Humane slaughter of wild-caught fish Recommendations for improving the welfare of over 1 trillion fishes caught in the wild annually

By James, K., Amarasinghe, U.S., Herath, T., Jayasuriya, N., Lines, J., Sneddon, L. and Randall, N.

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Humane Slaughter Association

A road map for industry and policymakers

May 2025

Contents

Humane Slaughter Association

The Humane Slaughter Association (HSA) is a charity dedicated to improving the welfare of animals consumed for food or produce during transport, slaughter, or when they are killed for emergency reasons.

The HSA's vision is of a world where all farmed animals are transported and killed humanely. Its mission is to promote and advance the use of humane methods through research, education and technical advancements to create practical and lasting improvements in the welfare of animals used in food production.

www.hsa.org.uk

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Acknowledgements

This research was funded by the Humane Slaughter Association using funds provided by a grant from Open Philanthropy. The authors wish to thank Alison Mood of Fishcount for developing and granting us permission to use a database designed to calculate fish numbers (lower and upper millions) captured globally each year. The authors also wish to thank Salvador Prats Aparicio for his contribution towards the systematic mapping of the existing scientific research underpinning humane stunning or stun/killing of finfish.

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Executive summary

An estimated 1.1 to 2.2 trillion wild finfish are caught globally each year (Mood & Brooke, 2024). As a substantial and growing evidence shows that fish are sentient beings capable of experiencing fear, pain and suffering, there is increasing international recognition of the need to improve their welfare during slaughter.

Most wild-caught fish are not humanely stunned before killing, and evidence suggests these fish may experience significant suffering between the time they are captured and their death. Currently, guidelines for the humane stunning of wild-caught fish are extremely limited, and legal protections for their welfare are rare.

This report summarises key findings and recommendations from a research project that investigated the overall feasibility of humane stunning of finfish in wild-capture fisheries.

Key recommendations

To increase awareness, uptake and demand for humane stunning or stun/killing of wild-caught fish, stakeholders across the fish supply chain need to work together to co-create solutions to barriers, and address knowledge gaps.

The following six-stage roadmap is recommended:

1. **Raise awareness** of fish sentience and welfare needs within wild-capture fisheries with the aim of increasing demand for better welfare.
2. **Incentivise engagement** with stakeholders in the supply chain by highlighting the benefits and feasibility of humane stunning whilst also exploring the feasibility of adding value to product through labelling or assurance schemes.
3. **Facilitate uptake** through further research and innovation to provide the fishing community with the technology and species-specific stunning parameters they require.
4. **Support uptake** of suitable technology by encouraging stunning equipment manufacturers to market their technology at a price point that is feasible to a range of business sizes.
5. **Enable change** by facilitating shared learning and peer-to-peer support from both processors and retailers for humanely stunned or stun/killed fish.
6. **Drive change** beyond voluntary uptake by integrating humane stunning or stun/killing into policy and legislation.

Foreword

Truly vast numbers of fish are caught in the wild every year to provide humans and animals with food, yet almost none of these fish are humanely stunned. This contrasts sharply with farmed livestock, where stunning prior to slaughter is now the norm, as is also the case for farmed fish in the UK. The lack of humane stunning for wild-caught fish is therefore one of the largest animal welfare problems worldwide, yet we can also look at it as an opportunity to make an enormous improvement to the welfare of over a trillion sentient animals every year.

"The lack of humane stunning for wild-caught fish is therefore one of the largest animal welfare problems worldwide, yet we can also look at it as an opportunity to make an enormous improvement to the welfare of over a trillion sentient animals every year."

To address this issue, the Humane Slaughter Association (HSA) funded the research that underpins this report (James at al. 2025) to examine ways to improve the welfare of wild-caught finfish at slaughter in commercial wild-capture fisheries. The research is objective, thorough, systematic, and based on all the information available at the time of writing. This approach has ensured that this report focusses on the facts, as well as the gaps in evidence which need to be filled, providing a clear and unbiased view of what we know, and crucially, what we still need to understand. Most importantly, the report goes beyond outlining the problem by proposing an approach which could be adopted to make real progress towards a more humane way of harvesting fish from the wild.

The HSA is committed to promoting humane methods to stun and slaughter all animals killed for food.

By commissioning this report, and the research upon which it is based, the HSA hopes to highlight this opportunity and encourage collaboration to address it. With a stronger focus on the welfare of wild-caught fish, we can begin to take practical and pragmatic actions to tackle this enormous animal welfare problem.

We hope that the fishing industry, food businesses, policymakers, equipment manufacturers, research funders, and other stakeholders will pay close attention to the recommendations and use them to make real-world improvements to fish welfare. **This opportunity to make perhaps the largest improvement to animal welfare in the 21st century is one that should be seized by all those involved.**

I would like to thank all the researchers who produced this excellent report and the stakeholders who gave their time to provide invaluable insights.

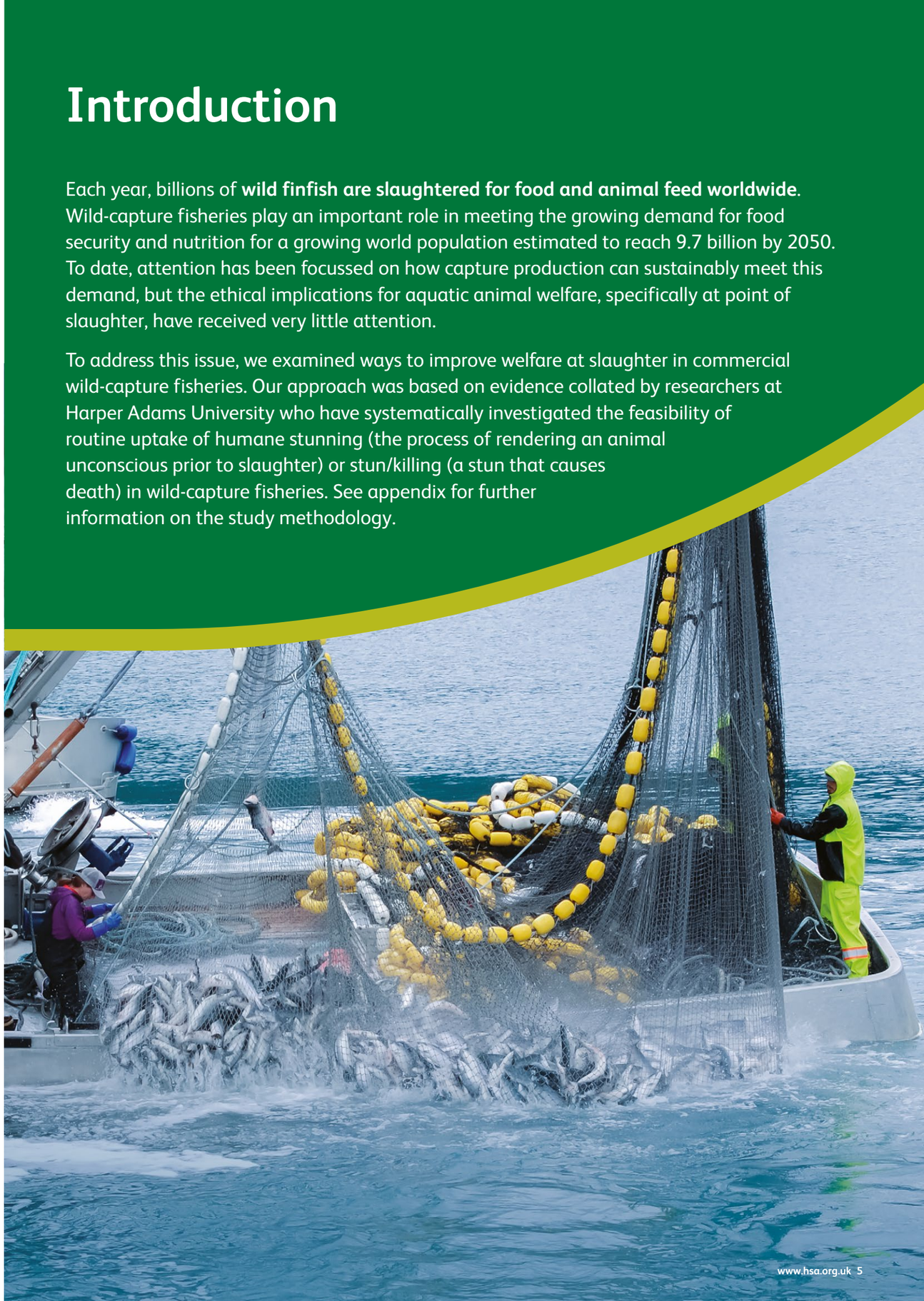
"This opportunity to make perhaps the largest improvement to animal welfare in the 21st century is one that should be seized by all those involved."

Dr Huw Golledge
Chief Executive Officer
and Scientific Director,
the Humane Slaughter Association

Introduction

Each year, billions of **wild finfish are slaughtered for food and animal feed worldwide**. Wild-capture fisheries play an important role in meeting the growing demand for food security and nutrition for a growing world population estimated to reach 9.7 billion by 2050. To date, attention has been focussed on how capture production can sustainably meet this demand, but the ethical implications for aquatic animal welfare, specifically at point of slaughter, have received very little attention.

To address this issue, we examined ways to improve welfare at slaughter in commercial wild-capture fisheries. Our approach was based on evidence collated by researchers at Harper Adams University who have systematically investigated the feasibility of routine uptake of humane stunning (the process of rendering an animal unconscious prior to slaughter) or stun/killing (a stun that causes death) in wild-capture fisheries. See appendix for further information on the study methodology.



Why the welfare of wild-caught fish matters

Scientific research supports the consensus that fish are sentient animals capable of experiencing pain and suffering (Braithwaite 2010; Broom 2014 & 2016; Sneddon et al 2020). In the UK, the Animal Welfare (Sentience) Act 2022 enshrines this in law.

Most commercially caught wild fish who are landed alive die by suffocation in air or ice water/slurry, or during processing where they are bled, gutted, or decapitated alive (Robb & Kestin, 2002). Death is not instantaneous, and fish often remain conscious, still able to experience pain and distress, for a considerable time.

Box 1 below outlines inhumane methods of fish slaughter and highlights the prolonged periods during which fish can suffer when these methods are used. For example, the average time to insensibility for seabream was 5.5 minutes (when asphyxiated in air), and cod and haddock were still conscious, as measured by EEG, 2 hours after landing on board a fishing vessel. These practices have been deemed inhumane for farmed fish by the European Food Safety Authority (EFSA) and the World Organisation for Animal Health (WOAH), based on scientific evidence (OIE 2022; EFSA 2009a-f).

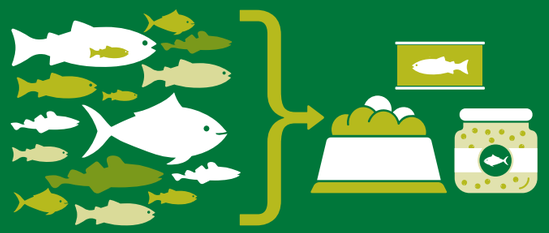
Animal welfare at slaughter is regulated, in many countries around the world, to minimise pain, distress and suffering at the time of killing. Regulations for humane slaughter of farmed land animals generally require that animals be rendered instantly unconscious so that they are insensible to pain before they are killed (simple stunning), or that death should be brought about instantaneously (stun/killing).

Few countries have specific legislation protecting the welfare of fish at the time of killing, so it is rare that humane stunning or stun/killing of fish is legally enforced. EFSA and WOAH recommend humane stunning or stun/killing in the slaughter of farmed fish (OIE 2022; EFSA 2009a-f) but have not considered wild-caught fish. In the UK, the voluntary RSPCA Assured farm assurance scheme requires farmed fish to be pre-stunned prior to slaughter (RSPCA Assured, 2024).

The scale of this welfare issue is vast. Although no official figures exist, it has been estimated that every year approximately

1.1 to 2.2 trillion

individual wild fish are caught for food or animal feed worldwide*.



*Mood A, Brooke P. Estimating global numbers of fishes caught from the wild annually from 2000 to 2019. *Animal Welfare*. 2024;33:e6. doi:10.1017/awf.2024.7

Box 1. Inhumane slaughter of fish

Using electroencephalogram (EEG), a measure of the electrical activity of the brain, to assess state of consciousness, scientists have shown that methods such as asphyxiation (suffocation), bleeding, gutting or decapitation of live fish do not cause immediate death or insensibility (loss of consciousness). Instead, fish remain conscious and able to experience pain and suffering before death finally occurs. Systematic mapping of existing scientific research on humane stunning and stun/killing of finfish has highlighted that the time taken for fish to reach insensibility is influenced by a range of factors including species, slaughter method and temperature. The following examples illustrate these findings:

Asphyxiation

Average time to insensibility, measured by loss of visual evoked response (VERs), which measures the brain's response to visual stimulation recorded by EEG, for gilt-head seabream was 5.5 minutes when asphyxiated in air, and 5 minutes when immersed in ice slurry (van de Vis et al 2003). Cod and haddock were still conscious, as measured by EEG, 2 hours after landing on board a fishing vessel and storing in dry bins (Lambooij et al 2012).

Exsanguination (bleeding)

Average time to insensibility, measured by loss of VERs recorded by EEG, for Atlantic salmon who were gill cut was 4.7 minutes (Robb et al 2000).

Decapitation

On average, decapitated eels took 13 minutes to become insensible as demonstrated by loss of VERs recorded by EEG (van de Vis et al 2003).

Existing stunning and stun/killing methods for fish

Stunning and stun/killing methods for farmed fish, regarded as humane and globally acceptable (OIE 2022; EFSA 2009a-f), fall into two main categories:

1. **Electrical:** in water and dry electrical stunning (Box 2)
2. **Mechanical:** percussive stunning (manual or automated), and spiking or coring (Box 3)

Depending on the species that the stunning is applied to, and the parameters used, the stun may cause death (stun/killing method), or the stun may be reversible and require a follow-up killing method before consciousness is recovered. In general, mechanical stunning, if applied correctly, is typically irreversible in fish, whereas unconsciousness following electrical stunning may be reversible (OIE 2022).

There is no single humane stunning or stun/killing method that is suitable for all finfish species since **there are over 30,000 species of fish which vary widely in their anatomy, physiology and ecology and this must be considered when developing stunning methods**.

The choice of method should take account of species-specific information where available and any stunning parameters (electrical and automated percussive stunning) that have been determined scientifically (OIE, 2022).

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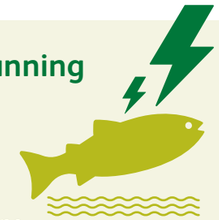
Box 2. Electrical stunning



Electrical stunning passes a current through the brain of the fish, causing an epileptic-like seizure, which results in immediate (within one second) unconsciousness and insensibility to pain. Unconsciousness must last long enough to ensure that the animal does not regain consciousness before a follow-up killing method can be applied. In some cases, electrical stunning is irreversible if a sufficient current is applied for an adequate duration.

Dry stunning

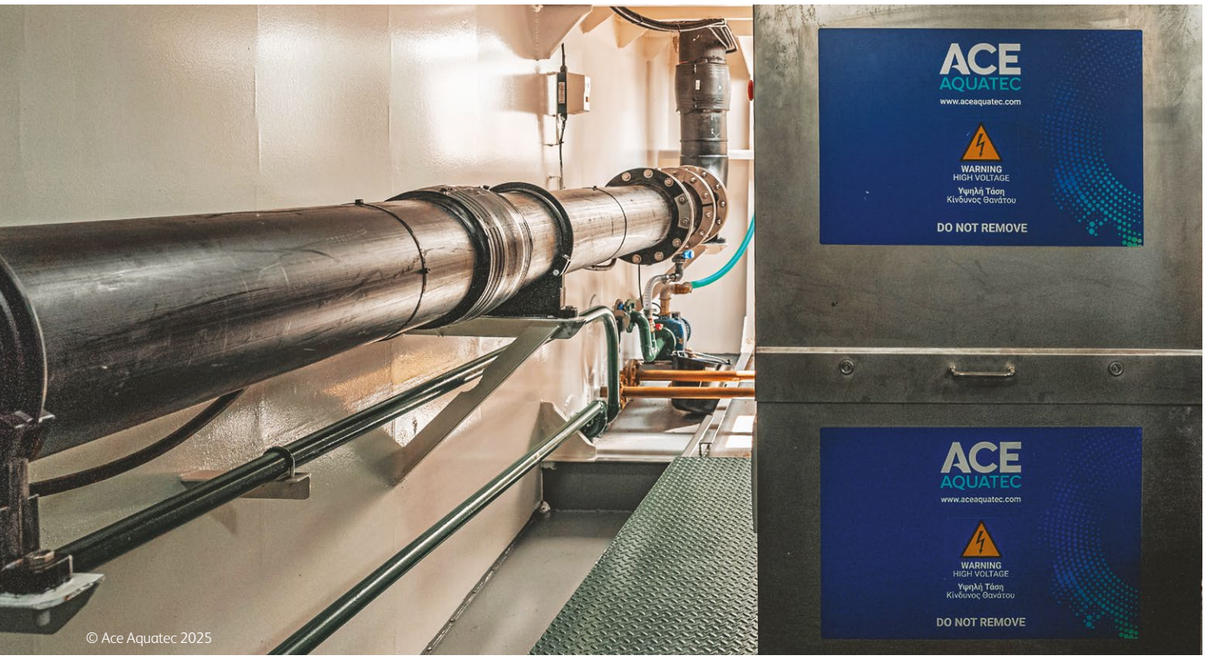
Electrical stunning systems are commercially available. Dry stunning typically involves removing fish from water and passing them over a conveyor belt which acts as one of the electrodes, with a chain of plate electrodes (steel flaps) hanging above, to complete the circuit (Boyland 2018). Fish need to enter the dry stunner in the correct orientation (headfirst) and without excessive struggling, to prevent pre-stun shocks or mis-stunning (Boyland 2018). Sometimes fish are sprayed with water on the stunning conveyor belt (semi-dry stunning).

Stunning in water

Stunning fish in water can reduce stress associated with exposure to air. Fish are exposed to an electric current in water, either within a water tank (batch system) or while water is continuously pumped through a pipe (continuous flow system) (Boyland 2018). The latest continuous flow electrical systems use annular electrodes imbedded into the pipe, to ensure continuity of the stun. The benefits of this system are that it involves no handling of live fish and that the electric field can be maintained regardless of fish size (Pyne-Carter 2021).

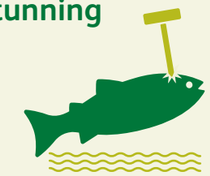
Species-specific electrical parameters are critical to ensure that stunning is effective.

Electrical stunning must not be confused with electro-immobilisation/electro-stimulation or electro-fishing which only immobilise fish and do not render them insensible, therefore exposing fish to suffering (Robb & Kestin 2002).



Box 3. Mechanical stunning

Percussive stunning



Percussive stunning involves applying a blow to the head, above or adjacent to the brain, with enough force to stun or kill the fish instantaneously. The effect and duration of the stun depends on the severity of damage to the nervous tissue and the degree to which the blood supply is reduced. This is determined by the force and velocity of the blow, as well as the weight and shape of the hammer or club (sometimes called a priest) (EFSA 2009b). Where loss of consciousness is recoverable, a follow-up killing method is required. For some species percussive stunning is not possible due to fish anatomy.

The percussive blow can be delivered manually using a club/priest or by an automated stunning machine. Manual percussive stunning is only practical for slaughtering a limited number of fishes (OIE 2022), and efficacy can be affected by worker fatigue and competency (Farm Animal Welfare Committee 2014).

Commercial automated machines are usually powered by compressed air. Some systems require an operator to orient the fish headfirst into the stunner but there are also ‘swim in’ systems, which minimise handling. One of the main disadvantages with automated stunners is that the machine needs to be re-calibrated for fish of different sizes.

Spiking and coring (also known as Ikijime)

Spiking and coring stun and kill fish by causing severe and irreversible damage to the brain (Robb & Kestin 2002). The brain is damaged either by pushing a solid, pointed metal rod into the head through the soft area above the brain stem which is then moved around to destroy the brain (spiking), or a hollow metal rod which is usually knocked into the brain (coring) (Boyland 2018).

The process can be performed manually or mechanically using a handheld ‘ikigun’. An automated ikejime machine is under development (Coldewey 2022). In some cases, fish are subsequently pithed using a flexible wire to destroy the spinal cord (Robb & Kestin 2002; Boyland 2018). For spiking and coring, accuracy in positioning and application of the device is crucial to avoid suffering (Robb & Kestin 2002). A web-based tool (ikijime.com) is available to help fishers accurately locate the brain of a range of fish species around the world.

Modifications to spiking include captive needle stunning, a system that pneumatically fires a needle into the brain which then injects compressed air. Captive needle stunning has been shown to cause immediate loss of consciousness in some species, such as eels (Lambooij et al 2002) but to our knowledge there are currently no commercial applications for this method.

How humane stunning or stun/killing can benefit the fishing community

Pre-slaughter stress can negatively impact flesh quality as a result of behavioural changes including increased physical activity and physiological effects such as changes in muscular pH in fish (Robb & Kestin 2002). Flesh quality can be important where consumers are willing to pay a premium for better quality. An example of synergy between improved welfare and flesh quality is recognised in wild-capture fisheries in the spiking and coring (Box 3) of tuna destined for lucrative sashimi markets (e.g. Starling and Diver 2005).

Sometimes product quality is not a driver because it is not required for the end market, for example when used for fishmeal/animal feed which can account for around 56 % of the global fish catch per year (Mood and Brooke 2024). In these cases, uptake can be encouraged through evidence of other benefits such as cost savings in terms of labour or time, and improvements in health and safety of the crew. For example, anecdotal evidence suggests that dry electrical stunning facilitates safer and easier catch handling and bleeding of large fish, thus improving worker safety.

Methods of stunning currently available and used in wild-capture fisheries

In commercial wild-capture fisheries, choice of stunning or stun/killing method must consider:

- Suitability for the species and whether stunning parameters have been determined for that species (electrical and automated percussive stunning).
- Compatibility of the method with fishing gears and fishery scale.

In some cases, new technology may need to be developed, or existing technology adapted for use on board vessels.

Table 1. Fishing terms and definitions

Term	Definition
Pelagic fish	Fish who live in the open ocean, away from the coast and the seabed. Examples include tuna, swordfish and smaller species such as anchovies, sardines and mackerel.
Gill net	A wall of netting designed to catch fish by their gills as they try to swim through. It can be set at various depths.
Hook and line capture	A fishing method using hooks and lines, which can be handlines, rod-and-reel, or longlines with multiple hooks.
Seine net	A large vertical fishing net designed to enclose fish. It has floats on the top and weights on the bottom. A purse seine net is a large fishing net used to encircle and capture schools of fish, typically in open waters.
Bycatch	The unintended capture of non-target species during fishing operations.
Trawling	A fishing technique where a net is pulled through the water behind one or more boats.
Bottom trawling	The net is dragged along the seabed. Can cause significant habitat disruption.
Pelagic/mid-water trawling	The net is towed through the mid-water column, targeting schooling fish.
Scottish bag net	A fixed fishing net used in coastal waters to trap salmon and sea trout in a bag or chamber.

Except for fisheries supplying the sashimi market, **only a small number of innovators globally** (e.g. Blue North Fisheries (Golden 2016), (Table 2)) **are currently aiming to practise humane stunning on a commercial scale, and only for a limited number of fish species** (Table 2). The small pelagic, mostly marine species (e.g. anchovies, sardines, mackerels), are caught in the highest numbers globally per annum, primarily using seine nets. At the time of writing, technology capable of stunning large volumes of fish in one go, has not been implemented in the wild-capture fisheries.

Table 2. Stunning or stun/killing methods in-use in wild-capture fisheries that aim to be more humane* (practice may have changed since data were collated).

Method	Example of fishery	Practical considerations for wild-capture fisheries
Dry stunning	**Blue North Fisheries:** line caught Pacific cod. **Ekofish:** trawled plaice. **Kirkella H 7 super-trawler:** Atlantic cod and haddock.	• Fish need orientating headfirst into the stunner, in single file. • Only suitable for fish of similar size. • Bycatch needs separating and debris that could damage the stunner or cause mis-stunning of fish (metal debris) removing. • Capital investment and cost to retrofit existing vessels. • Not suited to all types of fisheries, especially those capturing large volumes of fish, of different sizes, in a short space of time.
Manual percussive stunning	**Alaskans Own wild salmon:** line caught coho & king salmon. **Scottish Wild Salmon Company:** Scottish bag net caught Atlantic salmon.	• Labour-intensive. • Most suited to small fisheries catching limited numbers of fish. • Care needs to be taken not to damage the appearance of the fish (e.g. eye injuries such as haemorrhaging) which could impact fish price (e.g. Lyu et al 2015). • Anecdotal evidence suggests there could be long-term physical effects for fishers.
Automated percussive stunning	**Wild Salmon Direct:** Sockeye & coho salmon caught by purse seine and held alive in floating net pens until slaughter.	• Machine needs re-calibrating for fish of different sizes and is therefore less practical in wild-capture fisheries where fish are not always uniform in size. • Fish need orientating headfirst into the stunner, in single file. • Bycatch needs separating.
Spiking or coring	**Specialised fisheries supplying sashimi markets:** Yellowfin & bigeye tuna.	• Labour-intensive therefore most suited to small fisheries catching limited numbers of fish.

*Not all methods are validated in terms of how humane they are.

Views of fishing industry stakeholders

Consultation with stakeholders (including from fisheries, manufacturing, processing and retail), indicates that continuous flow in-water electrical stunning technology (see Box 2), commercially available and operational in the aquaculture sector, could be a feasible and effective option. Stakeholders confirmed that there is growing interest in the technology from wild-capture fisheries, and that implementation is likely in the near future. Demand will decide which species stunning parameters are determined for.

Some of the challenges and limitations of humane stunning technology were identified as:

- Capital investment;
- Physical footprint of the boat and generator size, which determine the capacity of the system;
- Running costs, especially the energy required for stunning in salt water (partial de-watering or reducing the salinity of water passing through the system may mitigate this issue);
- Fishery suitability (the technology is most suited to pelagic shoaling fisheries with limited by-catch or debris that could damage the stunner).

Cost benefits may include:

- Improved quality and shelf-life;
- Less downgrading of fish;
- Reduced labour requirements.

Table 3. Barriers to uptake of humane stunning or stun/killing in wild-capture fisheries identified by stakeholders working within the fish supply chain.
(Based on feasibility analysis)

Supply chain area	Barrier
Fisheries	• Attitudes towards fish sentience and welfare. • Fish already dead or near death when landed due to capture technique. • Not all stunning methods are compatible with all fishing gears or suitable for all species: challenging in mixed-species fisheries. • Capital and running costs of humane stunning technology. • Lack of evidence for a good return on investment. • Humane stunning not a top priority: an array of other economic, socioeconomic, regulatory and legislative issues takes higher priority.
Processing & retail	• Lack of demand for humanely stunned wild-caught fish. • Ability of processors and retailers to influence fisheries. Supply chains are often fragmented, and fish is sold to a wide variety of buyers, not all of whom want/demand humanely stunned fish. • No evidence that consumers will pay a premium for humanely stunned wild-caught fish. • Pioneers of humane stunning may be able to charge a premium: once it becomes standard practice or set in legislation the premium will likely dissipate. • Assurance schemes are difficult to audit on board vessels. • Difficult to sell 'humane stunning' to consumers. • Retailers want consistent messaging to consumers about humane stunning for all fish species. Potential negative consequences for promoting stunning in some fisheries but not others, where it might be less feasible. • Whilst some retailers recognise it is ethical to sell humanely stunned fish, they are hindered by a lack of understanding about humane stunning in the market.
Legislation	• General lack of legislation, guidelines and recommendations on a global scale to support humane killing of wild-caught fish.
Research & development	• Lack of multi-disciplinary approach to move humane stunning in commercial wild-capture fisheries forward. • Logistics and cost of on-board scientific testing of humane stunning equipment – lack of funding for feasibility studies.

Scientific knowledge gaps and future research needs

A number of knowledge gaps still exist, and further research is needed to provide all stakeholders with the information they need to move towards humane stunning, particularly regarding tailoring methods for specific species.

The following is a list of knowledge gaps and recommendations for further research:

- **Humane stunning parameters need to be determined for a wider range of finfish species and stunning methods.** Humane stunning parameters for specific stunning methods have only been scientifically researched for a small minority (approximately 2 %) of the >1,500 categories of wild finfish (species or groups of mixed species) caught for food and/or feed worldwide (FAO 2020).

- **To ensure welfare standards are being met, species-specific protocols to accurately assess state of consciousness on application of the stunning method need to be developed for a wider range of species.** Although more use of electroencephalogram (EEG) to accurately verify loss of consciousness on-application of the intended stunning method is recommended as the 'gold standard', more research is needed to correlate species-specific behavioural/visual indicators of consciousness to brain activity. These species-specific behavioural/visual indicators can be used to evaluate humane stunning in commercial practice where it is often difficult to obtain EEG.

- **Commercial feasibility trials for new and existing technologies/methods are needed.** To better understand the practicality of implementing humane stunning methods in wild-capture settings and any additional benefits to fishers, such as cost savings and improved crew safety.

- **Development of humane stunning technology that can be used on-board boats to stun large volumes of fish of non-uniform maturity/size, and that minimises handling and exposure of fish to air prior to stunning.** Continuous flow in water stunning technology is commercially available and used in the aquaculture sector but the technology has not yet been transferred to wild-capture settings, and stunning parameters remain to be determined for a wide range of wild-caught species.

- **The impact of stunning method on flesh quality needs to be further researched.** In many (but not all) scenarios humane stunning needs to either improve or be of no detriment to product quality to encourage commercial uptake.

- **To date, there has been no scientific verification of stunning methods in commercial wild-capture settings.** This is required to ensure that fish welfare and product quality standards are being met.

- **Research is needed to better understand how human behaviour in the fish supply chain influences uptake of stunning and demand for humanely stunned fish.** A multi-disciplinary approach to research, for example combining human behavioural theory with applied animal welfare, may improve understanding and help develop more effective strategies for change (Turnbull 2022).

Recommendations to encourage uptake of humane stunning or stun/killing in wild capture fisheries

To increase awareness, uptake and demand for humane stunning or stun/killing of wild-caught fish, **stakeholders across the fish supply chain need to work together to co-create solutions to barriers and address knowledge gaps.**

Stakeholders include:

- Wild-capture fisheries and experts from the aquaculture sector where humane stunning for some species in some countries is routine practice
- Academics with expertise in social, natural and physical sciences
- Wild-caught fish distributors, processors and retailers
- Humane stunning technology manufacturers
- Vessel builders
- Consumers
- Animal welfare NGOs
- Assurance scheme providers
- Policymakers

Recommendations for improving fish welfare at slaughter

The following six-stage roadmap is designed for stakeholders to engage with and build upon, to co-develop specific objectives and actions to achieve the aim of improving wild-caught fish welfare at slaughter through humane stunning or stun/killing:

1 Raise awareness

- Explore and implement ways of raising public awareness of fish sentience and welfare needs within wild-capture fisheries with the aim of increasing demand for better welfare.
- Raise awareness about humane stunning within the fishing, processing and retail sector to improve understanding in the market.
- Raise policymaker and research funder awareness to gain support for fish welfare and humane stunning.

2 Incentivise engagement

- Explore the feasibility of adding value to product through labelling or assurance schemes.
- Gather and disseminate evidence about the benefits and feasibility of humane stunning to actors in the supply chain (e.g. improved product quality, cost savings), to drive uptake and demand.

3 Facilitate uptake

- Conduct further research and innovation to provide the fishing community with the technology and species-specific stunning parameters they require.
- Research into gentler capture techniques to ensure that fish are landed alive before being intentionally slaughtered.
- Deliver advice and training to fishers about technology/methods that are suitable for their needs.

4 Support uptake

- Support from stunning equipment manufacturers to encourage uptake of their technology at a price point that is feasible to a range of business sizes. For example, the ability to rent rather than buy technology outright.

5 Enable change

Actions that provide the fishing industry with a way to maintain long term, beneficial change.

- Facilitate shared learning and peer-to-peer support.
- Support from processor and retailers for humanely stunned or stun/killed fish.

6 Drive change

The final stage of the roadmap takes the assumption that the previous stages have been met and have provided the fishing community with the level of support and incentive needed for voluntary uptake. Stage six focuses on driving action beyond voluntary uptake and integrating humane stunning or stun/killing into policy and legislation.

Conclusion

We believe that the recommendations outlined here are worthwhile and important steps towards improving the welfare of wild-caught fish during slaughter, as well as providing potential benefits to industry and the consumer through improved product quality and cost savings.

Although there is growing interest from stakeholders in new or adapted stunning technology, and implementation is likely in the near future, demand will ultimately decide which species stunning parameters are determined for and ultimately how many fish will be humanely stunned. Scientific knowledge gaps and future research also need to be prioritised to enable humane stunning or stun/killing to move forward in commercial wild-capture fisheries.

> **As it is now scientifically accepted that fishes have the capacity to suffer and experience pain, we hope that stakeholders involved at all stages of the wild-caught fish supply chain adapt their practices in line with recommendations to make meaningful improvements to the vast number of fish captured every year.**

Appendix

Methodology

Funded by the Humane Slaughter Association (HSA), researchers at Harper Adams University conducted a two-year study to investigate the feasibility of routine uptake of humane stunning or stun/killing in wild capture fisheries. Knowledge gaps and research needs were identified, along with technological, social, economic and behavioural barriers to uptake.

A multi-method approach was used, including:

A desk-based estimate of number of wild-caught fish

Using estimated mean weights (EMWs) for wild-caught finfish species and the Food and Agriculture Organisation of the United Nations (FAO) fisheries capture production tonnages, the number of wild-caught finfishes caught annually between 2000-2019 was estimated.

Systematic mapping

Systematic mapping of the existing scientific research underpinning humane stunning, or stun/killing of finfish was undertaken, identifying multiple knowledge gaps in the scientific evidence base. Systematic mapping is a globally recognised reviewing methodology (James et al 2016; CEE 2022) which follows rigorous, objective and transparent processes that, unlike traditional literature reviews, aim to reduce reviewer selection bias and publication bias.

Feasibility analysis

A feasibility analysis was carried out in consultation with stakeholders in the fish supply chain, including fishers, stunning technology manufacturers, fish processors, supermarket retailers and scientists, highlighting additional barriers to uptake of humane stunning in wild-capture fisheries (Table 3).

Free access to the full scientific paper: The peer reviewed scientific paper has been published in the open access journal *Animal Welfare*: James et al (2025) Humane stunning or stun/killing in the slaughter of wild-caught finfish: The scientific evidence base. Animal Welfare. https://doi.org/10.1017/awf.2023.30

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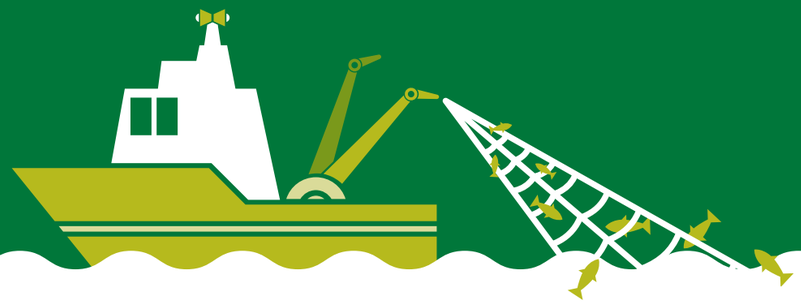

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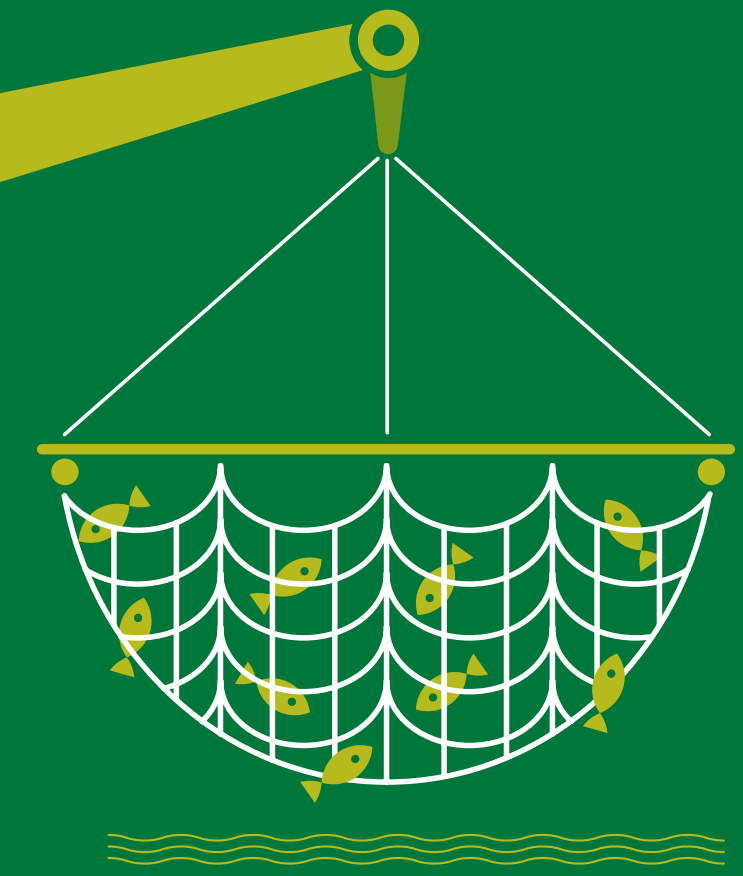

“This opportunity to make perhaps the largest improvement to animal welfare in the 21st century is one that should be seized by all those involved.”

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