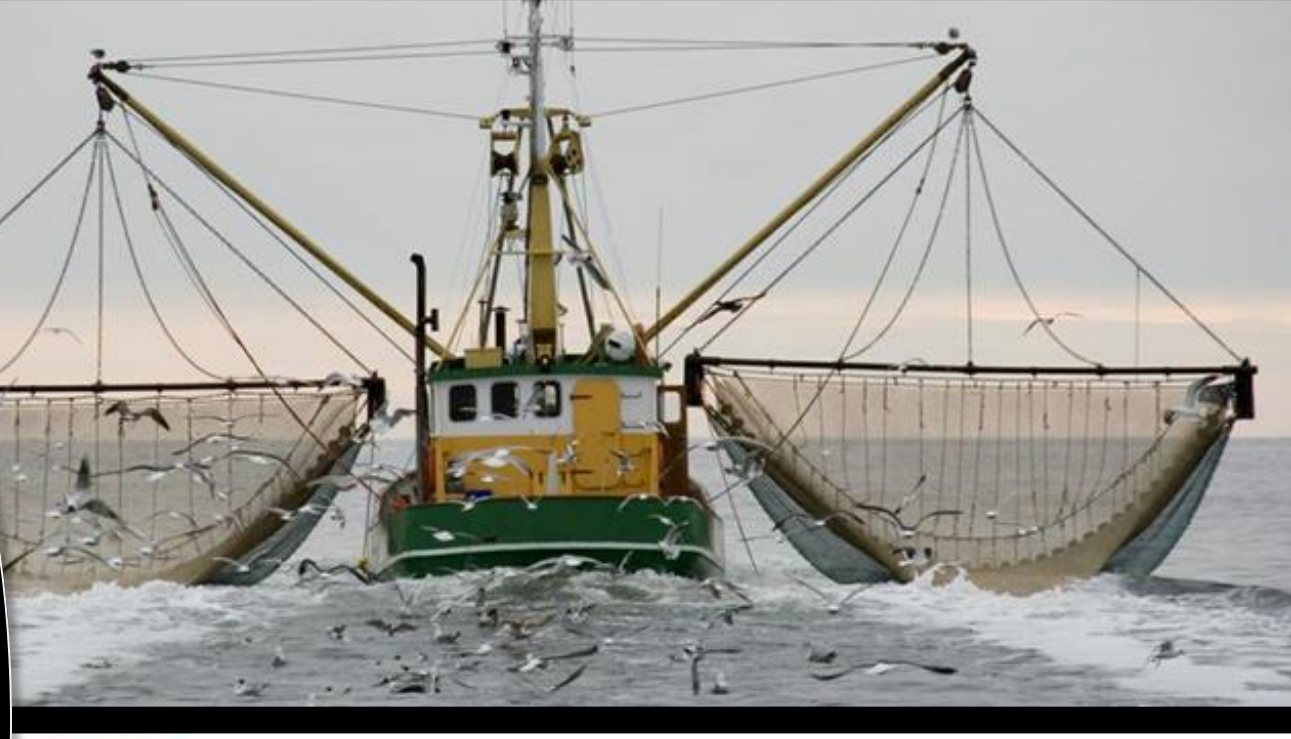
# What is the potential for more humane stunning methods for wild caught fish? :

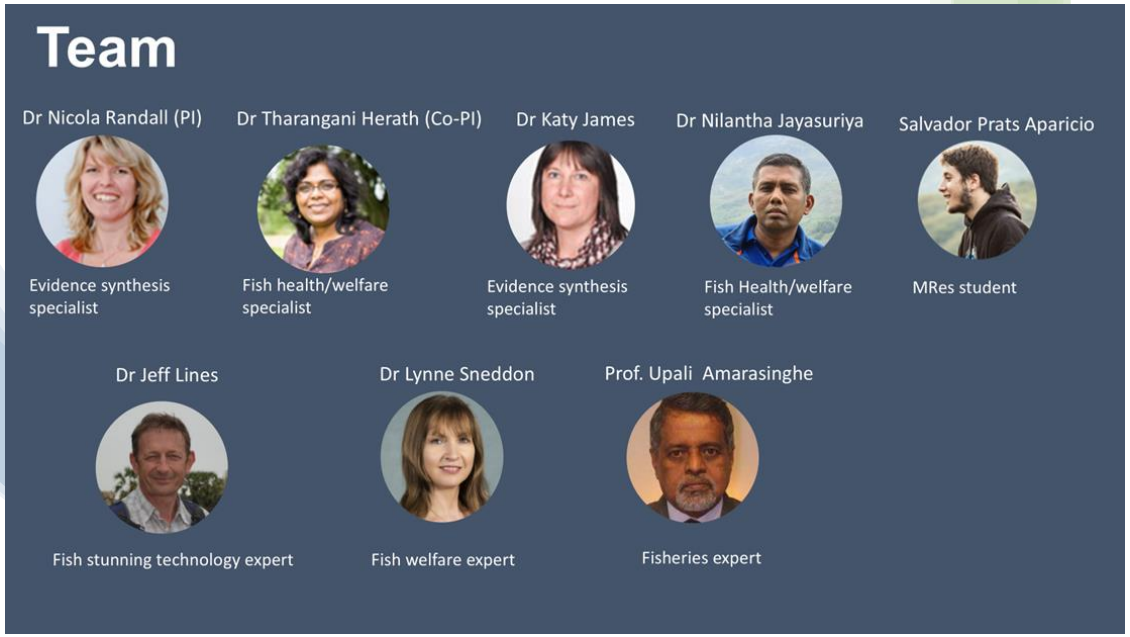


Harper Adams University

Centre for Evidence-Based Agriculture

ne Slaughter Associatio

# The problem




- **Each year > a trillion wild-finfish slaughtered for food and animal feed worldwide.***

- To date, attention 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 little attention.

*calculated using FAO production tonnage statistics together with estimated mean weights for fish species (calculated by Alison Mood, http://fishcount.org.uk/) .

# Does it matter?

- Research indicates that fish are sentient capable of experiencing pain and suffering (Braithwaite 2010; Broom 2014 & 2016; Sneddon et al 2020). In the UK the Sentience Act enshrines this in law.

- Most commercially-caught wild fish that are landed alive, die by:

  - suffocation in air or ice water/slurry, or

  - during processing where fish are bled, gutted or decapitated alive (Robb & Kestin, 2002).

- Fish often remain conscious, able to experience pain and distress, for a considerable time.

- Seemed inhumane for **farmed fish** by the European Food Safety Authority (EFSA) & World Organisation for Animal Health

# Objectives

**1. Overview of the worldwide commercial wild-capture fishing industry**

**2. Map the evidence relating to humane stunning of wild caught fish**

**3. Feasibility analysis**

Which fishing system/geographical area/species etc are most amenable to routine uptake of stunning

# 1. Overview of worldwide wild-capture fishing industry


Tonnage of each species captured & geographical distribution of capture:
**FAO FishstatJ v.2020 1.0 Capture production statistics**

Capture production – number of individuals:

$$\frac{\text{Species tonnage}}{\text{Species weight}} = \text{Number of individuals}$$

fishcount.org.uk
towards more humane commercial fishing

Literature, presentations, online resources:

- Fishing gears
- Killing methods
- Where humane stunning is being implemented
- Reasons for lack of uptake

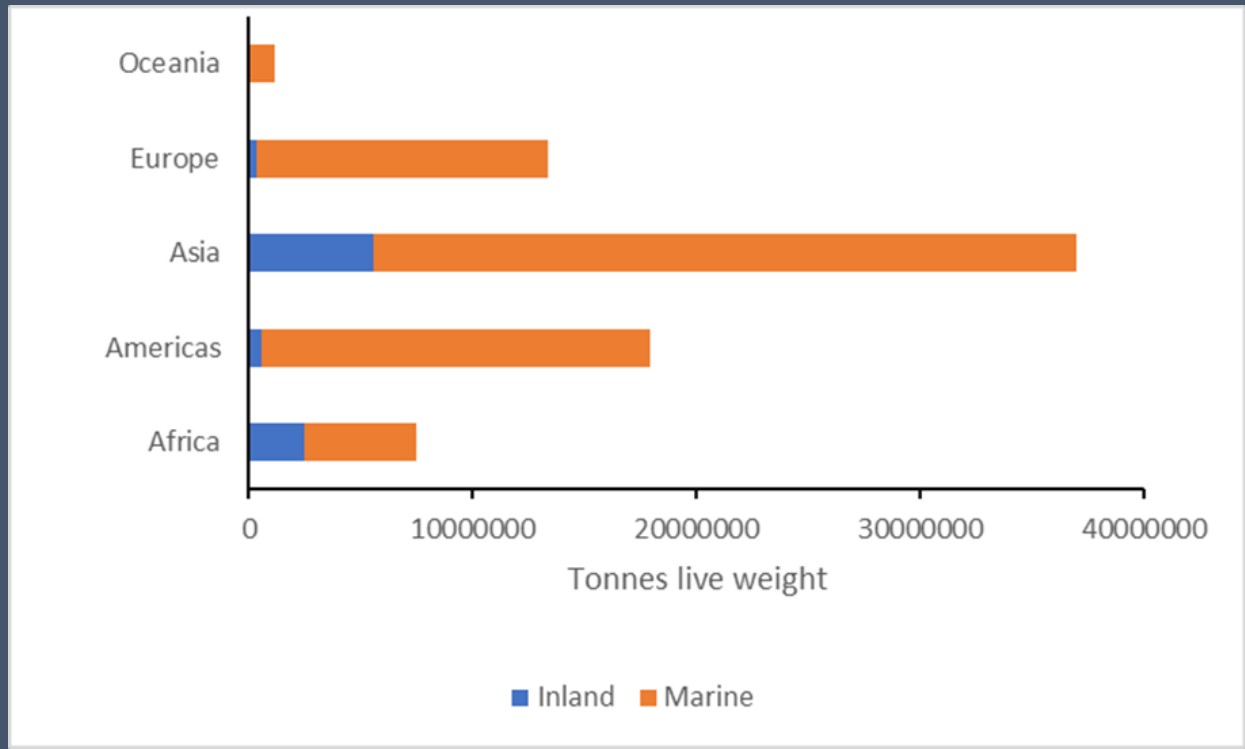
# Scope

- Wild finfish
  - marine, freshwater, brackish
- Commercial wild-capture
- Fish for human and non-human consumption
- Global
- Humane stunning/killing methods defined by the OIE and EFSA:
  - Electrical stunning
  - Percussive stunning
  - Spiking & coring
  - Free bullet

# Global capture production

- Worldwide capture production (1998-2018) averaged **77,020,863** tonnes per year
- Equates to an estimated **0.9 to 2.5 trillion** individuals captured per year

- Most are **Marine** capture
- **Asia** is the biggest producer



# Top 15 finfish captured globally

Species/mixed species ranked by number of individuals

| Rank | Lower millions | Number millions | Upper millions | Number millions |
|---|---|---|---|---|
| 1 | Peruvian anchovy | 228,609 | Peruvian anchovy | 662,967 |
| 2 | Japanese anchovy | 64,402 | Sardinellas nei | 141,333 |
| 3 | Sandeels nei | 44,181 | Stolephorus anchovies nei | 96,085 |
| 4 | European sprat | 36,020 | Anchovies nei | 82,343 |
| 5 | Black and Caspian Sea sprat | 22,855 | Japanese anchovy | 70,842 |
| 6 | Capelin | 15,246 | European anchovy | 66,943 |
| 7 | Araucanian herring | 14,788 | Capelin | 44,947 |
| 8 | European anchovy | 14,305 | Sandeels nei | 44,181 |
| 9 | Stolephorus anchovies nei | 13,249 | Bombay-duck | 43,017 |
| 10 | Silver cyprinid | 11,053 | Largehead haretail | 40,288 |
| 11 | European pilchard | 8,860 | Jack and horse mackerels | 39,329 |
| 12 | Pacific anchoveta | 5,897 | European sprat | 36,020 |
| 13 | Southern African anchovy | 5,764 | Black and Caspian Sea sprat | 31,703 |

- **Small pelagic species – heavily traded, widespread markets and complex network of producers and markets**
- **Mackerel, herring and sardine - human consumption**
- **Smaller fish species – typically fishmeal or fish oil**

**Majority of wild-fish killed inhumanely**

- Yellow fin tuna 6m
- Atlantic salmon 1m
- Anchovy 2-40 cm

Peruvian anchovy and Japanese Anchovy combined numbers of 300-800,000 million individuals captured per annum.

# 2. Systematic map of research into humane stunning of wild caught fish

Systematic mapping **rigorous, objective and transparent** method to collate, catalogue and describe literature relevant to a broad topic.

Collaboration for Environmental Evidence

| ID | FIRST_AUTHO | TITLE | YEAR | REFERENCE | REF_TYPE | TEXT_RE/ | LINK | ENGLISH | INTERVENTIOI | COUNTRY |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Aškinis, S. | Nutritious matter leaching from the rotation fi | 2001 | Aškinis, S., M. | Journal | Abstract | | Abstract o | Alteration of slu | Lithuania |
| 2 | Aškinis, S. | Investigations on phosphorus leaching in crop | 2003 | Aškinis, S. anc | Journal | Abstract | | Abstract o | Alteration of slu | Not clear |
| 3 | Beckwith, C. P. | Nitrate leaching loss following application of or | 1998 | Beckwith, C. F | Journal | Full text | | Yes | Manure type, alt | UK |
| 4 | Bouwer, W. | Relationships between agricultural land use an | 1991 | Mitteilungen | Journal | Abstract | | Abstract o | Not clear | Germany |
| 5 | Cameron, K. C. | Nitrogen leaching losses from different forms | 2004 | Cameron, K. C | Journal | Full text | | Yes | Manure type, alt | New Zeala |

| TIME_OF_YEAR_MEASI | FARM_SYSTEN | SAMPLING_LOCATIOI | SAMPLING_METHOD | FERTILIZER | FLOW_PATH | SOIL_TEXTURE |
|---|---|---|---|---|---|---|
| Not clear | Not clear | Lab | Water drainage/Drain | Organic Fertilizer | Subsurface | Loam |
| Not clear | Arable | Stream/River | Stream Sample | Organic Fertilizer | Groundwater | Silt loam |
| All Year | Arable | Field, Stream/River | Piezometer, Stream Sample | Not clear | Groundwater | |
| All Year | Arable | Field, Stream/River | Piezometer, Stream Sample | Not clear | Groundwater | |
| All Year | Mixed | Field | Piezometer | Not clear | Groundwater | |
| All Year | Mixed | Stream/River | Not clear | Not clear | Not clear | |
| Summer | Arable | Plot | Not clear | Inorganic Fertilizer | Surface | Silt loam |
| Autumn, Winter | Arable | Not clear | Not clear | Not clear | Groundwater | Not clear |
| Not clear | Arable | Plot | Lysimeter | Organic Fertilizer | Subsurface | Sand loam, loa |
| All Year | Dairy | Plot | Generic Collection System, Piezometer | Not clear | Subsurface, Surface | Silt clay loam |
| All Year | Not clear | Lysimeter | Lysimeter | Inorganic Fertilizer | Subsurface | Sand loam |
| Not clear | Dairy | Lab | Slurry Sample | Organic Fertilizer | | |
| All Year | Arable | Plot | Generic Collection System | Not clear | Surface | Silt loess |
| Autumn, Spring, Winter | Arable | Field | Soil core + leaching estimate | Not clear | Not clear | Loam, Loam cl |
| Not clear | Mixed | Stream/River | Not clear | Inorganic Fertilizer, Org | Not clear | Not clear |
| Summer | Arable | Plot | Not clear | Not clear | Surface | Karst geology |
| All Year | Not clear | Plot | Generic Collection System | Organic Fertilizer | Surface | Clay loam |
| Summer | Not clear | Plot | Generic Collection System | Inorganic Fertilizer | Surface | Silt loam |
| All Year | Arable | Plot | Monitoring well | Not clear | Groundwater | Silt loam |
| Summer | Arable | Plot | Generic Collection System | Not clear | Surface | Silt loam |
| All Year | Not clear | Plot, Stream/River | Monitoring well, Stream Sample | Not clear | Not clear | Loam |
| Not clear | Horticulture | Plot | Generic Collection System, Lysimeter | Not clear | Subsurface, Surface | Silt loam |
| Spring, Winter | Arable | Field | Not clear | Inorganic Fertilizer | Not clear | Clay loam |
| All Year | Arable | Plot | Water drainage/Drain | Not clear | Subsurface | Sand, Clay |
| All Year | Arable | Plot | Water drainage/Drain | Organic Fertilizer | Not clear | Sand loam |
| Summer, Winter | Not clear | Lysimeter | Water drainage/Drain | Not clear | Subsurface | Sand |
| Not clear | Not clear | Plot | Piezometer, Soil core-different depths | Not clear | Groundwater | Sand |

# Systematic map cont.

**Aim:** To systematically map primary research literature relevant to humane stunning of wild-caught fish

- Stunning methods & parameters tested for each species
- Fish welfare outcomes reported
- Impact of stunning on flesh quality
- Evidence for on-board stunning
- Cost-benefit analysis

# Trends and Knowledge gaps for future research

Key humane stunning parameters only **scientifically tested for a small minority** of commercially caught wild species & stunning methods

A few **Species-specific protocols** to accurately assess **state of consciousness** when evaluating stunning methods

Humane stunning relevant to wild-caught finfish mainly carried out on **farmed fish under controlled laboratory conditions**

**Knowledge and technology transfer from aquaculture** to aid development of humane stunning in wild-capture fisheries

Scientific verification of methods on-board commercial fishing vessels required to **ensure welfare & product quality standards are met**

Further research to show other **benefits** for **fishermen** e.g. labour savings, improved health and safety

# Humane stunning examples & barriers
# Percussive stunning

Scottish Wild Salmon Company
Usan - Montrose

**Scottish Wild Salmon Company -** Scottish bag net caught Atlantic salmon

**Wild Salmon Direct (Alaska)**
- Automated percussive
- Sockeye & Coho

**Manual Percussive stunning**
- Labour-intensive
- Most suited to small fisheries catching limited numbers
- Care needed not to damage appearance (eg eye injuries such as haemorrhaging) which could impact price (eg Lyu et al 2015).
- Anecdotal evidence suggests there could be long term physical effects for fishermen

**Automated percussive stunning**
- Machine needs re-calibrating for fish of different sizes
- So less practical in wild-capture fisheries where fish size varies.
- Fish need orientating head first into the stunner, in single file
- By-catch needs separating

# Humane stunning examples & issues
# Electrical stunning

**Blue North (Alaska)**
- Semi-dry electrical stunners
- Pacific cod
- Marketed as humanely killed

**Ekofish (Netherlands)**
- Dry electrical stunners
- Plaice, lemon sole, turbot and brill
- Marketed as humanely killed

**Dry stunning**
- Fish need orientating
- Only suits head first into the stunner, single file & fish of similar size
- By-catch needs separating and debris that could damage the stunner or cause mis-stunning (metal debris) removing
- Capital investment and cost to retrofit existing vessels

Not suited to all types of fishery, especially those capturing large volumes of fish, of different sizes, in short space of time

ACE AQUATEC

Investigating the feasibility of using electrical stunning on-board fishing vessels


# So a solution is not straightforward

- No humane stunning or stun/killing method suitable for all finfish species
  - over 30,000 species of fish which vary widely in anatomy, physiology & ecology
  - Highest numbers of fish are species of lowest value

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

# 3. Feasibility analysis

**Aim**

Which fishing system/geographical area/species etc are most amenable to routine uptake of stunning.

Aimed to ID:

- where the need for stunning greatest (i.e. animal numbers and suffering greatest)
- Identify where uptake most likely e.g. availability of technology, known stunning parameters etc
- Consider impact of use of a stunning method on sustainability

# Barriers to more humane methods

| Supply chain | Barrier |
|---|---|
| **Fisheries** | Attitudes towards fish sentience and welfare |
| | Fish already dead or near death when landed due to capture technique |
| | Not all stunning methods compatible with all fishing gear or suitable for all species: |
| | Capital and running costs of humane stunning technology |
| | Lack of evidence for a good return on investment |
| | Other economic, socioeconomic, regulatory and legislative issues take higher priority |
| **Processing & Retail** | Lack of demand for humanely stunned wild-caught fish |
| | Supply chains often fragmented, and not all buyers want/demand humanely stunned fish |
| | No evidence that consumers will pay a premium for humanely stunned wild-caught fish |
| | Once humane stunning becomes standard practice/legislated, premium may dissipate |
| | Assurance schemes difficult to audit on board vessels |
| | Difficult to sell 'humane stunning' to consumers |
| | Retailers want consistent messaging to consumers for all fish species. |
| | Some retailers recognise ethics but are hindered by a lack of understanding in the market |
| **Legislation** | General lack of global legislation, guidelines and recommendations |
| **Research & development** | Lack of multi-disciplinary approach in commercial wild-capture fisheries |
| | Logistics and cost of on-board scientific testing of equipment – lack of funding |

# Present vs future

## Present

Dry electrical stunning feasible for some species & fisheries.
Challenges: separation of by-catch & removal of debris causing stunner damage or mis-stuns; not scientifically tested in commercial setting regards welfare

Manual percussive stunning & spiking feasible for some species.
Challenges: Labour intensive; Suited to high value species - returns on labour; Worker competency & fatigue impact efficacy

Automated percussive stunning less feasible in wild-capture fisheries because fish are not uniform size

No one-size fits all stunning method suitable for all species and types of fishery

## Future

Continuous flow in-water electric stunning to stun large volumes of wild-caught fish, of different sizes, in a short space of time. Method suited to pelagic fisheries using e.g. seine nets.
Suitable for small pelagic species where animal numbers and suffering is greatest?

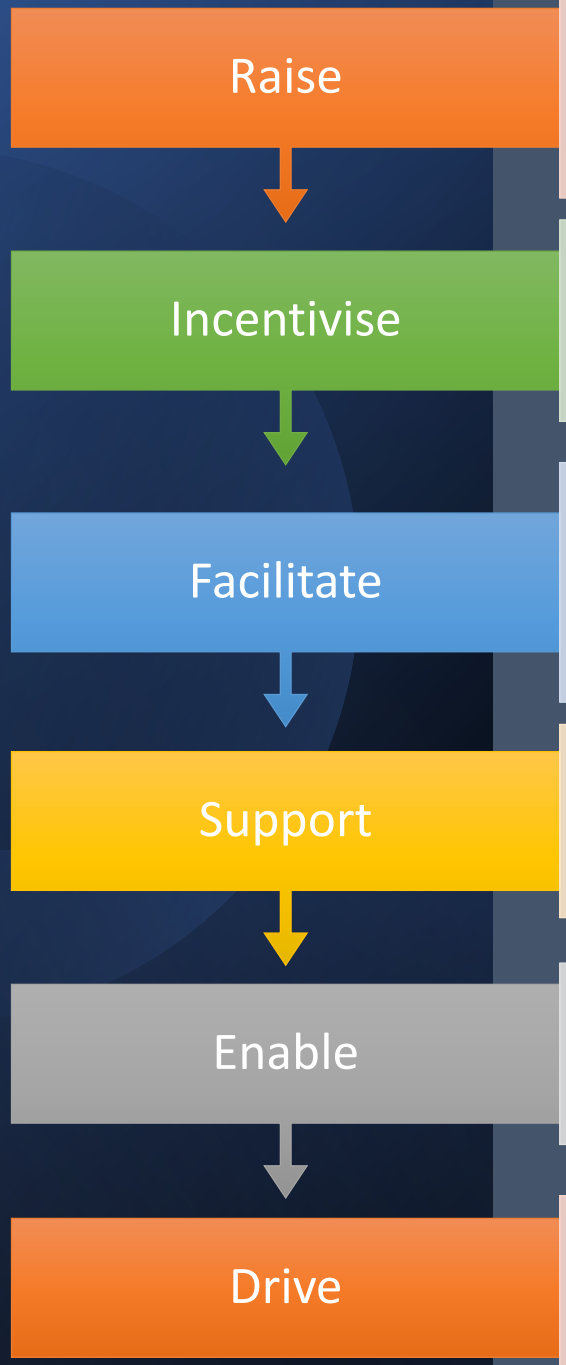
Challenges: Attitudes to fish welfare – fishermen & consumers; Identifying win-win benefits for fish & fishermen; Promoting humane stunning to consumers; Funding for research and feasibility studies; Collaboration between fisheries, research/tech companies and vessel builders

# How can we promote better welfare to the industry?

- Pre-slaughter stress can negatively impact flesh quality e.g. changes in muscular pH in fish (Robb & Kestin 2002).
- **Flesh quality** important where consumers willing to pay a premium. E.g. spiking & coring tuna for sashimi markets (eg Starling and Diver 2005).
- Sometimes product quality isn't a driver. **This is a major barrier!** (56% of finfish captured 2010 estimate to fishmeal/fish oil (Mood & Brooke 2024)
- Possibility to promote other benefits :
  - **cost savings** in terms of labour or time, &
  - improvements in **health and safety** of the crew.

  Anecdotal evidence, suggests that dry electrical stunning facilitates safer and easier catch handling and bleeding of large fish, so improving worker safety .

# Road map to change




**Raise awareness**

- Public awareness of fish sentience & welfare needed to increase demand
- The fishing, processing and retail sector to improve understanding in the market
- Policymaker and research funders to gain support for fish welfare and humane stunning

**Incentivise engagement**

- Gather & disseminate evidence of benefits (eg improved quality, cost savings), to drive supply chain uptake & demand
- Labelling or assurance schemes

**Facilitate uptake**

- Research & innovation to a) provide fishermen with technology & species-specific stunning parameters. b) ensure fish are landed alive before being slaughtered
- Deliver advice and training to fishermen about technology/methods suitable for needs

**Support uptake**

- technology at a price that is feasible to a range of business sizes. E.g.rent rather than buy technology

**Enable long term, beneficial change.**

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

**Drive change**

- Action beyond voluntary uptake and integrating humane stunning or stun/killing into policy and legislation.

# Thank you for listening

Thanks to the Humane Slaughter Association for funding this project.

nrandall@harper-adams.ac.uk