all relevant welfare hazards were identified and guidance for mitigation provided
  - assess scientific evidence underpinning the current guidance
  - make recommendations for revision of current guidance and additional guidance for previously unidentified hazards
- For chapters 7.3. and 7.4.
  - review the welfare concerns, advantages and disadvantages of each stunning and killing method against latest scientific evidence
  - make recommendations, if necessary. for revision of current guidance, and for the inclusion of additional stunning and killing methods.

## 2. Introduction

Many aquacultural practices are potentially stressful or injurious to fish. Transport, stunning and killing and the associated handling processes are amongst the practices most likely to cause stress or injury, and are, therefore, the subjects of the current WOA standards on fish welfare.

Section 7 of the Aquatic Animal Health Code (*Aquatic Code*) has four chapters on welfare of farmed fish: i. introduction (7.1.), ii. welfare of fish during transport (7.2.), iii. welfare aspects of stunning and killing of fish for human consumption (7.3.), iv. killing of farmed fish for disease control purposes (7.4.).

Chapter 7.1. sets out guiding principles and at a high level the scientific basis for recommendations. The principles, on which recommendations are made, are that there is a critical relationship between fish health and welfare, the use of fish carries and ethical responsibility to maintain welfare to the greatest extent possible and that the scientific assessment of fish welfare involves both data and value-based assumptions. The scope of Section 7 is partly defined by the clear exclusion of ornamental fish species. Given the large number of fish species which are farmed, the recommendations address fish welfare at a general level.

This report supports the implementation of WOAAH's Aquatic Animal Health strategy which proposed that the science of aquatic animal welfare be evaluated to determine whether standards continue to provide recommendations that are scientifically sound and meet the needs of Members (WOAH, 2021). The standards provide the basis upon which Members can develop aquatic animal welfare policies, industry regulation and legislation. Further, the standards can be used in capacity building and education by WOAAH. In many countries industry has taken the lead in developing Codes of Good Practice in collaboration with animal welfare charities, such as Royal Society for Protection of Cruelty against Animals (e.g. RSPCA, 2024). WOAAH standards can act as a benchmark for these codes.

The approach taken in this report has been that for each chapter welfare hazards currently addressed in the existing code and the recommended mitigation are identified. The scientific justification for the current guidance is reviewed against the existing evidence, for which Peeler (2025) is a key source. Again, using Peeler (2025), welfare hazards not currently addressed by the existing guidance are identified. Based on these analyses, recommendations are made revisions to Chapter 7.1., 7.2., 7.3. and 7.4. and for additional terms to be defined in the *Aquatic Code's* glossary.

### 3. Glossary

Currently the *Aquatic Code* does not define killing, slaughter or stunning, which are defined in the *Terrestrial Code*. It is recommended that these terms are defined in the glossary and Chapters 7.2.-7.4. edited accordingly. The definitions of killing<sup>1</sup> and stunning recommended below are consistent with those used in the glossary of the *Terrestrial Code*. The *Terrestrial Code* defines slaughter as 'any procedure that causes the death of an animal by bleeding'. A different definition more compatible with Chapter 7.4. is suggested.

Recommendation 1 – *glossary definitions*: add glossary definitions for 'killing', 'slaughter' and 'culling'.

"Killing" means any procedure that causes death of an aquatic animal.

"Stunning" means any mechanical, electrical, chemical or other procedure that causes immediate loss of consciousness and sensibility without pain, and may include instantaneous death; when used before *slaughter*, the loss of consciousness lasts until death from the *slaughter* process

"Slaughter" means killing, on farms or at an approved premise, for human consumption.

Further, it is recommended that the term 'culling' is defined in the glossary.

"Culling" means killing, on farms or at approved premises, for disease control purposes.

## 4. Chapter 7.1. Introduction

The guiding principles in Chapter 7.1. implicitly acknowledges that transport and slaughter may compromise fish welfare and thus the need for the standards. The principles could be strengthened by explicitly noting handling, transport and all steps throughout the process of slaughter, including the pre-slaughter stages, give risk to welfare hazards. Suggested text for an additional guiding principles is given below.

Recommendation 2 – *Guiding principle*. All steps throughout the process of handling, transport, stunning and killing may potentially compromise fish welfare. Improving fish welfare involves minimising the duration of each step, as well as the stress, pain, and distress from fasting stage prior to transport, through to crowding, pumping or netting, transport, and each step of the slaughter process.

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<sup>1</sup> 'Killing' means any procedure that causes the death of an animal – glossary (Chapter 2 *Terrestrial Code*)

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## 5. Chapter 7.2. Transport of live fish

### 5.1. Overview

The scope of the chapter encompasses transport by air, sea or land and both within and between countries. Responsibilities of the Competent Authority (CA) for exporting and importing, fish farm operators, and fish transporters are set out. In a separate article (7.2.3.) the required competence of those responsible for fish welfare during transport is detailed. Articles 7.2.4. and 7.2.5. provide guidance on planning transport and necessary documentation. The remainder of the articles (7.2.6.-7.2.9.) are structured around the temporal sequence of events associated with transportation, e.g. loading, transport, unloading. Fish transport inevitably involves handling, which is addressed at points throughout Chapter 7.2. The guidance is generic with respect to species and mode of transport (the articles refer to *vehicles* which are defined as ‘any method of transport by land, air or water’).

Articles on i) responsibilities (7.2.2.), ii) competence (7.2.3.), iii) planning transport (7.2.4.) and iv) documentation (7.2.5.) potentially apply to all the welfare hazards identified, and thus provide generic guidance that underpins recommendations in the articles that follow.

Article 7.2.2 places responsibilities on the CA (for exporting and importing jurisdiction), owners and managers of the fish at the start and end of the journey, transporters and the farm owner or manager are responsible for planning transport so that it meets welfare standards. The article also requires the CA to establish and ensure implementation of minimum standards for fish transport, thus establishing the legal framework for the welfare of transported fish. Article 7.2.3 links competence with responsibilities. Persons handling fish or responsible for them during transport should have the competence needed to fulfil their responsibilities.

Guidance on maintaining good welfare is contained in article 7.2.4. ‘planning the transport’. The article covers i) vehicle design and handling equipment, ii) water, iii) preparation of fish for transport, iv) species-specific recommendations, and v) contingency plans. A short article on documentation (7.2.5.) sets out the minimum requirements for the papers that should accompany the consignment.

Articles 7.2.6. to 7.2.8. cover loading, transporting and unloading the fish, respectively. The guidance is high level. Loading fish focuses on three issues which may cause injury or stress: crowding, inappropriate equipment / poor operation and water quality. It is noted that the same issues apply to unloading. The importance of monitoring of both fish and water quality, and the initiation of contingency plans in the event of a fish health emergency are highlighted.

### 5.2. Scientific evidence underpinning current guidance

The current guidance assumes fish sentience and a capacity to experience pain and stress. Specifically, the Chapter 7.2. assumes that fish will be affected by the quality of the transport water and may suffer from injury or stress at loading, during transport and at unloading. Peeler (2025) concluded that poor water quality, physical injury and stress can all lead to adverse welfare outcomes. It can be concluded that the current guidance is firmly based on a scientifically sound evidence base.

### 5.3. Welfare hazards and impacts: fish transport and handling

In the report on the review of scientific justification (Peeler, 2025), welfare hazards associated with fish handling and transport were identified and their impacts were assessed. The hazards and their impacts are tabulated in Table 6 and 7, respectively (in [Appendix 2](#)) and summarised in Table 1. Not all hazards apply to all methods of transport and impacts have been cross-tabulated with transport method in Table 8 ([Appendix 2](#)).

**Table 1. Welfare hazards associated with fish handling and transport (taken from Peeler, 2025)**

Welfare hazard	
HANDLING	TRANSPORT
Pre-transport starvation	Poor water quality
Crowding	High water temperature
Removal from water	Low water temperature
Pumping through pipes	High density of fish
Dry brailing	Abrasive surfaces
Wet brailing	Noise
Pond drainage	High tow speed <sup>1</sup>

<sup>1</sup> applies only to towing fish cages

An assessment is made whether in Chapter 7.2. i) welfare hazards were identified and ii) adequate guidance for mitigation provided.

Welfare hazards associated with handling:

Pre-transport starvation (i.e. fasting) is discussed (Article 7.2.4.) but limited guidance on food withdrawal is provided.

Crowding<sup>2</sup> is recognised in Article 7.2.6. as a potential hazard but guidance is not provided to minimise its potential negative welfare impact.

Removal from water and the time that fish may be out of water during the handling process are not discussed.

Pumping, or brailing fish, is discussed as part of the handling process but only in the context of equipment maintenance (Article 7.2.4.).

Pond drainage prior to harvest fish as part of the handling process is not discussed.

Welfare hazards associated with transport:

Poor water quality is a theme that runs through Chapter 7.2., specifically the importance of the quality of the transport water, and at the destination site are stressed.

It is noted that fish should be acclimatised to the temperature of the transport water if it is significantly different to the water temperature to which the fish are accustomed.

Chapter 7.2. recommends that reference is made to published data on recommended fish density for transport.

Abrasive surfaces are covered in the generic guidance that containers should be in good condition and loading equipment is properly constructed.

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<sup>2</sup> Crowding is also referred to in Chapter 7.3.

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Noise as a source of stress is not discussed.

Tow speed, and other hazards associated with towing cages such as poor weather, are not discussed as it is relevant only to towing cages (and transport mode specific advice is not provided).

#### **5.4. Recommended revisions: current guidance**

##### **5.4.1. Competent Authorities**

The CA for movement of fish within the county may be different to the CA for exporting and importing jurisdiction.

Recommendation 3 – *Competent Authorities*. Article 7.2.2. should apply to the CA or CAs with responsibility for exporting or importing live fish, transportation of live fish within the country, such as Government agencies with responsibility for managing the freshwater or marine environment.

##### **5.4.2. Responsibilities**

Recommendation 4 – *responsibilities*. In Article 7.2.2., it should be made clear that the owner or manager of the destination site (e.g. slaughter facility) is accountable for fish welfare when unloading. A nominated member of staff at the site should have responsibility for fish welfare.

##### **5.4.3. Competence and training**

Recommendation 5 – *competence and training*. In Article 7.2.3. in addition to requiring that training is provided, the standards should advise that the CA, fish owner or manager i) maintains training records, ii) provides refresher course, and iii) monitors performance of staff to ensure required level of competence has been achieved. Farmers should make available to the CA their staff's training records.

##### **5.4.4. Pre-transport fasting**

Current guidance recommends that feed is withheld prior to transport (considering species and life stage) (Article 7.2.4.). There are welfare benefits to starvation as the water quality during transport will be improved. However, starvation may cause stress in fish accustomed to regular feeding, and excessive food deprivation can result in depletion of immune status, body reserves and loss of body condition, which are associated with poor welfare. An appropriate period of starvation will depend on the species and size of the fish. Water temperature also influences gut evacuation rates. Thorough science-based recommendations for fasting and feed-withdrawal regimes are lacking (Hvas et al., 2024). According to Lines and Spence (2012) a range of food withdrawal period are found which are often considerably longer than necessary to simply empty the gut.

Recommendation 6 – *pre-transport fasting*. It is recommended that the current guidance is modified; the following is suggested: '*Prior to transport, feed, should be withheld from the fish for the minimum period necessary for gut evacuation, taking into account the species, life stage, size of the fish and the water temperature.*'

It is not possible to provide more detailed guidance at the general level. Some species specific guidance has been published by, for example, the UK's Farm Animal Welfare Council (FAWC) in the UK that recommended that Atlantic salmon could be fasted for up to 72 h prior to slaughter for food hygiene reasons, and that fasting above 50-degree days (water temperature \* days) should be avoided (cited by Hvas et al., 2024). The RSPCA have provided similar guidance for farmed rainbow trout (RSPCA, 2025) and Atlantic salmon (RSPCA, 2024). These recommendations are based largely on expert opinion and not a strong published evidence base.

##### **5.4.5. Contingency planning**

Article 7.2.2. (responsibilities) is clear about the responsibilities of owners and managers of fish at the start and end of the journey, and transporters during the journey to have a contingency plan for humane killing.

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Recommendation 7 – *contingency planning*. The CA should require as a condition of transportation, that contingency plans are in place, and that they accompany the fish during transportation. The CA should produce blueprints with clear criteria for fish owners, managers and transporters for contingency plans to ensure the plans meet the required standards. Stakeholders should be consulted by the CA in the drafting of contingency plans.

#### 5.4.6. Loading the fish

Fish are generally ‘crowded’ (i.e. kept at very high density in a confined area such as in a pond, tank or net) prior to loading. If being transported to a slaughter facility they may be crowded again prior to slaughter. Crowding creates unnatural and unusual conditions that may lead to stress, fear and physical injury. Current guidance can be developed to minimise welfare hazards arising from crowding.

Recommendation 8 – *crowding (time)*. Crowding should take place for as short a period as possible prior to loading.

Recommendation 9 – *crowding (space)*. The dimensions of the tank or pond used for confinements should be sufficiently deep to minimise the fish being exposed to air and light during confinement.

Recommendation 10 – *crowding (oxygen)*. DO levels should be monitored during crowding and supplementary oxygen provided if necessary.

#### 5.4.7 Conditions during transport

Currently guidance states that water quality should be monitored and adjusted to avoid extreme conditions, and that travel should be undertaken to minimise uncontrolled movements. More detailed guidance could usefully be provided to ensure good welfare is maintained during transport.

Recommendation 11 – *water quality*. Additional text should be added which describes the influence of, and inter-relationships between, stocking levels, temperature, duration of travel, aeration, ventilation and species on water quality should be described, notably DO and CO<sub>2</sub> levels

Recommendation 12 – *oxygen*. The demand for oxygen should be estimated based on species, life stage, biomass, and water temperature.

Recommendation 13– *ventilation and aeration*. Containers must be properly ventilated as tight container covers can result in a buildup of carbon dioxide. Aeration will also reduce the build up of carbon dioxide.

Recommendation 14 – *injury*. To minimise trauma through collisions, between fish or with the container, tanks should be completely filled.

Current guidance on water temperature is generic and does not go further than stating that fish should be transported at a water temperature appropriate for their species and transport method. Guidance could be expanded.

Recommendation 15 – *water temperature*. The generally applicable zones of optimum temperatures for transported fish are 6–8°C for cold-water fishes and 10–12°C for warm-water fishes in summer, 3–5°C for cold-water fishes and 5–6°C for warm-water fishes in spring and autumn, and 1–2°C for all in winter (Berka, 1982). Tanks should be well insulated to minimise temperature fluctuations.

Recommendation 16 – *fish density*. The density of fish will depend on species and water temperature and species-specific recommendations should be followed (Berka, 1982).

#### 5.4.8. Monitoring during transport

Monitoring conditions, notably water quality, during transport, is essential to ensuring good welfare (Peeler, 2025).

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Recommendation 17 – *monitoring*. For journeys longer than 30 minutes, fish should be transported in open systems with provision to maintain water quality and a means of monitoring water quality (Berka, 1982)

#### 5.4.9. Post transport activities

Article 7.2.9. could be expanded to provide guidance on water quality when fish are unloaded. At the end of the journey, fish are very likely to experiencing a degree of stress. Sudden exposure to water of different characteristics or low quality will further stress the fish and potentially result in mortality.

Recommendation 18 – *water quality*. The water quality, especially DO and carbon dioxide, of the tanks or containers into which the fish are unloaded is checked and adjusted if necessary.

### 5.5. Recommended revisions: new guidance

#### 5.5.1. General considerations

The concept of ‘closed’ and ‘open transport’ is important and informs a number of the current and proposed new articles.

Recommendation 19 – *definition closed and open transport*. Closed and open transport systems should be defined (see suggested text below).

*Many modes of transport of live fish can be categorised as closed or open, which differ on how the water is contained and whether external support is provided. The choice of method depends primarily on transport duration, the number of fish, and the species being moved. Closed systems are sealed container in which all the requirements for the survival of the fish are self-contained. The simplest of these is a tightly sealed plastic bag partly filled with water (usually one-third of the volume) and oxygen. The oxygen is sufficient for the journey, usually not more than 48 hours. Inevitably waste products (e.g. ammonia) accumulate over time and the water quality deteriorates. The open system consists of water-filled containers in which the requirements for survival are supplied continuously from outside sources. The containers are generally unsealed and open to the air. Oxygen is supplied from a source outside the container, for example a bottled oxygen tank or aerator stone. In open systems some water quality parameters are continuously managed.*

#### 5.5.2. Draining ponds

In many production systems ponds are drained as a means of harvesting fish. This activity is itself a welfare hazard which will result in stress, hypoxia and potentially physical trauma (see Peeler, 2025).

Recommendation 20 – *harvesting*. Alternative harvest methods, e.g. crowding and wet brailing, should be used in preference to pond drainage.

#### 5.5.3. Removal from water

Removing fish from water is unavoidable when handling fish in many production systems. However, it should be minimised; for example, the RSPCA standards require that when handling rainbow trout or Atlantic salmon (RSPCA, 2024, 2025) they are not out of water for more than 15 seconds. It is recommended that guidance is provided to ensure that the impact on welfare (stress and hypoxia) are minimised.

Recommendation 21 – *time out of water*. Handling of fish should be planned to ensure that fish are out of water for the minimum period possible.

#### 5.5.4. Brailing

It is recommended that guidance on brailing<sup>3</sup> is provided. Based on a review of the literature (Peeler, 2025), wet brailing is likely to negatively impact the fish less than dry brailing as they remain in water and thus less likely to suffer hypoxia and physical trauma.

Recommendation 22 – *brailing*. Wherever possible wet brailing should be practised in preference to dry brailing.

#### 5.5.5. Pumps and pipes

Current guidance requires pumping devices to be properly maintained and designed and operated (articles 7.2.5. and 7.2.6., respectively) and could be elaborated to help achieve these stated objectives.

Recommendation 23 – *pumps and pipes*. Pumps and pipes should not have abrasive edges or surfaces. Pumping pressure and flow rates should be monitored and adjusted as necessary. Pumps and pipes used for loading and unloading should be positioned to minimise height and distance over which fish are pumped and operated so that fish spend the shortest possible time being pumped. Fish should be slaughtered as soon as possible after delivery from the pumping system.

#### 5.5.6. Noise

Loud or sudden underwater noises, whether from human activities can trigger physiological and behavioural stress responses in fish (Oppedal et al., 2024).

Recommendation 24– *noise*. When loading and unloading fish, effort is made to minimise the noise levels.

#### 5.5.7. Transport mode specific recommendations

Current guidance can be improved by extending the scope of the chapter to include selected mode specific recommendations. The types of transport selected are associated with specific hazards which cannot easily be addressed in generic guidance.

##### Towing cages

Recommendation 25 – *towing speed*. Towing speed should be calculated when planning the transportation and be appropriate for the size and species of fish to avoid trapping the fish against the trailing wall.

##### Helicopter

Recommendation 26 – *oxygen*. As fish are transported at high density by helicopter, water should be supersaturated with oxygen prior to transport and continuously oxygenated during transport.

##### Air freight

Recommendation 27 – *oxygen and temperature*. For long air journeys reoxygenation should be considered and heat or gel packs used to maintain the optimal temperature. It should be noted that re-oxygenation may affect certification which requires that containers remain sealed until arrival at destination.

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<sup>3</sup> brailing in fish harvesting refers to using a net, often with a crane, to lift fish from a tank or enclosure.

## Well-boats

Recommendation 28 – *well-boats*. Vessel crew have completed an appropriate fish welfare course. Well-boats should be equipped with water quality monitoring and maintenance equipment. When operating with a closed valve systems CO<sub>2</sub> levels and DO levels must be closely monitored; CO<sub>2</sub> strippers should be used to remove CO<sub>2</sub> and water should be oxygenated. DO should be maintained at 7mg/l and CO<sub>2</sub> should not exceed 40mg/l

## **6. Chapter 7.3. Stunning and killing of farmed fish**

### **6.1. Overview**

Articles in Chapter 7.3. fall into two main categories i) facilities and handling and (articles 7.3.2-5) ii) stunning and killing methods (Articles 7.3.6.-8.). Article 7.3.2. requires that persons engaged in handling stunning and killing fish are competent in fish handling. Generic advice is provided on the size and design of the holding facilities. To ensure operations are conducted with minimal injury or stress to the fish, it is recommended that nets, tanks and equipment are well designed and maintained to minimise injury and that water quality and fish density is appropriate for the species.

There is some duplication between chapter 7.2. and 7.3. Guidance in chapter 7.2. on water quality, crowding, handling equipment and fasting pre-slaughter is in large part repeated in chapter 7.3. In addition, it is recommended (in 7.3.) that fish to swim into a stunning device with minimum handling.

A key principle set out in the scope of Chapter 7.3. (article 7.3.1) is that farmed fish should be stunned before killing and that stunning should ensure immediate and irreversible loss of consciousness. The importance of stunning before killing is supported by the scientific evidence (reviewed by Peeler, 2025) that fish are sentient and capable of experiencing pain and stress. Methods of mechanical and electrical stunning and killing methods are described, with guidance to minimise pain and stress. Other methods of killing are listed (7.3.6.) but not recommended as they have been shown to result in poor fish welfare. Examples of stunning and killing by selected species group (e.g. salmonids, carps) are provided (7.3.7.).

### **6.2. Welfare hazards: holding facilities, loading and unloading (articles 7.3.1. -7.3.5)**

Hazards associated with the design of holding facilities, unloading, loading transferring fish are not explicitly identified in Chapter 7.3. but the following hazards can be deduced from the guidance:

1. Untrained personnel
2. Inappropriately designed holding facilities and equipment
3. Operations undertaken without attention paid to minimising stress and injury

The guidance provided to mitigate these hazards are that:

- Staff are competent and experienced in fish handling
- Holding facilities are designed and constructed to hold certain species or groups of fish species
- Nets and tanks are designed to minimise injury
- Water quality and stocking density is suitable for the species
- Equipment for transferring fish is designed and maintained to minimise injury and stress

Guidance on loading and unloading largely duplicates text in Chapter 7.2. Current guidance recommends that:

- Fish should be crowded for as short a period as possible
- Handling of fish between transfers be minimised and fish should preferably not be handled out of water
- Equipment for handling fish be designed and operated to minimise injury
- Fish should not be starved before killing longer than is necessary to empty the gut
- There should be a contingency plan to address emergencies that arise during loading and unloading.

In the report from the review of science (Peeler, 2025), welfare hazards associated with stunning and killing were identified and the impact of the hazard were assessed, and summarised in Table 2. Not all hazards apply to all methods of stunning and killing, and impacts have been cross-tabulated in Table 2.

The hazards in Table 2 relevant to articles 7.3.4. and 7.3.5. are: i) handling, ii) time out of water, iii) crowding (prior to stunning or in the slaughter system). All these hazards are addressed the current guidance. The recommendations in the following section aim to strengthen and improve the usefulness and applicability of the current guidance.

The scientific consensus is that fish are sentient and able to experience pain and stress (Peeler, 2025). Further, there is a considerable body of evidence that loading, unloading and transferring fish can result in injury and stress (see Peeler, 2025). The current guidance in Chapter 7.3., articles 7.3.2.-5. are based on sound scientific evidence.

**Table 2. Welfare hazards associated with stunning and killing method identified by Peeler (2025)**

Welfare hazards	
Manual and hand fed automated percussive stunning and killing	Automated percussive stunning and killing
Handling	Crowded swimming in the system
Time out of water	Mis-stun
Mis-stun	Mis-cut
Mis-cut	
Electrical stunning (in water batch system)	Electrical stunning (dry system)
Crowding prior to stunning	Time out of water
Low current or voltage (mis-stun)	Crowding prior to stunning
Mis-cut	Low current or voltage (mis-stun)
	Mis-cut

### 6.3. Recommended revisions to Articles 7.3.1 to 7.3.5

#### 6.3.1. Article 7.3.1 Scope

The description of stunning method in article 7.3.1. requires that it ensures 'immediate and irreversible loss of consciousness', which is inconsistent with the sentence that follows which requires that killing take place before consciousness is recovered. Electrical stunning does not necessarily need to ensure that the loss of consciousness is irreversible.

Recommendation 29 – *scope*. Remove that text that states that stunning should result in 'irreversible loss of consciousness'.

#### 6.3.2. Article 7.3.2. Personnel

Only training in occupational health is recommended in the current guidance. Training and competence are linked. Guidance on training to achievable demonstrable competence makes explicit obligations of facility managers to organise training and keep records of training. Requirements of managers of slaughter facilities to ensure staff are trained in fish handling.

Recommendation 30 – *training*. Staff at holding unit of the slaughter facility should be trained in handling fish and specifically loading, unloading and transferring fish to minimise injury and stress.

Recommendation 31– *training*. The manager of a holding unit of the slaughter facility should be responsible for maintain training records for the staff (e.g. on fish handling).

Effective stunning is critical to minimising adverse welfare outcomes for fish. Guidance should focus on this aspect of the process.

Recommendation 32 –*training*. Staff responsible for stunning receive training so that they can i) recognise the signs and check for ineffective electrical or percussive stunning or recovery from stunning (e.g. eye movement, reaction to tail pinch), ii) operate stunning equipment effectively. Training records should be kept and available for inspection by the CA.

#### 6.3.3. Article 7.3.3. Transport

Welfare hazards associated with pre-slaughter handling and transport can have spillover effects that can impact fish welfare during the slaughter process.

Recommendation 33– *transport*. Article 7.3.3. should note that the steps leading up to slaughter (handling on farm, transport) may persist and impact the welfare of fish during the slaughter process.

#### 6.3.4. Article 7.3.4. Design of holding facilities

The first and second bullet points of article 7.3.4. cover design of holding facilities. Bullets 3 and 4 provide recommendations about the conditions under which should be held.

Recommendation 34 –*title*. Rename article 7.3.4. 'Holding fish prior to slaughter'.

Recommendation 35 – *operations*. Rephrase bullet point 3 to read 'Fish should be held under conditions that minimise risk of injury and stress'.

Recommendation 36 – *equipment*. Bullet 4.c. on equipment be moved to article 7.3.5.

#### 6.3.5. Article 7.3.5. Unloading, transferring and loading

The revisions suggested below to article 7.3.5. strengthen the current guidance by placing an obligation on the manager of the facility to maintain records to demonstrate that good welfare is being achieved. The recommendations are cross-referenced with the relevant bullet point (in parentheses).

Recommendation 37 – *water quality*. Records should be kept of water quality (notably DO) during periods of crowding and transport. The facility should have the capacity to provide supplementary oxygen (2a).

Recommendation 38 – *injury*. Incidents of fish death and injury occurring during handling, loading, transferring etc. should be recorded and the records made available for inspection and regularly analysed. If levels increase above an established threshold, potential causes should be investigated (2b).

Recommendation 39– *equipment maintenance*. The manager of a holding facility is responsible for keeping maintenance records for the equipment used to handle the fish (2f). Automated equipment should be tested at the start of each operation.

Recommendation 40 - *contingency plans* to address emergencies that might arise during unloading, transferring and loading fish should be approved by the CA and, if appropriate, other relevant authorities, and be a condition of operating a slaughter facility (2h).

Handling fish prior to slaughter is an important source of stress. The current standards can be strengthened with more explicit guidance on minimising time between arrival at a facility and slaughter and specifically the flow of fish into the stunning system.

Recommendation 41 – *handling at slaughter facility*. The facility should manage rate at which fish arrive to minimise delays prior killing (2d).

Recommendation 42 – *handling in stunning system*. The flow of fish into stunning systems should be a rate that minimises the time out of water and ensures fish enter the slaughter system singly (2d).

#### **6.4. Welfare hazards: stunning and killing (Articles 7.3.6. – 7.3.8.)**

Hazards associated with stunning and killing are not explicitly identified in Chapter 7.3. but the following hazards can be deduced from the general considerations (Article 7.3.6.):

- Choice of method of stunning and killing not suitable for the species
- Equipment not properly maintained or operated
- Effectiveness of the stun is not verified (by absence of consciousness)
- Back up stunning system not in place

In addition, guidance, makes clear in article 7.3.6. that a number of commonly practised methods of killing (listed below) result in poor welfare and should not be used if it is feasible to use mechanical or electrical methods.

- Chilling with ice in holding water
- CO<sub>2</sub> in holding water
- Chilling with ice and CO<sub>2</sub> in holding water
- Salt or ammonia baths
- Asphyxiation by removal from water
- Exsanguination without stunning

Article 7.3.6. (bullet 2) describes mechanical and electrical stunning and killing. Killing whilst conscious is an important hazard implicitly recognised by the current guidance.

The hazards identified above (from article 7.3.6.) are likely to lead an ineffective stun or physical trauma. There is considerable scientific evidence (reviewed by Peeler, 2025) that physical trauma from a mis-stun, killing without stunning (e.g. by evisceration) and other types of physical trauma (e.g. due to poorly operated equipment) cause significant pain and distress.

Current guidance advocates stunning (either mechanical or electrical) before killing (e.g. by gill slitting). The evidence reviewed by Peeler (2025) on methods of stunning and killing supports this advice. The clear scientific consensus is that fish can experience pain. There is a substantial and sound evidence base that fish experience pain and stress when subjected to killing methods listed above, i.e. methods that do not include stunning (see Peeler, 2025).

In the report from the review of science (Peeler, 2025), welfare hazards associated with fish stunning and killing were identified and the impact of the hazards was assessed. The hazards for mechanical and electrical stunning and killing are summarised in Table 2. Manual and hand-fed automated percussive stunning shared the same hazards and were grouped together. Hazards associated with other methods of killing which are not recommended in the current guidance are not discussed.

Handling and time out of water are discussed in article 7.3.5. on unloading, transferring and loading fish and not in article 7.3.6. on stunning and killing methods. The key hazards associated with the stunning and killing process are i) a mis-stun and ii) a mis-cut (when stunning is followed by exsanguination e.g. gill slitting). A failed attempt to stun will cause physical trauma and suffering and, secondly, result in exsanguination of a conscious fish. A mis-cut can lead to the fish recovering consciousness and dying from exsanguination.

Current guidance recognises that i) mechanical or electrical stunning may not result in death and ii) mis-stuns may occur and that fish may regain consciousness (before it is slaughtered). It is recommended that effective stunning is verified and that a back-up stunning system is necessary. The method of killing following stunning (e.g. exsanguination for salmonids) is not discussed, and therefore, the hazard of a mis-cut is not addressed in the current guidance.

#### **6.5. Recommended revisions to article 7.3.6.**

Revisions are only proposed for mechanical and electrical methods of stunning and killing. There is a broad consensus and a sound evidence base (see Peeler, 2025) that methods of slaughter when fish are not stunned prior to killing cause fish considerable suffering and should be considered unacceptable. It is, therefore, not appropriate to provide guidance on these methods.

Recommendation 43– *other killing methods*. Gill slitting and evisceration without pre-stunning should be added to the list of methods which result in poor welfare and should not be practised.

Recommendation 44 – *stunning and killing methods*. It should be noted in article 7.3.6. that spiking, coring and free bullets are suitable killing methods only for farmed tuna.

The chapter recognises and provides brief descriptions of the different methods of percussive (manual, hand-fed automated and automated) and electrical (in water batch and dry) stunning.

Recommendation 45 – *mechanical stunning*. It should be noted that automated percussive stunning should be designed and operated to minimise: i) crowding, ii) distance the fish needs to swim to avoid exhaustion, iii) the time out of water and iv) the duration of handling.

Recommendation 46 – *mechanical stunning*. When possible, automated mechanical stunning devices should be used in preference to manual percussive blows as the results are more reliable and level of mis-stuns is lower.

Recommendation 47 – *electrical stunning*. It should be noted that electrical stunning has the important advantage that it can be applied to large number of fish simultaneously, and fish can be handled when unconscious.

In article 7.3.7. it is noted that electrical stunning can be a stun/kill method. To achieve humane stunning and killing a two-stage method is recommended to ensure that insensibility is i) rapidly established and ii) irrecoverable stun, i.e. by applying a low-voltage maintenance stun (HSA, 2025)

Recommendation 48 – *electrical stunning*. A two-stage stunning method should be used to ensure an irrecoverable stun.

Recommendation 49 – *back up stunning*. Methods considered unacceptable for routine stunning and killing should not be used for fish which are mis-stunned or regain consciousness.

Recommendation 50 – *back up stunning*. The facility should keep records of the number of fish which required back-up stunning. If numbers increase above a predetermined threshold the functioning and operation of the equipment should be investigated.

Salmonids (Atlantic salmon and rainbow trout) are commonly exsanguinated after stunning or killing to improve carcass quality. Exsanguination is achieved by cutting 3 or 4 gills either manually or automatically by machine. Manual gill cutting is considered more reliable from a welfare perspective since the operator can take account of fish size and species (EFSA, 2009b). If a mis-cut occurs, the fish dies from asphyxiation in the exsanguination tank. Current guidance should be extended to include killing following stunning. A mis-cut is a recognised hazard that should be recognised in the standards.

Recommendation 51 – *exsanguination*. Text that could be added as an additional bullet point in article 7.3.6.; the following is suggested: *For some species, notably salmonids, exsanguination by gill cutting is routinely practised following stunning to improve flesh quality. If the stun is reversible and gill-slitting is not effective (i.e. a mis-cut), the fish will die from asphyxiation. Manual gill-slitting is recommended as a more reliable method than automated machine gill-slitting.*

## 6.5. Comparison of stunning and killing methods

The scientific evidence supports the guidance that mechanical and electrical stunning and killing methods should be used in preference to other methods which are recognised as having poor welfare results (listed in article 7.3.6.). However, current guidance suggests that alternative methods may be used if mechanical or electrical methods are not 'feasible'. Manual percussive stunning requires little equipment and can be undertaken under nearly all circumstances. However, farmers may find it easier and quicker to use other methods, e.g. asphyxiation. Guidance that stunning should always be practised could be strengthened.

Recommendation 52 – *method of stunning*. Stunning (electrically or mechanically) is always undertaken when fish are killed for human consumption unless exceptional circumstances prevail.

Based on the available evidence, automated percussive stunning can be recommended above manual percussive stunning, because the frequency of mis-stuns and the level of handling are lower. Electrical and automated stunning both have advantages and disadvantages, and it is not possible based on current evidence to favour one over the other on welfare grounds.

Recommendation 53 – *method of stunning*. Automated percussive stunning should be practised in preference to manual stunning.

## 7. Chapter 7.4. Killing fish for disease control purposes

### 7.1. Overview

Chapter 7.4. is concerned with the welfare of farmed fish which are being killed for disease control purposes (i.e. culled); culling in the course of normal farm operations (e.g. at grading) is out of scope. It is noted that fish welfare should be addressed in contingency plans for disease control. Culling may take place on farm or at an approved facility. Generic guidance is provided that applies at both farms and approved facilities to minimise injury and stress. If killing takes place on the farm the procedures should be agreed between the operator and the CA, and account for both fish welfare and biosecurity. Guidance focuses on the competencies and responsibility of the 'operational team' undertaking the culling. The advantages and disadvantages of anaesthetic agents and mechanical methods are reviewed (but it is noted that methods described in Chapter 7.3. may be used).

## 7.2. Welfare hazards

Chapter 7.4. does not explicitly identify welfare hazards; however, the following can be derived from the guidance provided:

- Poorly trained staff carrying out killing of diseased fish.
- Killing of fish whilst conscious
- Poor monitoring of fish welfare
- Exposure to anaesthetic agent (adverse reaction)
- Recovery from anaesthesia

These hazards are supported by the available scientific evidence on fish sentience and capacity to experience pain (see Peeler, 2025). The following welfare hazards were identified by Peeler (2025): i) crowding, ii) exposure to chemicals, iii) poor water quality and iv) insufficient anaesthesia (Table 3).

Maceration is a recommended method in the current guidance for newly hatched fish, embryonated, fertilised and unfertilised eggs. From a welfare perspective, this guidance is acceptable if newly hatched fish are judged not to be sentient. EFSA (2009a) concluded that '*we do not have sound scientific evidence to ascertain the exact stage of development or life form at which the neuronal capacity to perceive nociception is adequate or fully developed in various species of fish*'. However, fish are generally considered sentient once they reach the larval stage and become capable of independent feeding (Brown, 2022).

**Table 3. Welfare hazards associated with pharmacological methods of killing (from Peeler, 2025)**

Welfare hazard	Description and welfare impact
<b>Crowding</b>	Poor water quality, high density of fish resulting, exhaustion (stress) and physical trauma (pain)
<b>Exposure to chemicals</b>	Aversive taste/smell, irritation to skin, mucosa and gills (stress)
<b>Poor water quality</b>	Stress
<b>Insufficient level of anaesthesia</b>	Stress (direct and due to asphyxia)

## 7.3. Recommended revisions

The current guidance addresses the hazards identified by Peeler (2025). The suggested revisions to Chapter 7.4. are intended to align guidance with the current scientific thinking and improve their usefulness and application by both CA and farmers.

Recommendation 54 – *general principle*. Methods considered unacceptable for routine stunning and killing should not be used to cull fish for disease control purposes.

Chapter 7.4. places a strong emphasis on planning and responsibilities. Guidance could be clarified and elaborated. Specifically, the role of the CA should be made explicit.

Recommendation 55 – *role of the CA*. In article 7.4.2., it should be made clear that the first bullet refers to the contingency plans of the CA.

Article 7.4.4. sets out competencies and responsibilities of the operational team, including the team leader. It is not reasonable to expect that a farm or approved facility employee meets the competency requirements set out in 7.4.4.

Recommendation 56–*operational team*. The team can be composed of both CA and on-site personnel, but the team leader should be an experienced employee of the CA or approved by the CA.

The current guidance requires that on-site personnel responsible for killing fish are trained and competent (article 7.4.3.).

Recommendation 57 – *training*. The manager of the farm or approved facility should: i) ensure that their staff are trained in killing for disease control purposes, and specifically capable to implementing the relevant SOPs, and ii) maintains training records.

Killing fish using anaesthesia will invariably result in fish being crowded at high density so that the required level of exposure can be achieved without using large quantities of anaesthetic. This can result in stress due to high density and poor water quality.

Recommendation 58 – *planning*. The team leader should plan the culling operation so that water quality is maintained. It should be determined whether anaesthesia should be used (depending on the size of the fish); if so, fish should be anaesthetised as quickly as possible after entering the unit chosen for the procedure.

Guidance on use of anaesthetic agents (7.4.5. 1b) could be elaborated to take account of other factors affecting the amount of agent that should be used.

Recommendation 59 – *use of anaesthetic agent*. The dose of the agent used should be calculated based on planned exposure time, size and weight of fish, and water temperature to ensure a rapid and effective kill.

Guidance acknowledges that fish may regain consciousness if the chemical agent is too dilute.

Recommendation 60 – *back up stunning*. Provision is made for manual percussive stunning in case that fish are mis-stunned or regain consciousness.

Decapitation is described as an appropriate mechanical method of killing in current guidance. It is noted that it should be preceded by stunning, which will likely be by percussion. From both a welfare and biosecurity perspective lethal percussion without decapitation is preferable.

Recommendation 61 - *decapitation*. Consider removing or revising decapitation as a means of mechanical killing.

Maceration is a recommended method of destruction for newly hatched fish (as well as eggs); however, evidence is lacking about the life stage at which fish become sentient.

Recommendation 62– *destruction newly hatched fish*. Anaesthesia should be recommended as the preferred method of destruction of newly hatched fish.

Recommendation 63– *maceration*. Maceration should not be used as means of destruction for fish once they have reached the larval stage of development (and are feeding independently).

## 8. Cross cutting issues

An SOP is a set of step-by-step instructions that outline how to perform a specific task or activity within a business. SOPs are only referred to once in Section 7 (Article 7.4.3) which requires that SOPs describe operational procedures for the killing of fish for disease control purposes. SOPs serve as a reference for tasks, reduce miscommunication, and help standardise processes, and help ensure that tasks are consistently performed correctly and safely.

*Recommendation 64 – standard operating procedures*. In Chapters 7.2. and 7.3. recommendation could be made that farmers, transporters and slaughter sites develop SOPs for activities associated with transport, handling, stunning and killing.

In Table 4 procedures or activities referred to in section 7 which could benefit from being formulated as an SOP to ensure consistency and improve fish welfare are highlighted.

There is duplication in guidance on unloading fish between Chapters 7.2. and 7.3.

*Recommendation 65 – duplication.* Remove duplication on loading between chapters. Article 7.2.8. is revised to include additional guidance currently in article 7.3.5. which can then be deleted and replaced with a reference to Chapter 7.2.8. Suggested text for a revised article 7.2. is provided in [Appendix 3](#).

A number of suggested revisions relate to record keeping (e.g. training records, water quality, frequency of mis-stuns). These records should be available for inspection by the CA and could also be required by the CA as a condition of authorisation.

*Recommendation 66 – recording keeping.* The structure of articles on record keeping should be consistent between chapters.

**Table 4. Activities for which SOPs could be developed for Chapters 7.2. and 7.3.**

Article	Activity or process
<b>Chapter 7.2. Transportation</b>	
7.2..4	Planning transport (factors listed in this article should form basis of an SOP)
	Food withdrawal: SOP should set out how duration of food withdrawal should be calculated.
7.2..6	Loading fish, including crowding, use of equipment, water quality, fish density (in transport container).
7.2..7	SOP should cover i) inspections, ii) water quality monitoring and iii) method for euthanasia of fish in event of an emergency*
7.2..8	Unloading the fish, including crowding, use of equipment, water quality, and method for euthanasia for moribund or injured fish
<b>Chapter 7.3. Stunning and killing</b>	
7.3.6	Maintenance and operation of the stunning and killing equipment
	Operation of the stunning and killing equipment
	Method to evaluation consciousness
<b>Chapter 7.4. Killing for disease control purposes</b>	
7.4..3	Operational procedures suitable for the circumstance of the premises including method, equipment. handling and biosecurity considerations (e.g. disposal of carcasses).

\* alternatively, detail method in the contingency plan

## 9. Summary of recommendations

The revisions to Section 7 recommended in this report aim to provide additional descriptive text, achieve better alignment between Chapters, improve accuracy and consistency with the scientific evidence. The majority or suggested revisions elaborate and strengthen existing guidance and provide new guidance so that hazards not identified in the current text are addressed. In

Table 5 recommendations are categorised and cross-referenced by Chapter. Recommendations to revise guidance on contingency planning, training and record keeping are made in all three chapters. Handling, competence /responsibility, equipment and environment are other areas for which recommendations are made in two of the three chapters.

**Table 5. Recommendation categorised by Chapter**

Recommendation category	Chapter			
	7.2.	7.3.		7.4.
	Transport	Un/loading	Stunning /killing	Killing (disease control)
Competent Authority	✓			✓
Contingency plans	✓	✓		✓
Training	✓	✓	✓	✓
Handling	✓	✓	✓	
Environment	✓	✓		
Fasting	✓			
Monitoring	✓	✓		
Competence / Responsibility	✓		✓	✓
Equipment		✓	✓	✓
Method killing			✓	✓
Planning				✓
Record keeping	✓		✓	✓

## 10. Discussion

This report has systematically applied essentially the same approach to assess chapters 7.2., 7.3. and 7.4. The existing text has been examined to determine which welfare hazards have been addressed and the mitigations recommended. These hazards (and the mitigations) have been assessed against current scientific evidence and compared with hazards identified by Peeler (2025). Based on these analyses recommendations have been made for revisions. The clear scientific consensus based on substantial experimental and observational studies is that fish are sentient and able to experience pain and stress (see Peeler, 2025). On this basis, it is possible to conclude that the current guidance is scientifically justified. Over 60 recommendations are made. A few recommendations are made to address hazards not recognised in the current guidance. Revision to guidance on methods of stunning and killing aim to improve alignment with current scientific thinking. The majority of recommendations seek to develop Section 7 to better support both the CA and the aquaculture industry to raise fish welfare standards.

It can be argued that legislation should act to guide to fish farmers and those who handle and slaughter fish towards an understanding of what is expected of them (Anon., 2025). Industry Codes of Good Practices are a useful step in the right direction, but legislation is required if producers and others are to be held accountable and non-compliance identified and acted on. The proposed revisions support Members in developing legislation and its enforcement. Firstly, additional text is recommended to provide more information, for example, on modes of transport and methods of stunning and killing. Responsibility for fish welfare is shared between Government (i.e. the relevant CA), fish farming industry, fish transporters and managers of slaughter facilities. Several revisions clarify the respective roles and responsibilities of the Government (i.e. the CA) and the relevant industry actors. Several revisions recommend that fish farmers should be obliged to keep records of, for example, water quality,

mortality during transport, level of mis-stuns. Farmers and other industry players will be not be fully aware of potential welfare issues unless records, especially of injuries and mortalities, are recorded and periodically analysed. Further the role of the CA is enhanced if keeping such records is made a condition of authorisation and by asserting that CA have the right to inspect these records. Legislation or voluntary codes that define the standards required during the handling, transport, stunning and killing of farmed finfish, will require inspection systems to identify non-compliance. The recommendations on record keeping support the auditing of facilities and assessment of compliance.

There are areas of uncertainty where research is needed to provide scientific evidence to support improved welfare standards (FAWC, 2023). Guidance on fasting would benefit from research that investigates the balance between the welfare impacts of hunger/habituation to feeding and benefits in reduction in metabolism. Research is also required to establish the potential for recovery after electrical stunning that fails to induce cardiac arrest.

As stated in Chapter 7.1. many species of fish are farmed, and it is not practicable to develop recommendations for each species and so the recommendations address fish welfare at a general level. However, current guidance does discuss stunning and killing methods at a species level. It is recommended that this guidance is extended to exsanguination (which is common practice for salmonids). Current guidance does not consider recommendations for specific modes of transport. Guidance is proposed for some selected modes to provide Members with information on which to draft standards to regulate their industry.

In the future WOAHA may wish to consider extending the scope of its welfare standards in other areas. Chapter 7.1. also makes clear that the scope of the section 7 does not extend to ornamental fish. In 2007 it was estimated that more than 1 billion ornamental fish comprising more than 4000 freshwater and 1400 marine species are traded internationally each year (Whittington and Chong, 2007). Currently, guidance to minimise potential welfare hazards is lacking, and a need for international standards has been noted (Maia et al., 2025). WOAHA might consider whether it has a role to play in developing international standards for transportation of ornamental fish. Peeler (2025) noted that as the scientific consensus has settled on the question of fish sentience, the debate has moved on to regulation of welfare of other aquatic animals, notably crustaceans and cephalopods. For example, some UK supermarkets are planning to require electrical stunning of shrimp by the end of 2026<sup>4</sup>. Pressure is likely to increase as animal welfare groups campaign for international welfare standards for shrimp, lobsters and octopus to reflect current scientific thinking on their sentience and capacity to experience pain.

## 11. Conclusion

The current WOAHA standards on fish welfare provide scientifically sound, evidence-based guidance. Revisions to the current standards are recommended based on an assessment of welfare hazards associated with handling, transport, stunning and killing. The revisions are intended to provide Members with additional information and guidance to support the development of Codes of Good Practice, regulation and legislation. Many of revisions focus on recording keeping. Farmers and others involved in fish handling, transport and slaughter can only assess the welfare status of fish if water quality, frequency of injury and death, mis-stunning etc. are recorded. These data can highlight welfare concerns and assess whether interventions are successful. In addition, recording keeping is needed so the CA and others can audit compliance with legislation or Codes of Good practice.

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<sup>4</sup> [Waitrose to stop selling suffocated farmed prawns, as campaigners say they feel pain | Animal welfare | The Guardian Newspaper, 15 February 2025](#)

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### 13. Appendices

**Appendix 1:** Summary of recommended revisions to section 7 of the *Aquatic Code*.

Chapter	Title	Recommendations
3	Glossary	1
4	Chapter 7.1.: Introduction	2
5	Chapter 7.2.: Transport of live fish	3-29
6	Chapter 7.3.: Stunning and killing of farmed fish	30-54
7	Chapter 7.4.: Killing fish for disease control purposes	55-65
8	Cross-cutting issues	66-68

Recommendation 1 – *glossary definitions*: add glossary definitions for ‘killing’, ‘slaughter’ and ‘culling’.  
.....2

Recommendation 2 – *Guiding principle*. All steps throughout the process of handling, transport, stunning and killing may potentially compromise fish welfare. Improving fish welfare involves minimising the duration of each step, as well as the stress, pain, and distress from fasting stage prior to transport, through to crowding, pumping or netting, transport, and each step of the slaughter process. ....2

Recommendation 3 – *Competent Authorities*. Article 7.2.2 should apply to the CA or CAs with responsibility for exporting or importing live fish, transportation of live fish within the country, such as Government agencies with responsibility for managing the freshwater or marine environment.....5

Recommendation 4 – *responsibilities*. In article 7.2.2, it should be made clear that the owner or manager of the destination site (e.g. slaughter facility) is accountable for fish welfare when unloading. A nominated member of staff at the site should have responsibility for fish welfare. ....5

Recommendation 5 – *competence and training*. In article 7.2.3 in addition to requiring that training is provided, the standards should advise that the CA, fish owner or manager i) maintains training records, ii) provides refresher course, and iii) monitors performance of staff to ensure required level of competence has been achieved. Farmers should make available to the CA their staff’s training records.  
.....5

Recommendation 6 – *pre-transport fasting*. It is recommended that the current guidance is modified; the following is suggested: ‘*Prior to transport, feed, should be withheld from the fish for the minimum period necessary for gut evacuation, taking into account the species, life stage, size of the fish and the water temperature.*’ .....5

Recommendation 7 – *contingency planning*. The CA should require as a condition of transportation, that contingency plans are in place, and that they accompany the fish during transportation. The CA should produce blueprints with clear criteria for fish owners, manager and transporters for contingency plans to ensure the plans meet the required standards. Stakeholders should be consulted by the CA in the drafting of contingency plans.....6

Recommendation 8 – *crowding (time)*. Crowding should take place for as short a period as possible prior to loading. ....6

Recommendation 9 – *crowding (space)*. The dimensions of the tank or pond used for confinements should be sufficiently deep to minimise the fish being exposed to air and light during confinement. ....6

Recommendation 10 – *crowding (oxygen)*. DO levels should be monitored during crowding and supplementary oxygen provided if necessary. ....6

Recommendation 11 – <i>water quality</i> . Additional text should be added which describes the influence of, and inter-relationships between, stocking levels, temperature, duration of travel, aeration, ventilation and species on water quality should be described, notably DO and CO <sub>2</sub> levels .....	6
Recommendation 12 – <i>oxygen</i> . The demand for oxygen should be estimated based on species, life stage, biomass, and water temperature. ....	6
Recommendation 13– <i>ventilation and aeration</i> . Containers must be properly ventilated as tight container covers can result in a buildup of carbon dioxide. Aeration will also reduce the build up of carbon dioxide. ....	6
Recommendation 14 – <i>injury</i> . To minimise trauma through collisions, between fish or with the container, tanks should be completely filled.....	6
Recommendation 15 – <i>water temperature</i> . The generally applicable zones of optimum temperatures for transported fish are 6–8°C for cold-water fishes and 10–12°C for warm-water fishes in summer, 3–5°C for cold-water fishes and 5–6°C for warm-water fishes in spring and autumn, and 1–2°C for all in winter (Berka, 1982). Tanks should be well insulated to minimise temperature fluctuations. ....	6
Recommendation 16 – <i>fish density</i> . The density of fish will depend on species and water temperature and species-specific recommendations should be followed (Berka, 1982). ....	6
Recommendation 17 – <i>monitoring</i> . For journeys longer than 30 minutes, fish should be transported in open systems with provision to maintain water quality and a means of monitoring water quality (Berka, 1982).....	7
Recommendation 18 – <i>water quality</i> . The water quality, especially DO and carbon dioxide, of the tanks or containers into which the fish are unloaded is checked and adjusted if necessary.....	7
Recommendation 19 – <i>definition closed and open transport</i> . Closed and open transport systems should be defined (see suggested text below).....	7
Recommendation 20 – <i>harvesting</i> . Alternative harvest methods, e.g. crowding and wet brailing, should be used in preference to draining ponds. ....	7
Recommendation 21 – <i>time out of water</i> . Handling of fish should be planned to ensure that fish are out of water for the minimum period possible.....	7
Recommendation 22 – <i>brailing</i> . Wherever possible wet brailing should be practised in preference to dry brailing. ....	8
Recommendation 23 – <i>pumps and pipes</i> . Pumps and pipes should not have abrasive edges or surfaces. Pumping pressure and flow rates should be monitored and adjusted as necessary. Pumps and pipes used for loading and unloading should be positioned to minimise height and distance over which fish are pumped and operated so that fish spend the shortest possible time being pumped. Fish should be slaughtered as soon as possible after delivery from the pumping system.....	8
Recommendation 24– <i>noise</i> . When loading and unloading fish, effort is made to minimise the noise levels.....	8
Recommendation 25 – <i>towing speed</i> . Towing speed should be calculated when planning the transportation and be appropriate for the size and species of fish to avoid trapping the fish against the trailing wall. ....	8
Recommendation 26 – <i>oxygen</i> . As fish are transported at high density by helicopter, water should be supersaturated with oxygen prior to transport and continuously oxygenated during transport.....	8

Recommendation 27 – <i>oxygen and temperature</i> . For long air journeys reoxygenation should be considered and heat or gel packs used to maintain the optimal temperature. It should be noted that reoxygenation may affect certification which requires that containers remain sealed until arrival at destination. ....	8
Recommendation 28 – <i>well-boats</i> . Vessel crew have completed an appropriate fish welfare course. Well-boats should be equipped with water quality monitoring and maintenance equipment. When operating with a closed valve systems CO <sub>2</sub> levels and DO levels must be closely monitored; CO <sub>2</sub> strippers should be used to remove CO <sub>2</sub> and water should be oxygenated. DO should be maintained at 7mg/l and CO <sub>2</sub> should not exceed 40mg/l .....	9
Recommendation 29 – <i>scope</i> . Remove that text that states that stunning should result in ‘irreversible loss of consciousness’ .....	11
Recommendation 30 – <i>training</i> . Staff at holding unit of the slaughter facility should be trained in handling fish and specifically loading, unloading and transferring fish to minimise injury and stress. ....	11
Recommendation 31– <i>training</i> . The manager of a holding unit of the slaughter facility should be responsible for maintain training records for the staff (e.g. on fish handling). ....	11
Recommendation 32 – <i>training</i> . Staff responsible for stunning receive training so that they can i) recognise the signs and check for ineffective electrical or percussive stunning or recovery from stunning (e.g. eye movement, reaction to tail pinch), ii) operate stunning equipment effectively. Training records should be kept and available for inspection by the CA .....	11
Recommendation 33– <i>transport</i> . Article 7.3.3 should note that the steps leading up to slaughter (handling on farm, transport) may persist and impact the welfare of fish during the slaughter process. ....	11
Recommendation 34 - <i>title</i> . Rename article 7.3.4. ‘Holding fish prior to slaughter’. ....	11
Recommendation 35 – <i>operations</i> . Rephrase bullet point 3 to read ‘Fish should be held under conditions that minimise risk of injury and stress’ .....	11
Recommendation 36 – <i>equipment</i> . Bullet 4.c. on equipment be moved to article 7.3.5.....	11
Recommendation 37 – <i>water quality</i> . Records should be kept of water quality (notably DO) during periods of crowding and transport. The facility should have the capacity to provide supplementary oxygen (2a).....	12
Recommendation 38 – <i>injury</i> . Incidents of fish death and injury occurring during handling, loading, transferring etc. should be recorded and the records made available for inspection and regularly analysed. If levels increase above an established threshold, potential causes should be investigated (2b). ....	12
Recommendation 39– <i>equipment maintenance</i> . The manager of a holding facility is responsible for keeping maintenance records for the equipment used to handle the fish (2f). Automated equipment should be tested at the start of each operation. ....	12
Recommendation 40 - <i>contingency plans</i> to address emergencies that might arise during unloading, transferring and loading fish should be approved by the CA and, if appropriate, other relevant authorities, and be a condition of operating a slaughter facility (2h).....	12
Recommendation 41 – <i>handling at slaughter facility</i> . The facility should manage rate at which fish arrive to minimise delays prior killing (2d) .....	12
Recommendation 42 – <i>handling in stunning system</i> . The flow of fish into stunning systems should be a rate that minimises the time out of water and ensures fish enter the slaughter system singly (2d).....	12

Recommendation 43– <i>other killing methods</i> . Gill slitting and evisceration without pre-stunning should be added to the list of methods which result in poor welfare and should not be practised. ....	13
Recommendation 44 – <i>stunning and killing methods</i> . It should be noted in article 7.3.6 that spiking, coring and free bullets are suitable killing methods only for farmed tuna. ....	13
Recommendation 45 – <i>mechanical stunning</i> . It should be noted that automated percussive stunning should be designed and operated to minimise: i) the time (due to crowding), ii) distance the fish needs to swim to avoid exhaustion, iii) the time out of water and iv) the duration of handling. ....	13
Recommendation 46 – <i>mechanical stunning</i> . When possible, automated mechanical stunning devices should be used in preference to manual percussive blows as the results are more reliable and level of mis-stuns is lower. ....	13
Recommendation 47 – <i>electrical stunning</i> . It should be noted that electrical stunning has the important advantage that it can be applied to large number of fish simultaneously, and fish can be handled when unconscious. ....	13
Recommendation 48 – <i>electrical stunning</i> . A two-stage stunning method should be used to ensure an irrecoverable stun. ....	13
Recommendation 49 – <i>back up stunning</i> . Methods considered unacceptable for routine stunning and killing should not be used for fish which are mis-stunned or regain consciousness. ....	14
Recommendation 50 – <i>back up stunning</i> . The facility should keep records of the number of fish which required back-up stunning. If numbers increase above a predetermined threshold the functioning and operation of the equipment should be investigated. ....	14
Recommendation 51 – <i>exsanguination</i> . Text that could added as an additional bullet point in article 7.3.6; the following is suggested: <i>For some species, notably salmonids, exsanguination by gill cutting is routinely practised following stunning to improve flesh quality. If the stun is reversible and gill-slitting is not effective (i.e. a mis-cut), the fish will die from asphyxiation. Manual gill-slitting is recommended as a more reliable method than automated machine gill-slitting</i> . ....	14
Recommendation 52 – <i>method of stunning</i> . Stunning (electrically or mechanically) is always undertaken when fish are killed for human consumption unless exceptional circumstances prevail. ....	14
Recommendation 53 – <i>method of stunning</i> . Automated percussive stunning should be practised in preference to manual stunning. ....	14
Recommendation 54 – <i>general principle</i> . Methods considered unacceptable for routine stunning and killing should not be used to cull fish for disease control purposes should not use methods. ....	15
Recommendation 55 – <i>role of the CA</i> . In article 7.4.2, it should be made clear that the first bullet refers to the contingency plans of the CA. ....	15
Recommendation 56– <i>operational team</i> . The team can be composed of both CA and on-site personnel, but the team leader should be an experienced employee of the CA or approved by the CA. ....	16
Recommendation 57 – <i>training</i> . The manager of the farm or approved facility should: i) ensure that their staff are trained in killing for disease control purposes, and specifically capable to implementing the relevant SOPs, and ii) maintains training records. ....	16
Recommendation 58 – <i>planning</i> . The team leader should plan the culling operation so that water quality is maintained. It should be determined whether anaesthesia should be used (depending on the size of the fish); if so fish should be anaesthetised as quickly as possible after entering the unit chosen for the procedure. ....	16

Recommendation 59 – <i>use of anaesthetic agent</i> . The dose of the agent used should be calculated based on planned exposure time, size and weight of fish, and water temperature to ensure a rapid and effective kill.....	16
Recommendation 60 – <i>back up stunning</i> . Provision is made for manual percussive stunning in case that fish are mis-stunned or regain consciousness. ....	16
Recommendation 61 - <i>decapitation</i> . Consider removing or revising decapitation as a means of mechanical killing. ....	16
Recommendation 62– <i>destruction newly hatched fish</i> . Anaesthesia should be recommended as the preferred method of destruction of newly hatched fish. ....	16
Recommendation 63– <i>maceration</i> . Maceration should not be used as means of destruction for fish once they have reached the larval stage of development (and are feeding independently). ....	16
<i>Recommendation 64 – standard operating procedures</i> . In Chapter 7.2. and 7.3. recommendation could be made that farmers, transporters and slaughter sites develop SOPs for activities associated with transport, handling, stunning and killing. ....	16
<i>Recommendation 65 – duplication</i> . Remove duplication on loading between chapters. Article 7.2..8 is revised to include additional guidance currently in article 7.3..5 which can then be deleted and replaced with a reference to Chapter 7.2..8. Suggested text for a revised article 7.2. is provided in Appendix 4. ....	17
<i>Recommendation 66 – recording keeping</i> . The structure of articles on record keeping should be consistent between chapters. ....	17



Appendix 2: Welfare hazards associated with handling and transport (extracted from Peeler, 2025)

**Table 6. Welfare hazards associated with fish handling (taken from Peeler, 2025)**

Welfare hazard	Welfare impact				
	Stress	Hypoxia (stress)	Physical trauma (pain)	Exhaustion (stress)	Hunger (stress)
Pre-transport starvation	✓				✓
Crowding	✓	✓	✓		
Removal from water	✓	✓			
Pumping through pipes	✓	✓	✓	✓	
Dry brailing	✓	✓	✓		
Wet brailing	✓		✓		
Pond drainage	✓	✓	✓		

**Table 7. Welfare hazards by impacts associated with transport (taken from Peeler, 2025)**

Welfare hazard	Welfare impacts				
	Stress (mental)	Stress (metabolic)	Hypoxia (stress)	Physical trauma (pain)	Exhaustion (stress)
Poor water quality	✓	✓	✓	✓ <sup>2</sup>	
High water temperature	✓	✓			
Low water temperature	✓	✓			
High density of fish	✓	✓		✓	
Abrasive surfaces				✓	
Noise	✓				
High tow speed <sup>1</sup>					✓

<sup>1</sup> applies only to towing fish cages; <sup>2</sup>organ damage if water quality extremely poor

**Table 8. Welfare impacts associated with transport method (taken from Peeler, 2025)**

Transport method	Welfare impacts				
	Stress	Stress (metabolic)	Hypoxia (stress)	Physical trauma (pain)	Exhaustion (stress)
Wellboats (closed)	✓	✓	✓	✓	
Wellboats (open)	✓			✓	
Lorry (closed)	✓	✓	✓	✓	
Lorry (open)	✓			✓	
Helicopter	✓		✓	✓	
Air freight	✓	✓	✓		
Towing cages	✓			✓	✓

**Appendix 3:** Revised Article 7.2.8.: Unloading (incorporating guidance from the current Article 7.3.5.)

1. The principles of good fish handling during loading apply equally during unloading.
2. Fish should be unloaded under conditions that minimise injury and stress.
3. The following points should be considered:
  - a. Fish should be unloaded as soon as possible after arrival at the destination, allowing sufficient time to ensure that the unloading procedure does not cause harm to the fish. Water quality (e.g. temperature, oxygen and CO<sub>2</sub> levels) should be assessed on arrival of fish prior unloading, and corrective action taken if required. Some species of fish should be acclimatised if there is a likelihood of the fish being unloaded into water of a significantly different quality (such as temperature, salinity, pH).
  - b. Where possible any injured or moribund fish should be separated and killed humanely in accordance with the guidance in this chapter.
  - c. The crowding periods of fish should be as short and infrequent as possible to avoid stressful conditions arising.
  - d. The handling of fish during transfers should be minimised and preferably fish should not be handled out of water. If fish need to be removed from water, this period should be kept as short as possible.
  - e. Equipment used to handle fish, for example nets and dip nets, pumping devices and brailing devices, should be designed, constructed and operated to minimise physical injuries (e.g. pumping height, pressure and speed are important factors to consider).
  - f. There should be a contingency plan to address emergencies and minimise stress during unloading, transferring and loading fish.

Note: i) Bullet point g. in 7.3.5.<sup>5</sup> should be moved to article 7.3.4. and ii) bullet point e. in Article 7.3.5.<sup>6</sup> should be moved to Article 7.3.6.

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<sup>5</sup> Fish should not be fasted (deprived of food) before killing for longer than is necessary, e.g. to clear the gut or reduce organoleptic properties

<sup>6</sup> Where feasible, and when applicable, fish should be allowed to swim directly into a stunning device without handling to avoid handling stress