



Update to the 2014 FAWC Opinion on the welfare of farmed fish at the time of killing

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**Animal Welfare Committee
Seacole Wing
2 Marsham Street
London
SW1P 4DF**

Animal Welfare Committee (AWC) Opinions

AWC Opinions are short reports to Government¹ on contemporary topics relating to animal welfare. They are based on evidence and consultation with interested parties. They highlight particular concerns and indicate issues for further consideration by Governments and others.

AWC is an expert committee of the Department for Environment, Food and Rural Affairs in England and the Devolved Administrations in Northern Ireland, Scotland and Wales. More information about the Committee is available at <https://www.gov.uk/government/groups/animal-welfare-committee-awc>

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Welfare of Farmed Fish, 2014

¹ Where we refer to “Government” we are addressing the Department for Environment, Food and Rural Affairs in England, the Scottish and Welsh Governments, the Northern Ireland Assembly and other responsible Government Departments and Agencies.

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Scope

1. UK governments have asked the Animal Welfare Committee (AWC) to update the 2014 Opinion on the welfare of farmed fish at the time of killing² published by the then Farm Animal Welfare Committee (FAWC).
2. This should include consideration of the farmed fish industry in the UK in 2022 and how markets for the production of farmed fish may have changed since 2014. Also an assessment of fish stunning and slaughter methods, and related operations, that may have changed in practice and the scientific and commercial drivers behind these changes.
3. AWC has been asked to review the 2014 FAWC recommendations and advise whether these remain valid, have been overtaken by events or have become more pressing in order to protect the welfare of farmed fish at the time of killing.
4. It is not intended that this report rewrite the 2014 Opinion but instead that it adds to its information base and reviews its recommendations in the light of changes in the industry over the last 8 years.
5. AWC has reviewed the scientific literature produced since 2014, conducted a written call for information, met with experts and visited farmed fish production systems in the UK.
6. AWC is aware of the growing interest in the welfare of decapods and cephalopods at the time of killing and the Humane Slaughter Association sponsored research ongoing in this area. This advice will confine itself to the scope of the 2014 Opinion and only cover farmed finfish (as well as wild caught eels kept alive for food production later and the welfare at killing of cleaner fish used in the salmon industry). Fish bred and kept for restocking of recreational fisheries or natural waterways are not covered.

Background

7. The 2014 FAWC Opinion on the welfare of farmed fish at the time of killing provided advice to governments on the principles to be applied to farmed fish welfare at killing; the level of UK production in 2014; the legal context; national and international considerations; ethical issues; and an assessment of the impact on fish welfare of the stunning and slaughter methods, and related operations, involved in emergency killing, routine culling and harvesting of farmed fish for the table. It made a number of recommendations to improve the welfare of farmed fish at the time of killing and in annexes recommended a variety of stunning and killing methods that should be used on a number of farmed fish species, with detailed parameters where these were available in the scientific literature.

² [Opinion on the welfare of farmed fish at the time of killing.pdf](https://publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/424242/Opinion_on_the_welfare_of_farmed_fish_at_the_time_of_killing.pdf) (publishing.service.gov.uk)

8. AWC continues to support the principles set out in the 2014 Opinion that aim to ensure the slaughter or killing of farmed fish (and other related kept animals) is humane. These are:

- i. All personnel involved with slaughter or killing of animals have a duty of care and must be trained and competent;
- ii. Only those animals that are fit and healthy should be caught, loaded and transported to the slaughter site;
- iii. Any handling of animals prior to slaughter or killing must be done with consideration for the animal's welfare;
- iv. In the slaughter facility, only equipment that is fit for the purpose must be used;
- v. Prior to killing an animal, it must either be rendered unconscious and insensible to pain instantaneously or unconsciousness must be induced without pain or distress; and
- vi. Animals must not recover consciousness before death ensues.

9. The 2014 Opinion gave FAWC the opportunity to contribute to an EU Commission report on the protection of farmed fish at the time of killing, which was to comment on the possibility of introducing certain requirements regarding the protection of fish at the time of killing, considering animal welfare aspects as well as the socioeconomic and environmental impacts. The Commission's report was published in March 2018³.

10. The EU Commission concluded that, despite noting animal welfare deficiencies in a number of the countries surveyed to inform the report, it was not appropriate to propose specific legislative requirements and that the objectives of protecting farmed fish at the time of killing could be achieved by voluntary means.

11. In the absence of European regulatory proposals, the UK fish farming industry has widely adopted voluntary codes as part of their membership of producer organisations and assurance schemes, such as the Code of Good Practice for Scottish Finfish Aquaculture⁴ and RSPCA Assured⁵, which apply welfare standards through the production process. For example, RSPCA Assured certifies some 70% of Scottish salmon production⁶.

12. Following publication in 2021 of the Post Implementation Review of the Welfare of Animals at the Time of Killing (England) Regulations 2015⁷, governments are considering a number of improvements that could be made to legislation and practice on welfare at killing, including detailed provisions for the welfare of farmed fish. To aid these considerations AWC is updating the 2014 Opinion on the welfare of farmed fish at the time of killing. This is also in the context of a review of European legislation on the protection of animals at the time of killing and rising lobby pressure.

³ [SANTE/12021/2017-EN Rev. 1 \(europa.eu\)](https://ec.europa.eu/sante/files/2021/12/2021-EN-Rev-1.pdf)

⁴ [Code of Good Practice | Salmon Scotland](https://www.salmonscotland.gov.uk/good-practice)

⁵ [RSPCA Assured higher welfare standards for salmon & trout](https://www.rspca.org.uk/assured)

⁶ [What is RSPCA Assured? | Salmon Scotland](https://www.salmonscotland.gov.uk/assured)

⁷ [Welfare of Animals at the Time of Killing \(England\) Regulations 2015: post implementation review - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/94444/welfare-of-animals-at-the-time-of-killing-regulations-2015-post-implementation-review)

13. During consultation on the Post Implementation Review of WATOK, AWC as well as others, e.g. RSPCA, British Veterinary Association, have called for the 2014 FAWC recommendations to be accepted and for detailed provisions for the welfare of farmed fish at the time of killing to be established. This has been echoed during the call for information for this report.

14. Animal welfare is a devolved matter, so in addition to retained Regulation 1099/2009 on the protection of animals at the time of killing applying currently in GB, there are different pieces of domestic legislation implementing and enforcing those regulations in England, Scotland, Wales and Northern Ireland. The Northern Ireland Protocol also complicates matters in that Northern Ireland is still subject to the EU version of Regulation 1099/2009 and cannot make autonomous changes to this legislation.

15. There are very different populations of farmed fish in the different territories of the UK. The vast majority of salmon are farmed and killed in Scotland, while trout are reared and killed in most of the territories of the UK. Responsibility for these issues and populations is devolved, and policy development for different species might need to be led by different competent authorities.

16. Many fish farms processing trout are small or micro businesses and consideration will need to be given to the proportionality of controls. For comparison, there is a class of farm-based poultry (and rabbit) producers that provide small quantities of meat direct to local consumers and retailers under Article 11 of retained Regulation 1099/2009 where there is less regulation and supervision than in approved slaughterhouses that are overseen by the Food Standards Agency. While there may be less supervision, the principles around safeguarding welfare at slaughter still apply.

Number of animals involved

17. Where animals are considered sentient creatures, good and bad welfare events are experienced at an individual level. While the severity/strength/duration of the impact on the individual must be considered, it is also important to have a reasonable knowledge of the numbers of individuals involved as this allows recognition of the overall impact of an industry and the implications of change.

18. Difficulties arise in quantifying the numbers of individual animals on fish farms, i.e. numbers produced, production mortality and slaughter numbers. Although eggs laid down and young fish are usually counted, production is typically reported by weight (tonnage) at the end of the cycle. As with other farmed species, slaughter figures alone do not reflect farmed populations, with culling and mortality at various stages. **It is recommended that bodies producing UK statistics should consider additional data collection on, or estimation of, the number of individual finfish farmed in the UK.** This could include the number of fish that reach slaughter weight and the number of fish that die or are culled.

19. Appendix 3 provides more detail and estimates of the average numbers of farmed fish produced annually in the UK over the last 10 years of available statistics (2011-2020). An estimated 52.4 million farmed fish were killed for food annually, with

a further 12.7 million being produced for other purposes. Given the parallel rearing of different year-classes, the 2014 FAWC report suggestion of in “*excess of 100 million fish being grown in farms at any particular time*” is still considered valid.

20. Atlantic salmon continues to dominate UK fish farming, and production has increased. In 2020, 37.7 million salmon (192,129 tonnes) were slaughtered in Scotland, compared to 32.1 million (154,164 tonnes) in 2010. Production of other species for consumption has typically declined since 2010: Rainbow trout 12,471 tonnes (an estimated 13.1 million fish) in 2020 vs 13,593 tonnes in 2010; brown trout 164 vs 574 tonnes; sea bass 0 vs 473 tonnes; tilapia – 0 vs 135 tonnes. Production of halibut (confidential due to the limited number of producers) has continued. Common carp production for food continues to be negligible, with angling being the main use.

21. The term ‘harvested’ in place of slaughter and its related operations was used in the 2014 Opinion, but AWC understands that the term is now disliked by some as, despite having a definition of ‘to catch and kill’, it could be inferred to compare farmed fish with the (non-sentient) arable harvest.

22. Proactive culling of sick or moribund farmed fish and those that would not survive the next production phase can represent a better welfare outcome than subsequent mortality.

23. A major industry change over the last 10 years is the use of farmed (and wild-caught) lumpfish and wrasse as cleaner fish, a biological control for parasitic sea-lice on farmed salmon. Farmed production of cleaner fish is increasing, with production in Scotland in 2020 reported at 15.1 million fish. This update deals with issues relating to the killing of cleaner fish in paragraphs 72-78.

Legal context

24. Regulation 1099/2009 on the protection of animals at the time of killing (PATOK), as retained in UK domestic legislation by the European Union (Withdrawal) Act 2018, requires that farmed fish are spared avoidable pain, distress or suffering during their killing and related operations, but the regulation specifically excludes farmed fish from its other detailed provisions⁸. There is no mention of farmed fish in the Welfare of Animals at the Time of Killing (England) Regulations 2015 (WATOK) (nor in similar legislation in Scotland, Wales and Northern Ireland).

25. Implementing some of the recommendations outlined in this (and the 2014) opinion could require changes to PATOK as well as to WATOK. Powers to make amendments to certain parts of PATOK were transferred to competent authorities in the UK by The Animals (Legislative Functions)(EU Exit) Regulations 2019⁹. The

⁸ [Council Regulation \(EC\) No 1099/2009 of 24 September 2009 on the protection of animals at the time of killing \(Text with EEA relevance\) \(legislation.gov.uk\)](#)

⁹ [The Animals \(Legislative Functions\) \(EU Exit\) Regulations 2019 \(legislation.gov.uk\)](#)

Retained EU Law (Revocation and Reform) Bill¹⁰ may provide other means to amend PATOK.

26. Government may also adopt in WATOK national rules stricter than those in PATOK for killing and related operations outside of a slaughterhouse; for slaughtering and related operations on farmed game; and for religious slaughter. Existing national rules are found in the Schedules to WATOK.

27. WATOK was made under s.2.2 of the European Communities Act 1972 (now revoked). To amend WATOK, secondary regulations would need to be made under section 12 of the Animal Welfare Act 2006, where a requirement of these powers is that "*The appropriate national authority may by regulations make such provision as the authority thinks fit for the purpose of promoting the welfare of animals for which a person is responsible,*" (or under the Animal Health and Welfare (Scotland) Act 2006). Separate secondary regulations relating to protecting and improving the welfare of farmed fish at the time of killing could also be made under Section 12 of the Animal Welfare Act 2006 (or Section 26 of the Animal Health and Welfare (Scotland) Act 2006).

28. It is now widely accepted that finfish species are sentient animals with some cognitive functioning and perceptual experience of pain. This is an objective opinion based on a large body of scientific research and does not depend on humans feeling empathy for fish. Excepting thirst, the Five Freedoms apply to fish. The continued development, implementation and review of fish stunning systems by industry for the major farmed species is therefore welcomed. AWC therefore reaffirms the recommendation of the 2014 Opinion that stunning of farmed fish should be a regulatory requirement.

29. Under our duty of care for them, farmed fish are entitled to the same high level of protection from predators that other farmed species enjoy. Protection from predators is typically achieved by netting fish cages and ponds to exclude birds of prey and, in coastal areas, seals. On land, nets may be fixed several metres above ground level to allow people and vehicles to pass beneath. It is not acceptable, nor legally permissible, for predation of farmed animals to be permitted or encouraged as part of a farm experience for paying visitors.

Welfare at killing

Welfare when culling and at emergency killing

30. As outlined in the 2014 opinion, fish are killed for health, welfare or legal reasons at different stages of the farming process, and the methods employed may differ from those used at slaughter. Only humane methods should be used, and these should be applied as quickly as possible after removal from water.

31. Culling of fish populations (primarily for disease control) may be carried out, as well as culling of juvenile fish in freshwater that are deemed unlikely to thrive in

¹⁰ [Retained EU Law \(Revocation and Reform\) Bill - Parliamentary Bills - UK Parliament](#)

the later stages of production. During production in freshwater or at sea, it may be necessary to remove and euthanise moribund fish. In these cases, the primary methods employed are immersing fish in water containing a lethal dose of anaesthetic (typically MS222 or benzocaine), manual/mechanical percussive stunning or electrical stunning. The specific method used depends on the size of the fish, the number to be killed and the availability of equipment on the premises.

32. There is some evidence that anaesthetics are aversive to at least some species of fish (e.g., zebrafish, Readman et al 2013¹¹) Importantly, however, rainbow trout showed no avoidance to three anaesthetic agents (Readman et al 2017¹²) suggesting salmonids may be more tolerant than other species. However, comprehensive systematic research across farmed species that compares the response to different anaesthetic agents at all relevant developmental stages is lacking. In practice, anaesthesia is used primarily to cull small fish in the freshwater phase and a double maximum dose is generally used. Application of such high anaesthetic doses is likely to rapidly induce unconsciousness. Fish should be regularly monitored after application of anaesthetic to confirm death. Staff should be trained, and competency assessed for any available method of culling. As emphasized in our earlier opinion, asphyxia, hypoxia, or chilling on ice are not acceptable methods of killing farmed fish at any stage, even in emergency situations.

Welfare at slaughter and related operations

Handling, transport

33. Fish may be handled, for husbandry reasons, on a number of occasions prior to slaughter. Reasons include movement to different accommodation, grading, vaccination, other veterinary treatments (e.g. lice treatment/management) and thinning. Some of these processes (e.g. vaccination) will involve the fish being anaesthetised prior to handling.

34. For other processes, whilst much of the handling and movement of the fish occurs within water via dedicated handling systems (e.g. pipework), at least some of this handling will require fish to be removed from water (dewatering). Time spent out of water should be minimised as removal from water will be distressing for all fish, notwithstanding that oxygen resilience varies between species. A specific comment from the 2014 report (para 58, 2014) was that fish should be kept out of water for a maximum of 15 seconds and RSPCA Assurance standards set a maximum of 15 seconds for dewatering. The handling and slaughter processes observed by AWC during this review had conscious fish out of water for considerably less than 15 seconds.

35. Some, but not all, salmon operations have introduced an electrical stunning stage prior to dewatering for slaughter, by introducing an electrical field to the water

¹¹ [Readman GD, Owen SF, Murrell JC, Knowles TG. Do fish perceive anaesthetics as aversive? PLoS One. 2013 Sep 23;8\(9\):e73773. doi: 10.1371/journal.pone.0073773. PMID: 24086294; PMCID: PMC3781131.](https://doi.org/10.1371/journal.pone.0073773)

¹² Readman GD, Owen SF, Knowles TG, Murrell JC. Species specific anaesthetics for fish anaesthesia and euthanasia. Sci Rep. 2017 Aug 2;7(1):7102. doi: 10.1038/s41598-017-06917-2. PMID: 28769117; PMCID: PMC5541135.

passing through the pipe. This is to render the fish unconscious prior to dewatering, as well as to facilitate handling.

36. (Ref Para 59, 2014) For salmon (and large trout), there is widespread use of pumping using vacuum pumps specially designed for fish, to minimise net-based handling and to reduce the time a fish is out of water. Pipe diameter is optimised according to fish size. Pumping pressure and length of pipelines, as well as systems where fish swim against the water flow, necessitate constant monitoring of flow rates and communications between those in charge of pumping operations and the slaughter point. There is a quality as well as a welfare imperative not to damage fish in this process.

37. (Ref Para 60, 2014) In contrast to the 2014 report, a significant proportion (around 50%) of salmon are now slaughtered in dedicated vessels, at pen side. Fish are crowded (by raising the floor of the pen), then pumped directly from the pen to the slaughter vessel.

38. The remainder will be transported in wellboats equipped with large water tanks to accommodate fish, from the sea pen to an on-shore slaughter facility. Fish are moved from the pen to the wellboat by pumping. Journey times to the slaughter facility can vary considerably, from minutes to several hours.

39. (Ref Para 63, 2014) Systems observed by AWC indicated that rates of delivery of fish were closely monitored, allowing them to be slowed – or stopped – in the event of issues with the rate of slaughter. On occasion in these systems, backlogs can be challenging to manage, although the fish in the system observed were not dewatered prior to electrical stunning and unconsciousness. However, some systems with long pipes will have an appreciable period (several minutes) from leaving the vessel to stunning and bleeding. RSPCA Assured Salmon standards require that dwell times in pipes (exiting wellboats for slaughter) do not exceed 10 minutes (T9.4.2).

40. (Ref Para 64, 2014) AWC was informed that almost no loading/unloading of salmon for slaughter occurs by net. AWC saw net capture of smaller trout; however, larger trout were pumped. It was mentioned on many occasions during evidence gathering that damage leading to carcass downgrades has a financial as well as a welfare consequence so is avoided as far as possible.

41. (Ref Para 65, 2014) In the systems that AWC saw, water monitoring was undertaken during transport. Key water quality parameters are oxygen and carbon dioxide levels, pH and particulates. These can be maintained by circulating fresh seawater in the wellboat, adding oxygen or stripping carbon dioxide dependent on the circumstances. RSPCA Assured standards (for both trout and salmon) require wellboats to be equipped with water quality monitoring and maintenance equipment. The RSPCA Salmon standard also requires monitoring of water quality at the end of the pumping pipe from the wellboat.

Crowding

42. Crowding describes a process where fish are gathered into a smaller area, and is carried out for grading, to apply medicinal treatments, in preparation for de-lousing, and before slaughter. The extent of crowding may vary depending on the situation (e.g., application of medicinal treatments requires approximately 70% reduction in holding facility volume versus closer crowding pre-handling for slaughter). Crowding is stressful and the number of occasions it is applied to any group should be minimised. The RSPCA and HSA recommend that crowding duration should not exceed 2 hours. **Oxygen levels should be monitored during crowding and supplemental oxygen delivered if necessary. Operators should be trained to recognise fish density and stress responses, so that this can be balanced with efficiency of fish capture/treatment and duration of crowding.**

43. The crowding operation seen during the management of large trout at an inland site for slaughter involved a circular tank, with the use of “curtains” to reduce the volume of the tank that fish could occupy. As fish were removed for slaughter, the available area/volume within the tank was gradually reduced. However, at no point was the depth of the available space reduced. Supplementary oxygen was added to the water during this crowding operation.

44. **AWC recommends that consideration should be given to stipulating a maximum number of crowding occasions for each group of fish.** Accurate grading on entry to on-growing facilities should minimise the need for multiple grading sessions, bearing in mind that grading may also involve prior feed withdrawal.

45. Pre-slaughter feed withdrawal serves to lower metabolic rate, reduce stress and oxygen demand and improves water quality during crowding. It also contributes to better food hygiene at processing. While it is recognised that wild fish may endure long periods without feeding, there is some evidence that regularly fed farmed fish may experience stress and/or exhibit aggression as a result of feed withdrawal. AWC saw some signs of habituation to regular feeding in farmed trout at the site visit.

46. RSPCA standards for salmon recommend a maximum fasting duration of 72 hours. For trout, food withdrawal must not exceed 54 degree days, an approach recognising that water temperature will strongly influence gut emptying time and that response to feed at lower temperatures is less. The trout standard is based on industry-led research, but similar work has not yet been carried out for salmon.

47. The physiological and behavioural effects of relevant feed withdrawal times for salmon should be determined at different temperatures, and this work is necessary to underpin conclusions about the welfare consequences of this practice. Relevant welfare-related measures would include gut fill, rebound feeding motivation and other behavioural responses.

Stunning and killing

48. AWC continues to believe that the humane stunning of farmed fish is necessary to prevent pain and distress. Fish must be rendered unconscious and insensible to pain near instantaneously or unconsciousness induced without pain or distress. Consciousness must not be recovered until death ensues.

49. There has been the recent development of on-vessel cage side stunning systems, these include mechanical percussive and electrical stunning. Fish welfare must be monitored and protected no matter the location of the stunning and slaughter system. Controls and monitoring should be provided for both on-shore and on-vessel systems.

Atlantic salmon

50. Electrical stunning is used in some processing facilities to stun before dewatering to reduce stress and improve handling. Also used as a primary means of stunning in some processing facilities on-shore and on vessels.

51. Some processing facilities on-shore and on vessels have moved towards mechanical percussive stunning either instead of electrical stunning or in combination with it. Most of the mechanical percussive stunning systems in use were considered by industry to kill all fish but bleeding is still carried out for certainty and for quality purposes.

52. Mechanical percussive stunning equipment has been developed with scientific parameters for stunning/killing salmon. Fish size can be adjusted for by the equipment, but a wide range of fish sizes with different lengths of head in a single batch of fish could be challenging. Although AWC was told that the force delivered should produce an effective stun/kill in most fish, there were backup mechanical percussive stunners on the assessment table that the fish were moved to where checks of unconsciousness took place.

53. Salmon will all be bled either by manual gill cutting or, now more commonly, by an automatic blade, which can be associated with the mechanical percussive stunner, that enters below the head severing the blood vessels located there.

54. Despite improvements in automated stunning systems, there remains the potential for salmon to enter the stunner in an incorrect orientation (tail or side presentation). Continuous monitoring and the ability to intervene both during and after stunning is essential. Back-up stunning and bleeding methods must be available to protect the welfare of mis-stunned salmon.

55. Throughputs in automated stunning systems (on-shore and on-vessel) have increased with the adoption of multi-lane stunning systems. In these systems it is essential that processors have sufficient staff to monitor and intervene during the dewatered and stunning/bleeding stages.

56. In the event of equipment failure, back-up stunning and bleeding procedures must be in place to process fish that cannot be returned to holding tanks. Only

humane methods should be used, and these should be applied as rapidly as possible to protect fish welfare.

Rainbow trout

57. Electrical stunning is the primary method of stunning. Purpose built electrical water tanks or electrical in-pipe stunners are used in larger throughput trout production, while small premises may use an electrical field applied in a plastic box for small numbers of fish.

58. Operators utilising bespoke electrical stunning systems use parameters based on published research or guidance from experts in the field. As previously recommended in the 2014 report, operators should be able to demonstrate that the key parameters identified in 2014 (see *tables 1-6*) are properly applied.

59. Trout behaviour must be continually monitored for signs of effective stunning. Generally, this is best monitored by the operator bleeding the fish. Throughput should be controlled to prevent delays in the stun, to gill cutting and to allow operators time to monitor stunning effectiveness.

60. Larger trout (3-4kg) would be bled largely by gill cutting but smaller portion size trout might not be bled immediately if they have been killed outright by the electrical stun.

61. There is limited information for the electrical stun to bleeding interval. **Further research is required to establish the potential for recovery after electrical stunning that fails to induce cardiac arrest and whether a defined maximum stun to bleeding interval is required.**

Atlantic halibut and common carp

62. Halibut are usually dextral (right sided) and, as a flatfish, are potentially easier to restrain by hand at percussive stunning compared to the major UK farmed species. For sinistral (left sided) individuals, the location of the percussive blow requires adjustment¹³. This is likely to demand skill to ensure the welfare of these individuals is not compromised and may not be possible within a mechanized process. Electrical stunning, as set out in the 2014 Opinion, may therefore be preferable for this species.

63. For carp, electrical stunning is essential due to skull shape and thickness reducing the reliability of percussive stunning¹⁴. In practice, electrical and percussive stunning are often successively used to minimize the risk of individuals remaining conscious at slaughter¹⁵.

¹³ JA Lines and J Spence, 'Safeguarding the welfare of farmed fish at harvest', *Fish Physiology and Biochemistry* 38 (2012), 153–62 (157).

¹⁴ E Lambooj, M Pilarczyk, H Bialowas, JGM van den Boogaart, JW van de Vis, 'Electrical and percussive stunning of the common carp (*Cyprinus carpio* L.): neurological and behavioural assessment', *Aquacultural Engineering* 37 (2007), 171–9.

¹⁵ K Retter, K-H Esser, M Lüpke, J Hellmann, D Steinhagen and V Jung-Schroers, 'Stunning of common carp: results from a field and a laboratory study', *BMC Veterinary Research* 14 (2018), 205.

Oversight, inspection, and enforcement

64. To promote good fish welfare the industry and welfare organisations have worked together to put in place codes of practice and farm assurance. Customers, particularly retailers, also set out their own welfare requirements. Compliance with codes and assurance standards has proved to be beneficial for fish welfare and results of audits have provided evidence of standards being achieved. **Voluntary codes and assurance standards should be reviewed regularly and updated as the knowledge of fish welfare develops through scientific research. Auditing for compliance with codes and assurance standards should be carried out by suitably trained personnel.**

65. The Animal and Plant Health Agency is currently responsible for investigations into the welfare of farmed fish in England, Scotland and Wales. Local authorities also have responsibilities for farmed fish welfare. In England and Wales, there is no routine animal welfare inspection programme at farmed fish processing premises. Scheduled welfare visits to farmed fish processors in Scotland are now carried out by trained APHA inspectors in liaison with Marine Scotland Fish Health Inspectors in accordance with the requirements of the Scottish Government and in addition to assurance standards and customer audit inspections.

66. In England and Wales, the roles of the Centre for Environment, Fisheries and Aquaculture Science (Cefas) Fish Health Inspectorate are currently authorisation of fish farms; routine inspections to monitor the health of fish and industry compliance with the conditions of authorisation and biosecurity requirements; and investigation, identification, and control of serious (listed) diseases of fish and of new and emerging disease threats.

67. When legislation is made defining the standards required during the gathering, handling, slaughter or killing of farmed finfish, it will be necessary to have inspection systems in place that can identify non-compliance with those regulatory standards. The systems should be risk based and proportionate with some provision for earned recognition and external oversight (Ref paragraph 16).

68. Data from internal professional audits could be shared to reduce the burden of additional inspections. Inspections by the Competent Authorities should be carried out by trained personnel and should, where possible, use technology such as CCTV monitoring. The experience of inspections at fish processing premises recently introduced in Scotland should be useful when establishing any future system. CCTV would best be focussed on the stunning and slaughter facilities, especially in smaller operations. CCTV could be used to monitor stunning and killing on seagoing vessels where first hand physical inspection could be challenging.

69. **Regulations should be put in place to ensure that there are reasonable enforcement powers and penalties for those who fail to comply with the legislation and deliberately harm farmed fish or who fail to protect fish welfare during slaughter and killing.**

70. **Regulations should cover the fish being farmed and any other fish used in the production process, thus providing protection for cleaner fish, which can also be subject to stress and harm during slaughter and killing operations.**

71. Farmed fish slaughter premises currently have no compulsory veterinary inspections or mandatory CCTV in place, although CCTV was present in all salmon processors as a requirement of assurance standards and in larger trout processing premises. **CCTV should be used at farmed fish slaughter sites, with recordings kept for 90 days and available to inspectors.**

Cleaner fish

72. Cleaner fish have not previously been considered to be protected by the welfare at killing legislation because they are not 'bred or kept for the production of food, wool, skin, fur or other products'; rather, they provide a service. AWC would argue that they should be covered by the welfare at killing legislation if they are killed and ultimately used for products such as animal feed or fertiliser. **Regulations for the killing of farmed fish should apply to cleaner fish used in the farming process.**

73. Cleaner fish are not covered by the Welfare of Farmed Animals (England) Regulations 2007 (and similar legislation in Northern Ireland, Scotland and Wales), which specifically exclude fish. Cleaner fish are currently used in the salmon industry so only found in on-growing facilities in Scotland. There are significant cleaner fish hatcheries in England and Wales producing juveniles for deployment in Scotland. There are also fisheries for wild wrasse in south-west England, which are held and accumulated by fishers before transport to Scotland.

74. Cleaner fish do fall under the definition of a 'protected animal' in the Animal Welfare Act 2006 and the Animal Health and Welfare Act 2006 in Scotland and must therefore be afforded protection from unnecessary suffering. For an offence to be committed, suffering would result from an act or failure to act by a person, when the person knew, or ought reasonably to have known, that the act or failure to act would have been likely to have caused this suffering and that the suffering is unnecessary.

75. Cleaner fish mortality rates should be monitored and recorded. Causes include 'swim bladder disease' (which is a symptom or condition that has multiple causes), other diseases and predation. An unknown proportion of these fish therefore reach states when they need to be euthanised.

76. The 2014 Opinion recommended separating out cleaner fish to avoid predation during feed withdrawal and industry have confirmed that cleaner fish do have refuge areas in the sea pens with narrow mesh or masking with plastic screens. They can also be fished from the pens in creels. When fish are pumped from the sea pens salmon and cleaner fish both travel through the pipe, but AWC saw on the wellboat used for slaughter that a separator grid directed cleaner fish to different tanks for euthanasia.

77. Lumpfish make up the majority of cleaner fish used in salmon production¹⁶. For lumpfish, the standard method of stunning prior to killing is an overdose of anaesthetic.

78. Several wrasse species are also used in aquaculture. Stunning is by a percussive blow to the top of the head for larger wrasse and by an overdose of anaesthetic for smaller wrasse.

Eels

79. Eels that are wild caught but then are kept alive for a period of time before being killed for food production are considered to be subject to the welfare of animals at the time of killing legislation because they are 'kept for the production of food, wool, skin, fur or other products' (Article 3(1) PATOK). As such, eels must be spared avoidable pain, distress or suffering during their killing and related operations.

80. Farmed eels in Europe and elsewhere are commonly chilled to low temperature in ice water then placed in iced brine for killing. However, research suggests that responses to pain stimuli may continue even after 12 minutes in ice water¹⁷. Although iced brine is an effective killing method, unconsciousness can take 30 seconds or more and this is likely to cause severe pain and stress. Some eels are also killed by salting out of water, which AWC also does not believe to be humane.

81. The European Food Safety Authority (EFSA) has recommended electrical stunning followed by immediate killing and has suggested that, to improve stunning reliability, technology needs to be developed that is able to deliver high voltage and high current in combination¹⁸. A further report by the Aquaculture Advisory Council has stated that such equipment is now available and in use¹⁹.

82. Whether the method of stunning being used on kept eels contravenes Article 3(1) of PATOK would largely be a question of fact, and ultimately for legal determination. Enforcers, such as local authorities or APHA, using veterinary or other expert judgement, would need to consider the available evidence to assess whether the method being used to kill the eels is causing avoidable pain, distress or suffering. Part of that analysis would include considering if alternative methods would cause less suffering. The methods commonly used (chilling or salting, decapitation and live evisceration) may be causing avoidable pain and suffering as a more humane method has been identified (electrical stunning).

83. In order to preserve freshness, eels are sometimes sold chilled to low temperature but still live, and research has suggested a correlation between

¹⁶ Scottish Fish Farm Production Survey 2019, 36-7.

¹⁷ E Lambooi, JW van de Vis, RJ Kloosterboer and C Pieterse, 'Welfare aspects of live chilling and freezing of farmed eel (*Anguilla* L.): neurological and behavioural assessment', *Aquaculture* 210 (2002), 159-69.

¹⁸ Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on welfare aspects of the main systems of stunning and killing farmed eel (*Anguilla anguilla*). *The EFSA Journal* (2009) 1014, 1-42.

¹⁹ [Slaughter report AAC report.pdf \(aac-europe.org\)](#)

subjective sensory assessments and measurements of chemical levels present.²⁰ Retail customers are likely to lack the necessary competence to keep a sentient food animal and to kill it humanely. The sale of live eels to consumers is therefore not acceptable from an ethical viewpoint.

84. AWC recommends that legislation should require that eels are electrically stunned and killed before sale to trade or retail customers.

Recommendations

85. The Recommendations from the 2014 Opinion are repeated here in the format **(X, 2014)**. Most of these continue to apply but have also been amended, augmented and added to in the section of the report below.

86. Sections of the industry have implemented some recommendations from the 2014 Opinion, but they have not been actioned by all or translated into legislation. AWC has been asked to update its advice to aid the government and the devolved administrations in their consideration of detailed rules for the welfare of farmed fish at the time of killing and as part of this to reassess the FAWC recommendations.

(88, 2014). All personnel involved with slaughter or killing must be trained, competent and aware of their duty of care.

Additional or augmented recommendations:

87. *(88, 2014) Government should legislate to require that all personnel involved with the killing of farmed fish and its related operations are trained, competent and aware of their duty of care.*

88. *(88, 2014) Industry should ensure that those involved in the gathering, handling, slaughter and killing of farmed fish are suitably trained to perform their duties competently and with care in accordance with the regulations. Those responsible for slaughter and killing should be able to recognise the signs of ineffective electrical or percussive stunning.*

(89, 2014). Research effort should be applied to: • identifying feed withdrawal limits that balance the welfare impacts of hunger/habituation to feeding and reduction in metabolism. • detecting, retrieving and killing sick and moribund fish.

Amended/augmented recommendations:

89. *(89, 2014) Feed withdrawal should be calculated by industry in degree days to take account of the temperature-dependent metabolism of farmed fish as cold blooded animals.*

²⁰ Yesim Özogul, Gulsun Özyurt, Fatih Özogul, Esmeray Kuley and Abdurrahman Polat, 'Freshness assessment of European eel (*Anguilla anguilla*) by sensory, chemical and microbiological methods', *Food Chemistry* 92 (2005), 745–51.

90. (89, 2014) *Further research, supported by government and industry, is required to establish the potential for recovery after electrical stunning that fails to induce cardiac arrest and whether a defined maximum stun to bleeding interval is required.*

(90, 2014). For killing procedures that require it, the time from removal of the fish from water to unconsciousness and killing should be kept to a minimum.

(91, 2014). Cleaner-fish should be removed from sea pens when feed is withdrawn from salmon or larger trout prior to harvest to avoid the risk of predation.

(92, 2014). Water quality should be monitored regularly and recorded and should be maintained at acceptable levels during the transport of fish.

Amended/augmented recommendations:

91. (92, 2014) *Operators should ensure that oxygen levels are monitored during crowding and supplemental oxygen delivered if necessary. Operators should be trained to recognise farmed fish density and stress responses, so that this can be balanced with efficiency of fish capture/treatment and duration of crowding.*

92. (92, 2014) *AWC recommends that consideration should be given to stipulating a maximum number of crowding occasions for each group of farmed fish.*

(93, 2014). Transfer to the killing facility should be by a method and at an appropriate rate to avoid stress and injury but also to prevent delay prior to killing, especially if fish are (partially) out of water.

Amended/augmented recommendations:

93. (93, 2014) *Operators should ensure that transfer of farmed fish to the slaughter facility should be in water and that the water quality and oxygen concentration should be monitored and maintained at sufficient levels to prevent stress.*

94. (93, 2014) *Operators should ensure that, where farmed fish are pumped to slaughter facilities, pumping pressure and flow rates are constantly monitored, with communications maintained between those controlling the pumping operation and the slaughter point.*

(94, 2014). All farmed fish must be stunned before killing, whether or not death accompanies the stun (as in stun/kill methods) or follows a short time after the stun but before the fish has the time to regain consciousness.

Amended/augmented recommendations:

95. (94, 2014) *Government should legislate to ensure that all farmed fish are stunned before killing using stun/kill methods or that killing takes place before consciousness is regained.*

96. (94, 2014) *Government should legislate to ensure that stunning of farmed fish take place in water or immediately after removal from water. A back-up stunning process must be available.*

(95, 2014). Operators killing fish should be able to demonstrate that the key parameters identified in this Opinion (including tables 1-6) are properly considered.

Amended/augmented recommendation:

97. (95, 2014) *Operators killing farmed fish should be able to demonstrate that the key parameters identified in 2014 (see Tables 1-6) are properly applied.*

(96, 2014). Emergency killing, including where automated stunning or other methods fail, should not be by methods considered inhumane at other times. A backup method of manual stunning, such as a priest, must be available in the killing facility.

(97, 2014). Pharmaceutical methods of killing should take account of dosage, exposure time, size and weight of fish, water temperature and other relevant factors to ensure a rapid and effective kill.

(98, 2014). Operators should be trained to recognise the signs of ineffective percussive or electrical stunning

(99, 2014). Fish farms and other sites killing fish should appoint a suitable person to be responsible for animal welfare.

(100, 2014). Slow chilling only sedates cold-water fish so is not an acceptable method of stunning and should not be used. Warm-water fish eventually become sedated and even killed, but the time is relatively long, and the water quality will affect the stress levels of the fish.

(101, 2014). Asphyxiation does not result in immediate unconsciousness and has been shown to be stressful to farmed fish. It should not be an allowable method of killing.

(102, 2014). The use of CO₂ saturated water, live chilling (with or without CO₂) and the cutting of the gills of conscious fish are not considered humane methods of killing and should not be used.

Amended/augmented recommendations:

98. (99,100,101,102, 2014) *The following methods are considered inhumane and should be illegal for the killing of farmed fish*

- a. *Slow chilling in iced water*
- b. *Asphyxiation*
- c. *CO₂ saturated water*
- d. *Cutting of gills in conscious fish*

(103, 2014). The stunning, slaughter and killing of fish should be included in EU welfare legislation.

Amended/augmented recommendations:

99. (103, 2014) *Government should ensure that protections for the welfare of farmed fish during their killing and related operations are included in UK legislation. Legislation should be written so as to be easily amended to take account of a changing knowledge base.*

100. (103, 2014) *Government must ensure that any legislation on detailed protections for farmed fish at the time of killing includes proportionate inspection systems that can identify non-compliance with those regulatory standards.*

101. (103, 2014) *Regulations should be put in place to ensure that there are reasonable enforcement powers and penalties for those who fail to comply with the legislation and deliberately harm farmed fish or who fail to protect fish welfare during slaughter and killing.*

Additional recommendations:

102. *Bodies producing UK statistics should consider additional data collection on, or estimation of, the number of individual finfish farmed in the UK.*

103. *Fish farms should have a contingency plan in place which has been tested and must include provisions for the loss or malfunction of equipment, disease outbreak or invasion by predators.*

104. *Industry and standards providers should ensure that voluntary Codes of Practice and assurance standards are reviewed regularly and updated as the knowledge of fish welfare develops through scientific research.*

105. *Auditing for compliance with voluntary Codes and assurance standards should be carried out by suitably trained personnel.*

106. *Government should require CCTV to be used at farmed fish slaughter sites, with recordings kept for 90 days and available to inspectors.*

107. *Regulations for the killing of farmed fish should apply to cleaner fish used in the farming process.*

108. *Industry should ensure that systems are designed to minimise stress on cleaner fish during feed withdrawal, gathering and separation.*

109. *Legislation should require that eels are electrically stunned and killed before sale to trade or retail customers.*

Annexes in the 2014 Opinion

These have been reassessed and represent good practice.

APPENDIX 1 - Membership of AWC – 2022

Peter Jinman – Chairman*
Madeleine Campbell – AWC Chair 2023
Martin Barker*
Dr Andy Butterworth
Richard Cooper
Dr Jane Downes*
Dr Troy Gibson*
Dr David Grumett*
Dr Carmen Hubbard
Richard Jennison*
Richard Kempsey
Dr Dorothy McKeegan*
Dr Romain Pizzi
Dr Pen Rashbass
Professor Sarah Wolfensohn
Dr James Yeates

The WAK sub-committee members from 2022* agreed to continue work to complete this report.

Advisors

Joe Anzuino – Animal and Plant Health Agency (APHA)
Tim Ellis & Jason Mewett – Centre for Environment, Fisheries and Aquaculture Science (Cefas)
Collin Willson – Food Standards Agency (FSA)
Charles Allan – Marine Scotland

Secretariat

Richard Aram
Rebecca Thomas

APPENDIX 2 - Those who gave evidence or assistance

Ace Aquatec
Animal Equality
Aquaship UK
British Trout Association
British Veterinary Association
Compassion in World Farming
Conservative Animal Welfare Foundation
Fish Veterinary Society
Humane League
Humane Slaughter Association
Mowi Scotland Ltd
Royal Society for the Prevention of Cruelty to Animals
Salmon Scotland
Scottish Sea Farms
University of Stirling

AWC would also like to thank all the farms and their staff who assisted with visits.

APPENDIX 3: Numbers of finfish farmed and killed for food in the UK

The UK has a diverse finfish farming industry with farms across the UK (Defra, 2015), sited in the sea, associated with freshwater bodies, and indoors. Finfish are farmed not only for food, but also for sport (stocking of angling waters), as functional working animals (cleaner fish), as pets (ornamental fish), and for environmental purposes (restocking of wild populations).

There is increasing interest in the numbers of farmed fish due to recognition that any potential animal welfare issue is related to the number of individuals involved (Ellis et al., 2016; Franks et al., 2021). The Fish Health Inspectorates (MSS, Cefas, DAERA-NI) collect data on production from hatcheries, nurseries and ongrowing farms. Scottish Environmental Protection Agency (SEPA) also collect monthly data for marine cage sites in Scotland on the biomass on farm and of mortalities (Scotland's Aquaculture, 2022). However, the available data and statistics are not generally amenable to calculation of the numbers of finfish slaughtered and on farms because:

- production (and stock and mortalities) is typically quantified as biomass (in tonnes) rather than by number of individuals.
- the farming cycle typically spans more than one year, and production varies between years.
- the production cycle typically consists of successive stages, e.g. broodstock/hatchery, nursery, on-growing, involving transfers between sites.
- collection of data varies between the devolved administrations and is aligned with international reporting obligations which focus on statistics for food production (Eurostat, 2022; FAO, 2019).
- production is often defined as sales, so statistics may exclude: i) interim stages within the production cycle where companies are vertically integrated, and ii) non-commercial production e.g. for environmental purposes.
- some data are confidential due to limited numbers of producers.
- there is a general lack of information on losses during production.

Recognising these limitations, the annual numbers of different species (or groups) output from UK finfish farms have been estimated (Table 1); these figures include those killed for food and produced for other purposes. These estimates have been made using statistics (for 2011-2020), available since the 2014 FAWC reports, with biomasses converted to numbers using ball-park figures for mean weight. The figures presented are rounded averages (or just recent data for new activities), with an indication of whether these are static, increasing or decreasing. The figures under-estimate the metapopulation of finfish on farms which will be greater due to the parallel production of different year-classes, losses throughout the production cycle, and gaps in data collection (e.g. number of fish produced for environmental restocking in Scotland).

AWC were told that pre-smolt mortality rates in farmed salmon production were in the range of 5-10%. Survival of Scottish salmon (number slaughtered/number of smolt input) for 2014-2019 year-classes was ca. 76%²¹.

With increasing recognition of finfish as sentient beings, **it is recommended that bodies producing UK statistics consider additional data collection on, or estimation of, the number of individual finfish farmed in the UK.** Finfish farms typically use operational software which is based around numbers of individuals (as well as biomass from weight estimates/measurements), so farm level data should be available.

²¹ Table 28 in [Scottish Fish Farm Production Survey 2021 - gov.scot \(www.gov.scot\)](https://www.gov.scot/resources/documents/2022/04/Scottish_Fish_Farm_Production_Survey_2021_-_gov.scot.pdf)

Table 1: Indication of annual numbers of finfish slaughtered for food and produced for other uses in the UK, and current trends (↑ = increasing; ↔ = static; ↓ = decreasing). Shaded cells indicate a lack of data.

Species (group)	Killed in food production chain		Produced for other uses (excluding on-growing)								Total
			Cleaner fish		Angling (salmonids often killed for food)		Pets		Environmental restocking		
Atlantic salmon	36,000,000	↑	-		-		-		800,000	↓	36,800,000
Rainbow trout	16,000,000	↔	-		2,600,000	↓	-		-		18,600,000
Farmed cleaner fish: lumpfish, wrasse species	?		5,700,000	↑	-		-		-		5,700,000
Other freshwater fish: carp, tilapia, coarse fish	100,000	↓	-		500,000	↔	1,400,000	↔	1,000,000	↔	3,000,000
Other salmonids: brown (sea) trout, Artic char, brook trout, hybrid trout	100,000	↓	-		400,000	↓	-		200,000	↓	700,000
Other marine fish: sea-bass, halibut, turbot, cod	200,000	↓	-		-		-		-		200,000
Wild caught cleaner fish: wrasse species	?		100,000	↑	-		-		-		100,000
Total	52,400,000	↑	5,800,000	↑	3,500,000	↓	1,400,000	↔	2,000,000	↓	65,100,000

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References cited in the text of this report are not an exhaustive list of the scientific evidence reviewed by AWC in the preparation of this advice.



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