Shrimp welfare at slaughter (*Penaeus vannamei*)

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Decapod welfare UK

Status: This version of this Act contains provisions that are prospective.
Changes to legislation: There are currently no known outstanding effects for the Animal Welfare (Sentience) Act 2022. (See end of Document for details)

Animal Welfare (Sentience) Act 2022

2022 CHAPTER 22

An Act to make provision for an Animal Sentience Committee with functions relating to the effect of government policy on the welfare of animals as sentient beings. [28th April 2022]

BE IT ENACTED by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

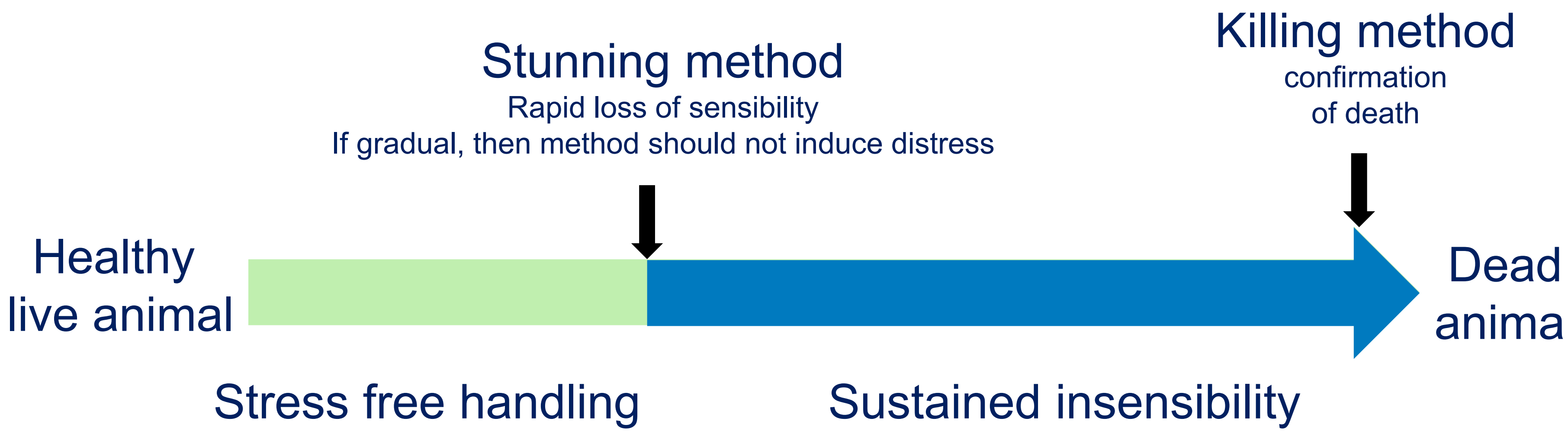
JOHN LEWIS PARTNERSHIP | JOHN LEWIS | WAITROSE

Responsible sourcing of Crustaceans: wild and farmed

Our central recommendation

We recommend that **all cephalopod molluscs and decapod crustaceans** be regarded as sentient animals for the purposes of UK animal welfare law. They should be counted as "animals" for the purposes of the Animal Welfare Act 2006 and included in the scope of any future legislation relating to animal sentience.

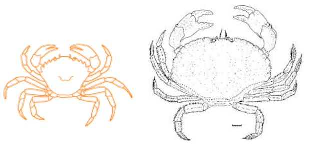
Humane slaughter of farmed animals



Adapted from J Turnbull 2025 FVS meeting

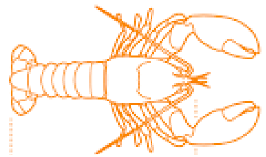
Publications in electrical stunning (ES) in decapods

Reference	Species	Weight (g)	Device	Electrical parameters	Duration of stun cycle (s)	Assessment	Recovery time
Roth and Øines (2010)	*Cancer pagurus*	400-500	Custom	170 V m^{-1} AC + 530 V m^{-1} AC	1 + 120	Responses of eyes, antennules and appendages as Behavioural Score	40 min
Roth and Grimsbø (2016)	*Cancer pagurus*	400-500	Modified STANSTAS	170-530 V m^{-1} AC	1-10	Responses of eyes, antennules and appendages as Behavioural Score	30% of animals recovered after 60 min
Fregin and Bickmeyer (2016)	*Homarus americanus* *Astacus leptodactylus*	400-800 40-50	LAVES and CRUSTASTUN™	20 V DC 110 V AC	0.5 - 10 5 or 10	Neuronal responses and FFT power spectra (FFTPS) in abdominal nerve cord in response to mechanical stimulation of body parts	2-3 h
Weineck et al. (2018)	*Procambarus clarkii* *Callinectes sapidus* *Litopenaeus vannamei*	13-25 140-245 20-30	Custom	120 V AC	10	Behaviour (body movements and antennules) and cardiac activity	5-10 min
Albalat et al. (2022)	*Nephrops norvegicus*	60-70	CRUSTASTUN™	110 V AC	5	Neural responses (CNS, sensory & motor) and body movements	No recovery before 4 h
Neil et al. (2022)	*Cancer pagurus*	400-500	CRUSTASTUN™	110 V AC	10	Neural responses (CNS, sensory & motor) and body movements	No recovery before 4 h
Astanasoff et al. (2022)	*Procambarus clarkii*	40-50	Custom	50 – 300 V DC	3 – 10	Tail reflex	5 min at highest voltage
Kells et al. (2023)	*Jasus edwardsii* *Paranephrops zealandicus*	721-1760 28–61	CRUSTASTUN™	110 V AC	5 - 10	Global neural activity (FFT analysis) and body movements	Not determined (no measures beyond 5 min post-stun)
Present Study	*Carcinus maenas* *Homarus gammarus*	28-40 570-630	CRUSTASTUN™	110 V AC 110 V AC	5 10	Neural responses (CNS, sensory & motor) and cardiac activity	No recovery before 4 h

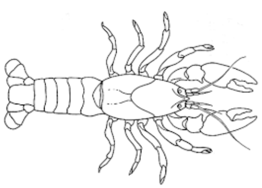


Carcinus maenas
Cancer pagurus

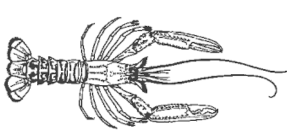
Penaeus vannamei



Homarus sp



Procambarus clarkii



Nephrops norvegicus

10.3389/fanim.2024.1378350/full

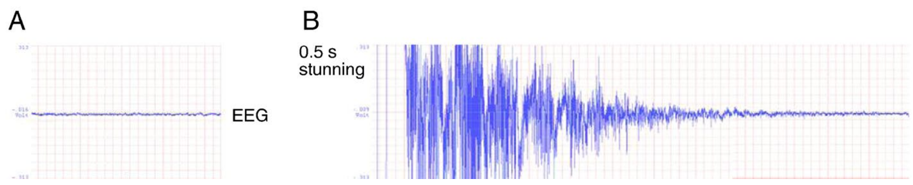
Data approaches to assess effectiveness of stunning

- **Behavioural responses**

- The European Food Safety Authority (EFSA) considers an animal to be insensible if **neurological activity** (EEG) demonstrates one or more of the following:

  - Loss of Evoked Responses (ERs), like VERs for example

  - Generalised tonic-clonic seizures (high EEG fluctuations)



[Lambooij et al (2010) https://doi.org/10.1016/j.aquaculture.2009.12.022](https://doi.org/10.1016/j.aquaculture.2009.12.022)

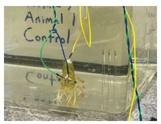
  - Prolonged period of Total Power to values <10% pre-stun

Assessing the impact of different stunning methods

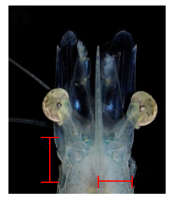
Lab-based: Controlled trials. Working with different species.

Field work: Trials in commercial farms (Honduras, Vietnam, Thailand, India)

Behaviour, neurological recordings

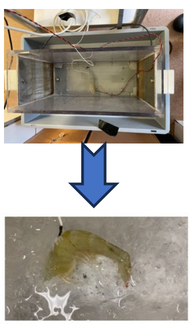


Animals lightly anaesthetised in Eugenol (2 min); before electrode needles are introduced into the animals and animals are left to recover for 10 min



Adapted from Meth et al. (2017)

Electrical stunning



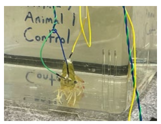
Cold shock

Different temps (5 to -2.5 °C)

Behaviour, welfare, quality

O1 Effectiveness of the stun (electrical or cold-shock)	O2 Welfare mapping	O3 Quality
Behaviour of individual shrimp (stationary cameras) RECOVERY	Scoring of external damage using FAI Farms scoring	Heat exposure: Thermal camera
Behaviour such as tail-flip response to cold-shock in batches of animals	Proxy for stress: L-lactate in haemolymph and muscle pH	Defects/downgrades as noted by processors
	Time taken for animals to be harvested	Shelf life and microbiology: noted by processors

Assessing stunning efficiency in lab conditions: Electrical stunning versus cold shock



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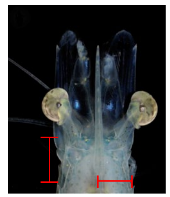

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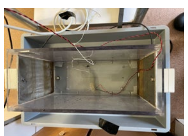
Electrical stunning



Cold shock

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- **Behavioural responses**

- **Neurological responses**

  The European Food Safety Authority (EFSA) considers an animal to be **insensible** if neurological activity (EEG) demonstrates one or more of the following:

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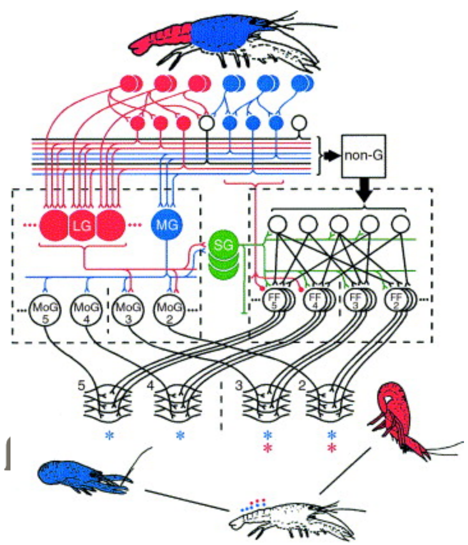
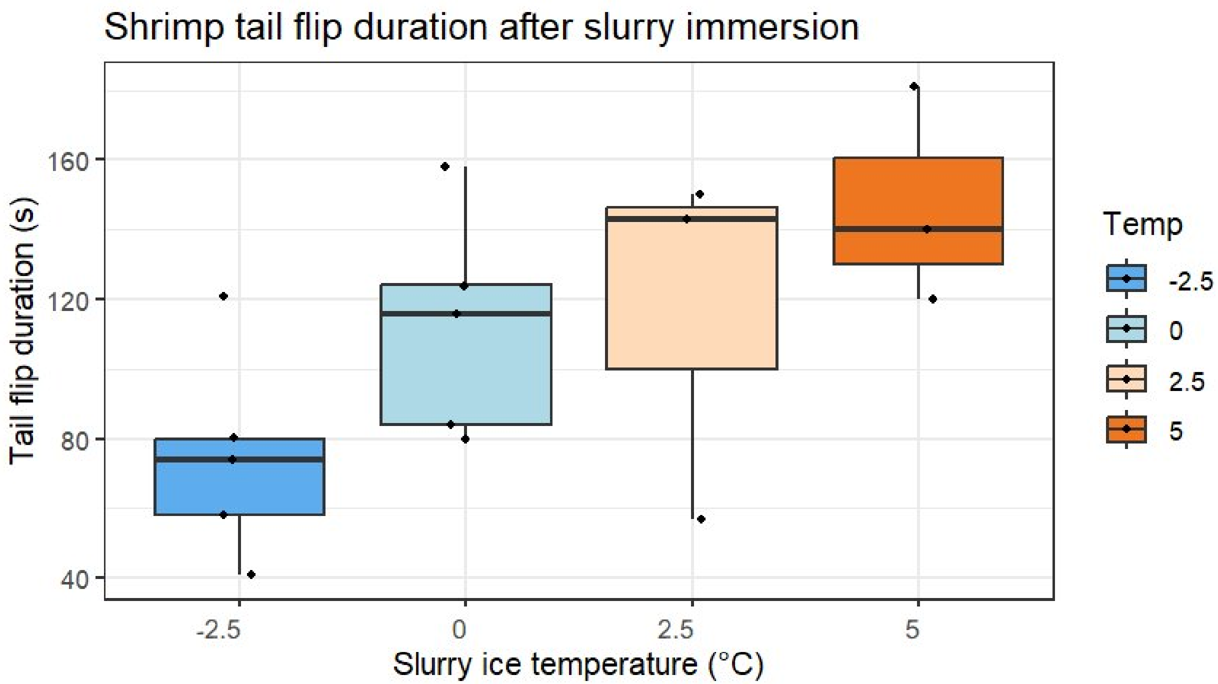
Behavioural response to cold shock: Tail flipping

Animals exposed to a cold shock they consistently display a tail flip followed by some muscle twitching.

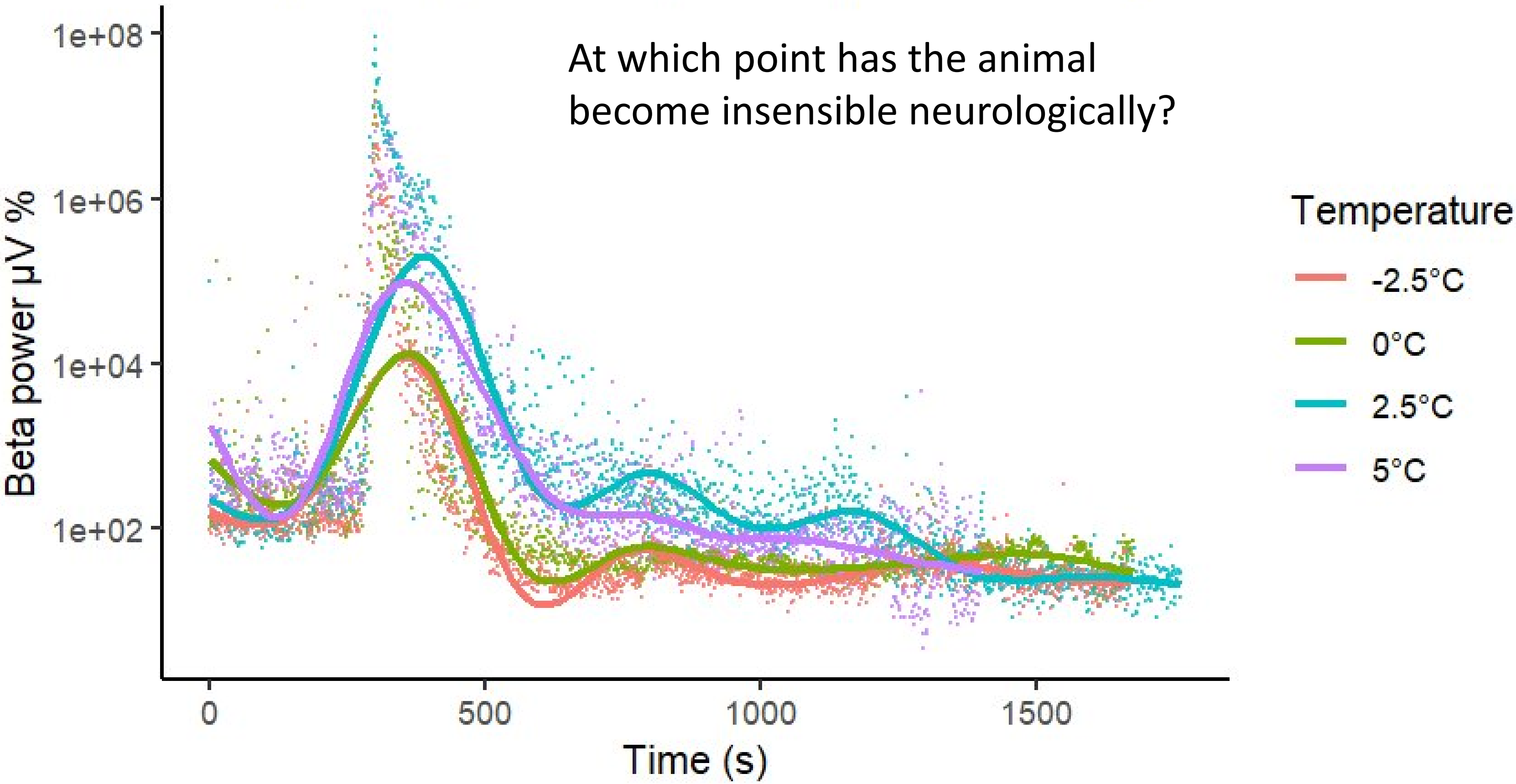
Tail flip is a behavioural arousal/startle response mediated by giant axons.



Tail flip and muscle twitching is temperature dependent

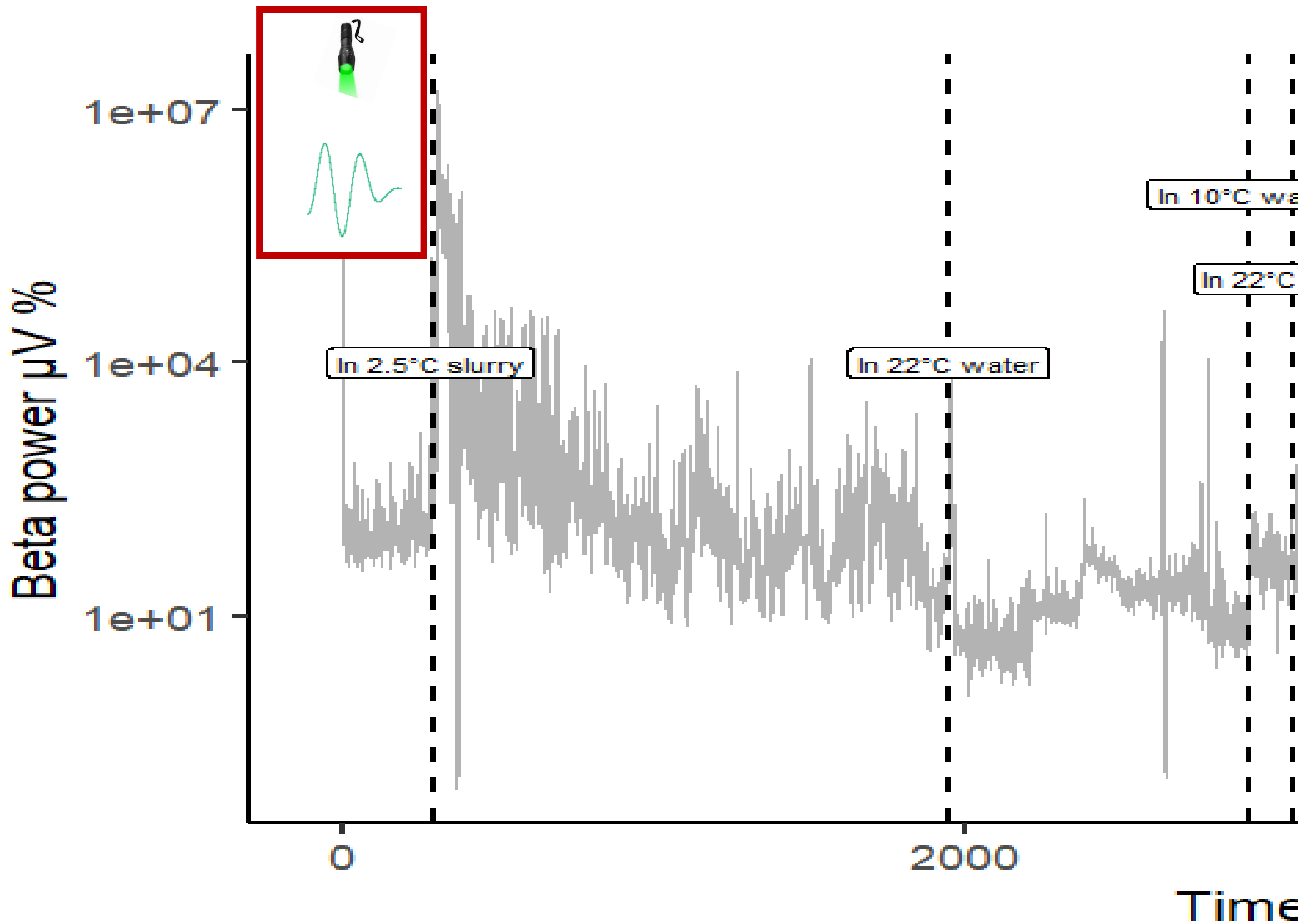


Neurological recordings during cold shock



Total power in the Beta frequency decreases faster at 0 and -2.5°C
Assessing decrease in total power has interpretation issues as it is a continuum.

Visual evoked responses (VERs) during cold shock



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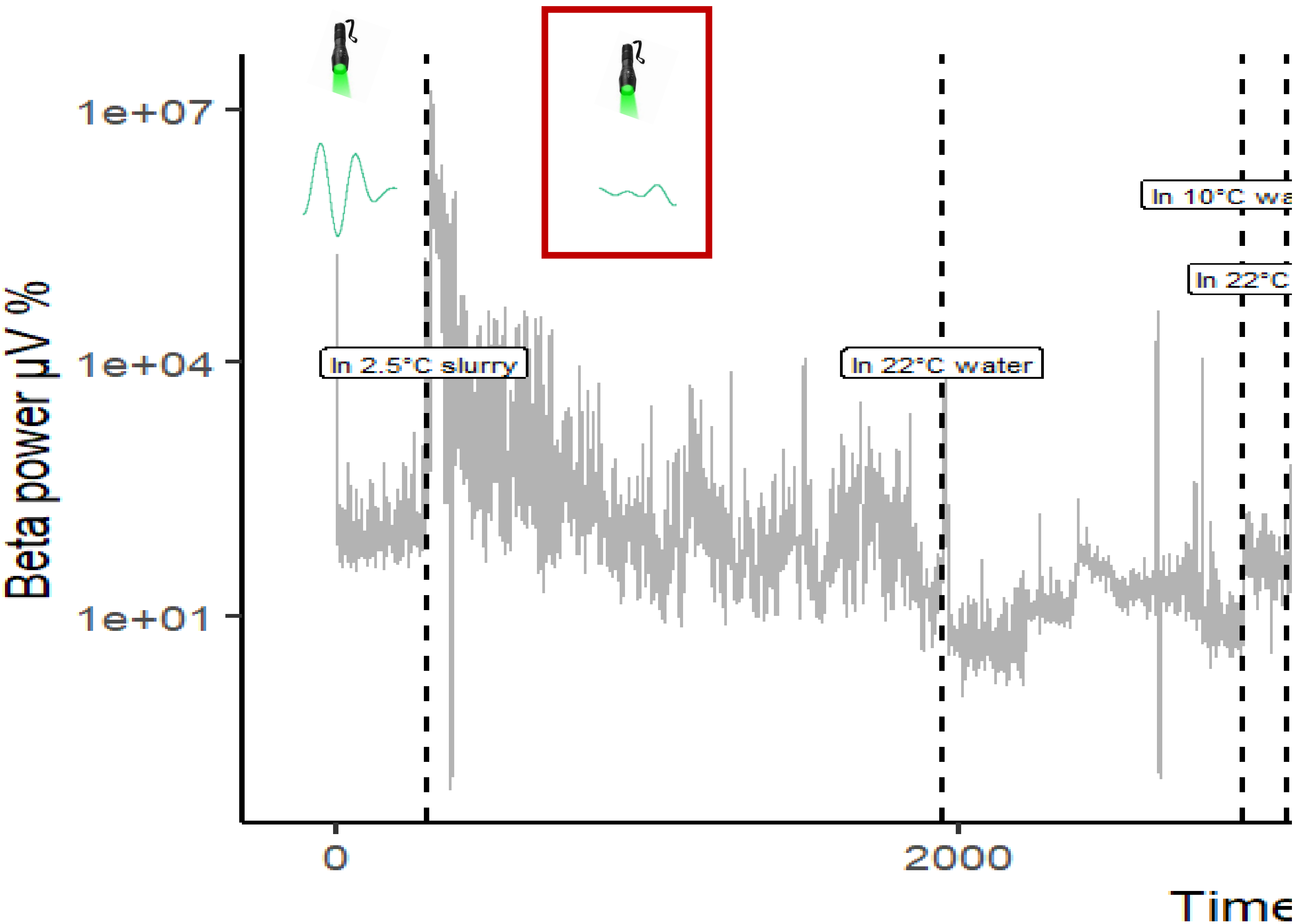

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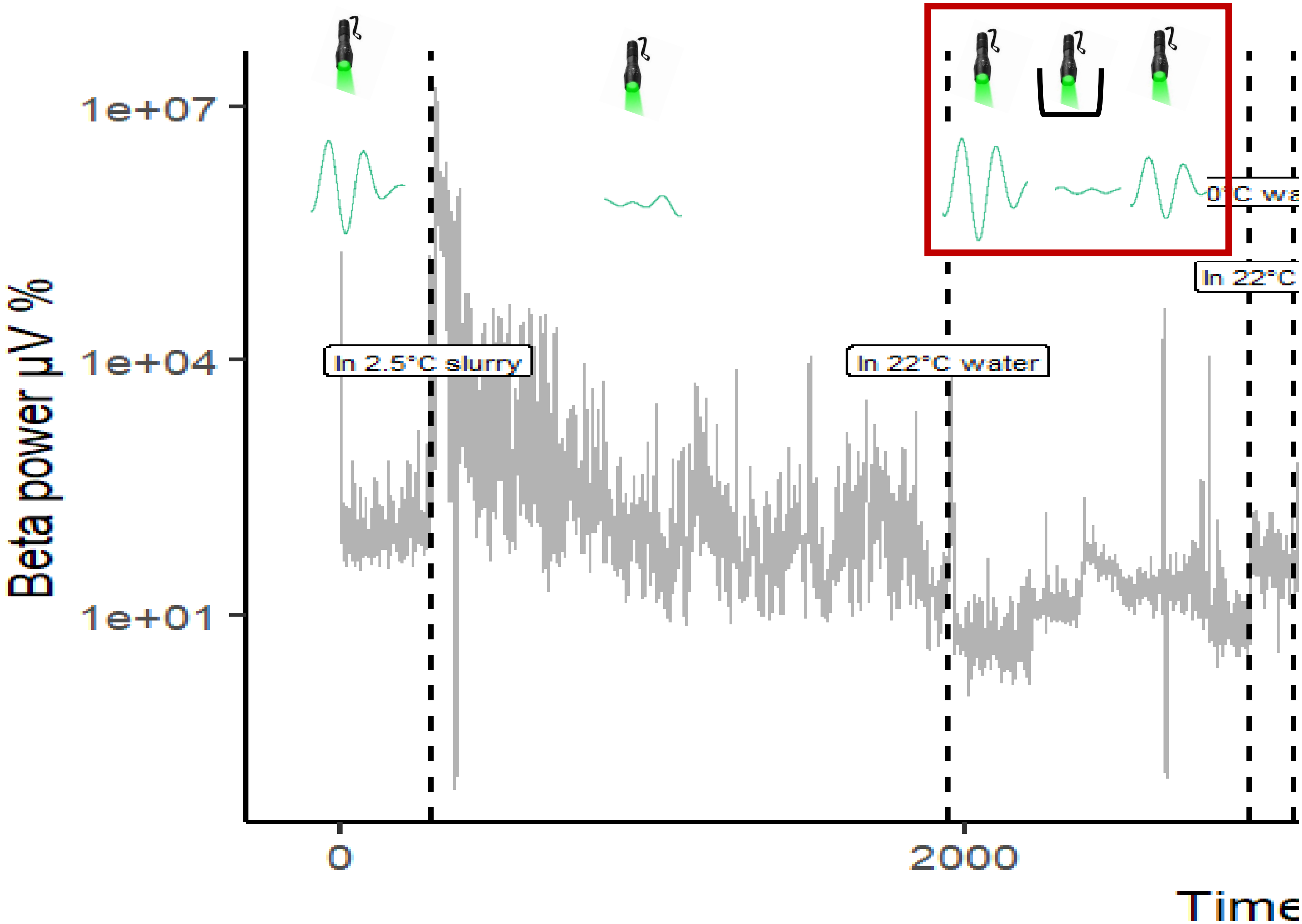
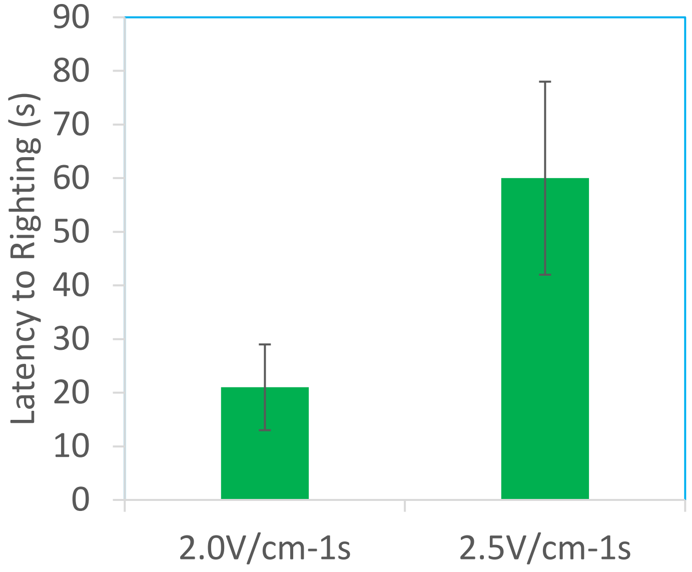


Behavioural response to electrical stunning

#	Code	Description
1	**AA01**	**Laying on side with no or very little activity**
2	AA02	Uncoordinated swimmeret movement
3	AA03	Uncoordinated walking leg movement
4	**AA04**	**Coordinated swimmeret action**
5	AA05	Coordinated walking leg action
6	**AA06**	**Animal regains a righting position**



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6	**AA06**	**Animal regains a righting position**

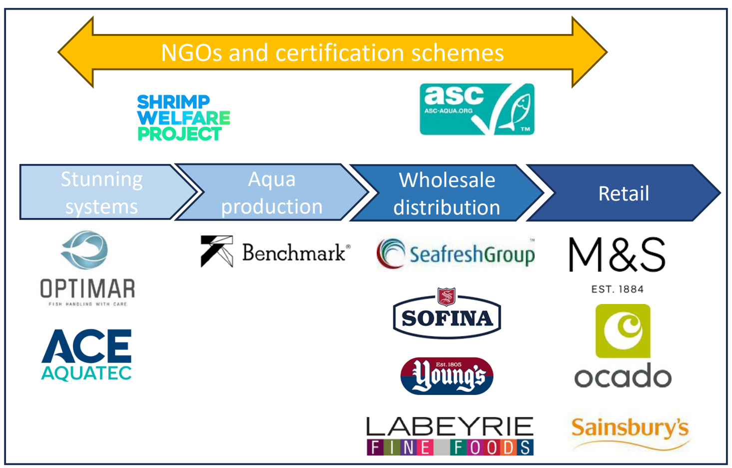
After electrical-stunning animals do not behaviourally respond to the cold shock (no tail flip)

However, the response is not consistent: in many cases animals might appear ‘stunned’ but then they respond to a cold-shock exposure

Currently, analysing neurological data from electrically stunned animals

Assessing the impact of different stunning methods

Field work: Trials in commercial farms (Honduras, Vietnam, Thailand, India)



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Impact of different stunning protocols in farms: Honduras case-study

O1 Effectiveness of the stun (electrical or cold-shock)	**O2 Welfare mapping**	**O3 Quality**
Behaviour of individual shrimp (stationary cameras) **RECOVERY**	Scoring of **external damage** using FAI Farms scoring	Heat exposure: Thermal camera
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Sampling points




Cold shock (ICE)

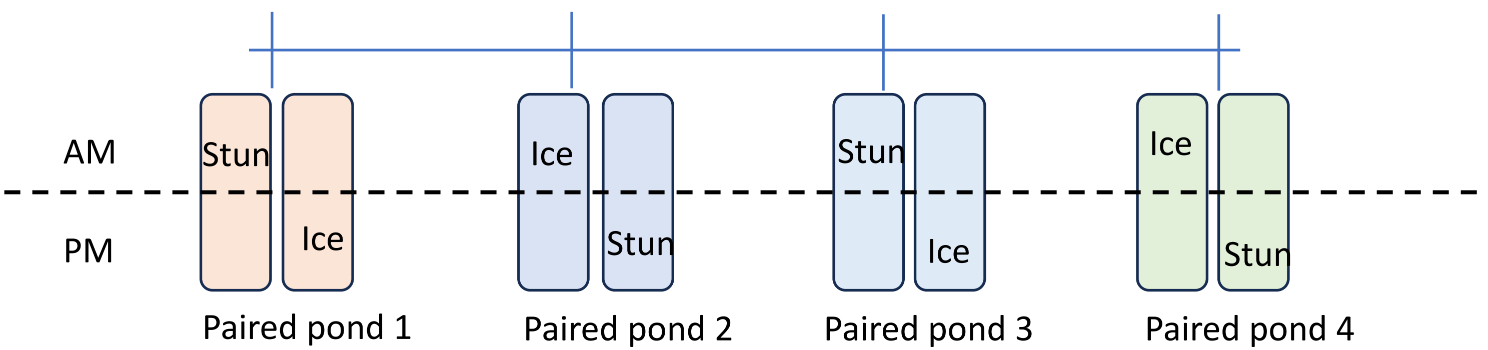
- **Control**
- Before cold-shock dip
- After cold-shock dip
- **30 min ice**

Electrostunning (ES)

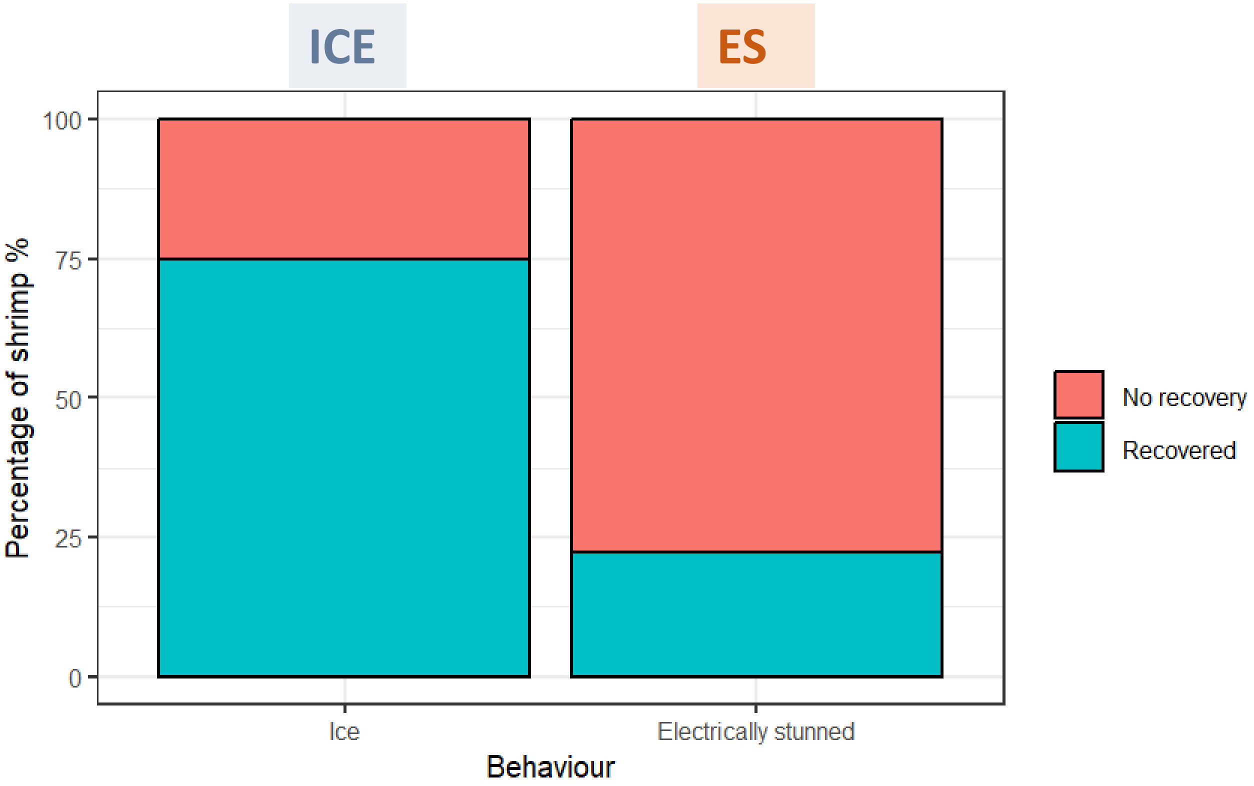
- **Control**
- Before stunner
- After stunner
- After cold-shock dip
- **30 min ice**





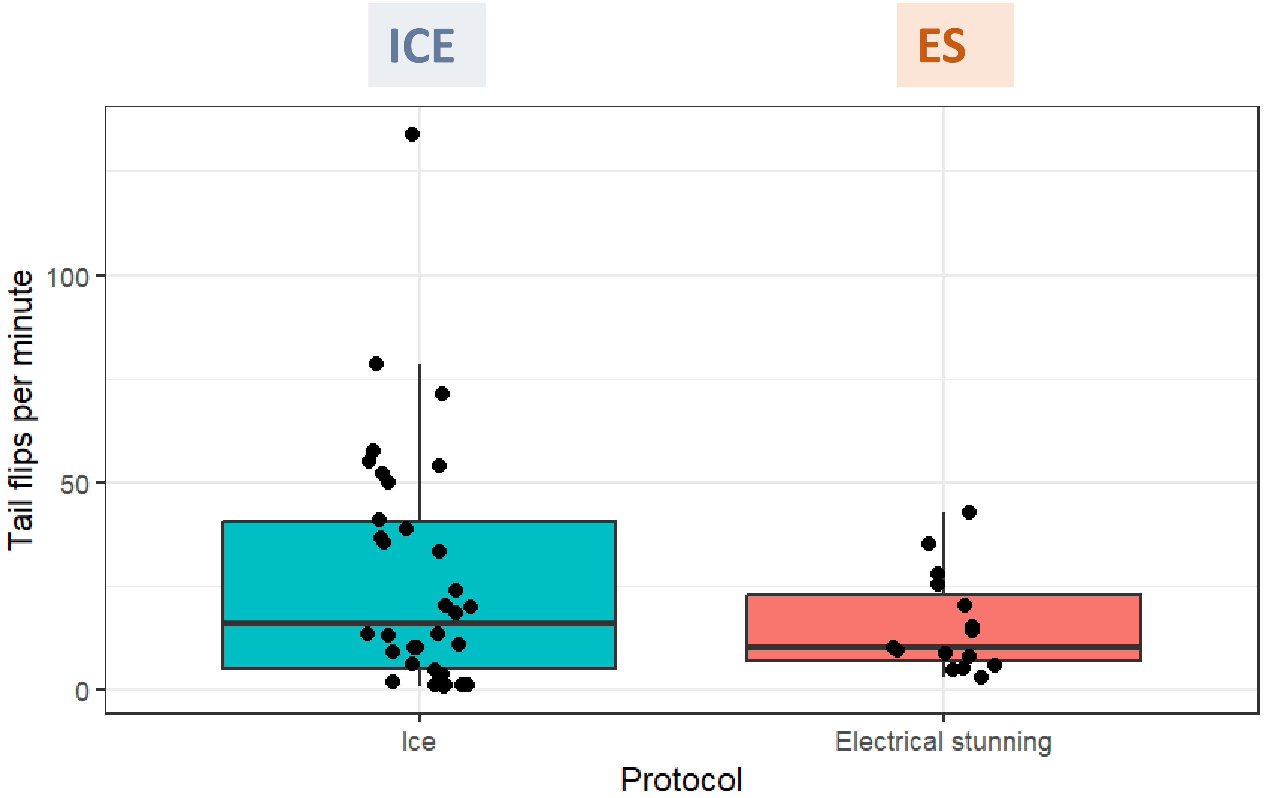


Efficacy of the stun: Recovery after stunning



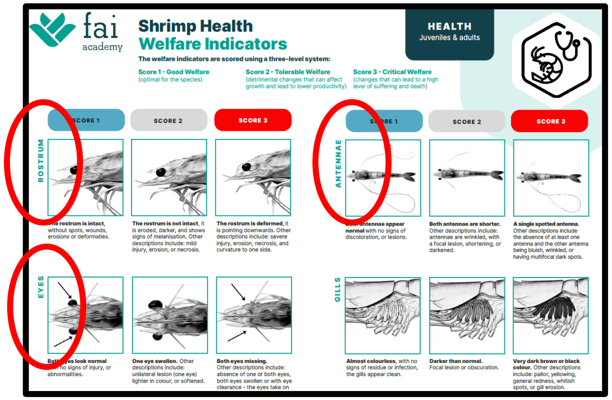
Animals from the ICE protocol: 75% of ice shrimp recovered within 3 min when returned to ambient temp **water in contrast to animals from the ES protocol** from which only 22% recovered within 3 min.

Tail flip response observed in farm trials

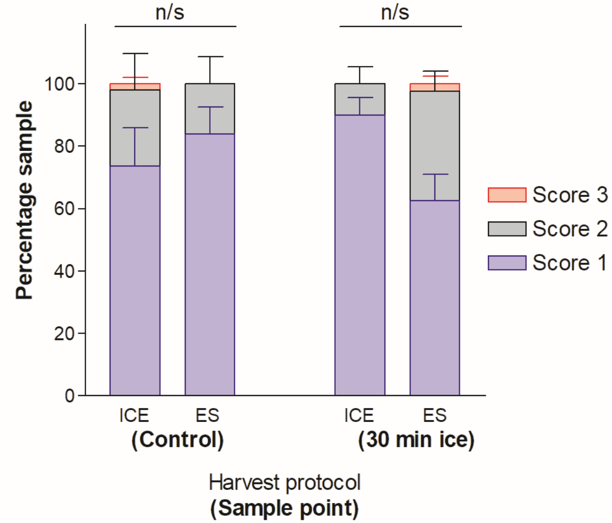


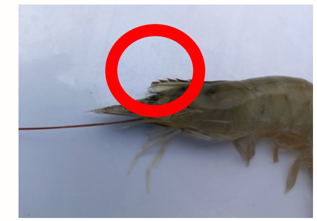
No significant difference in tail flipping frequency between protocols (general linear model; p=0.16)

Scoring of external damage using FAI Farms scoring

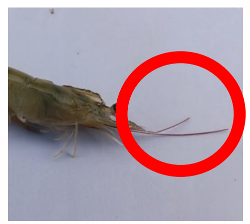


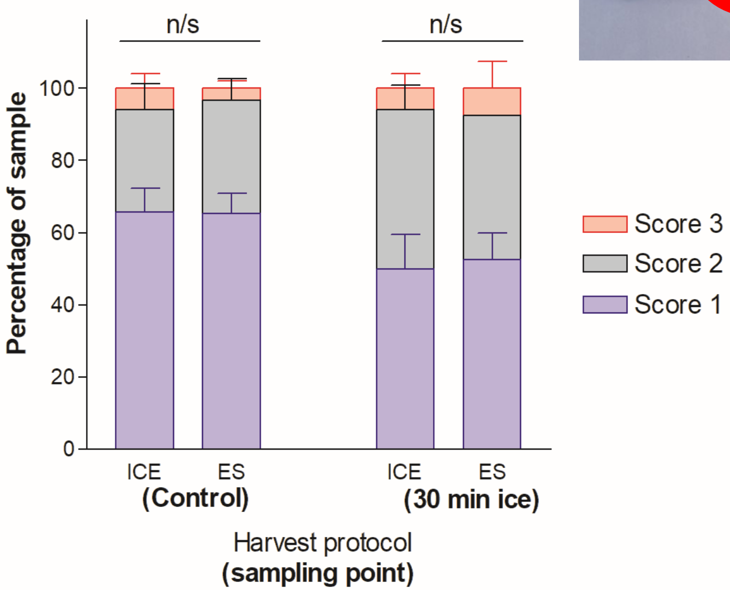
ROSTRUM



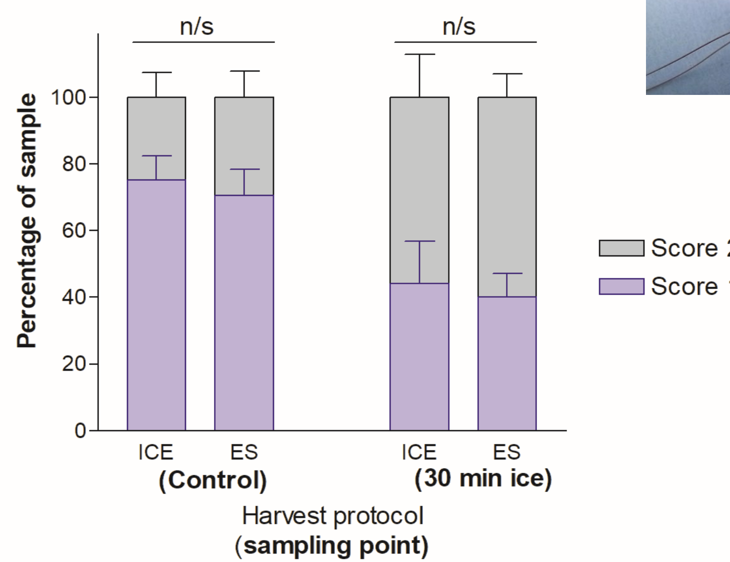


ANTENNAE

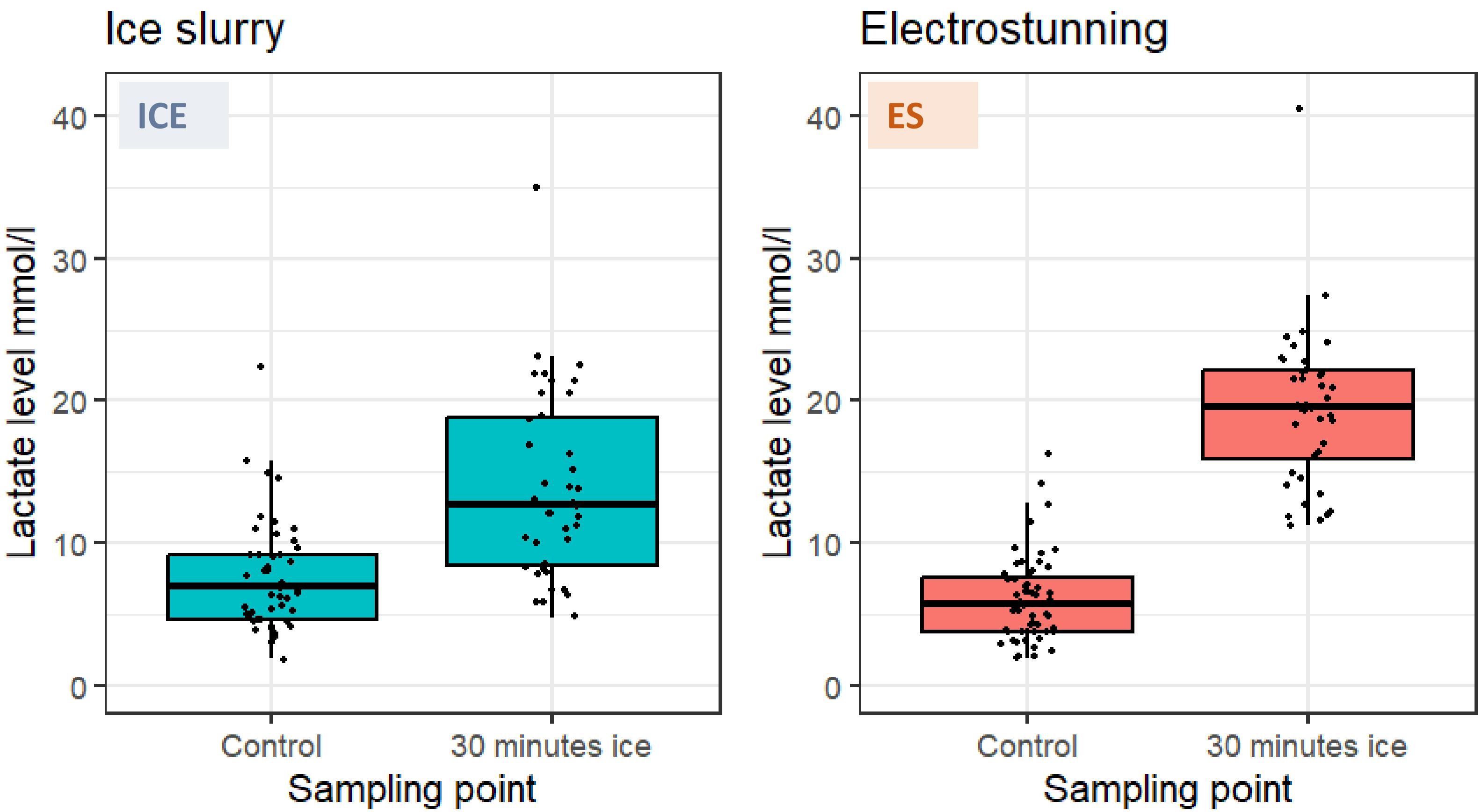


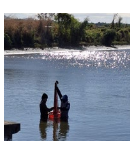


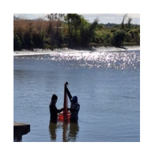
EYES



L-lactate increase as a proxy for stress





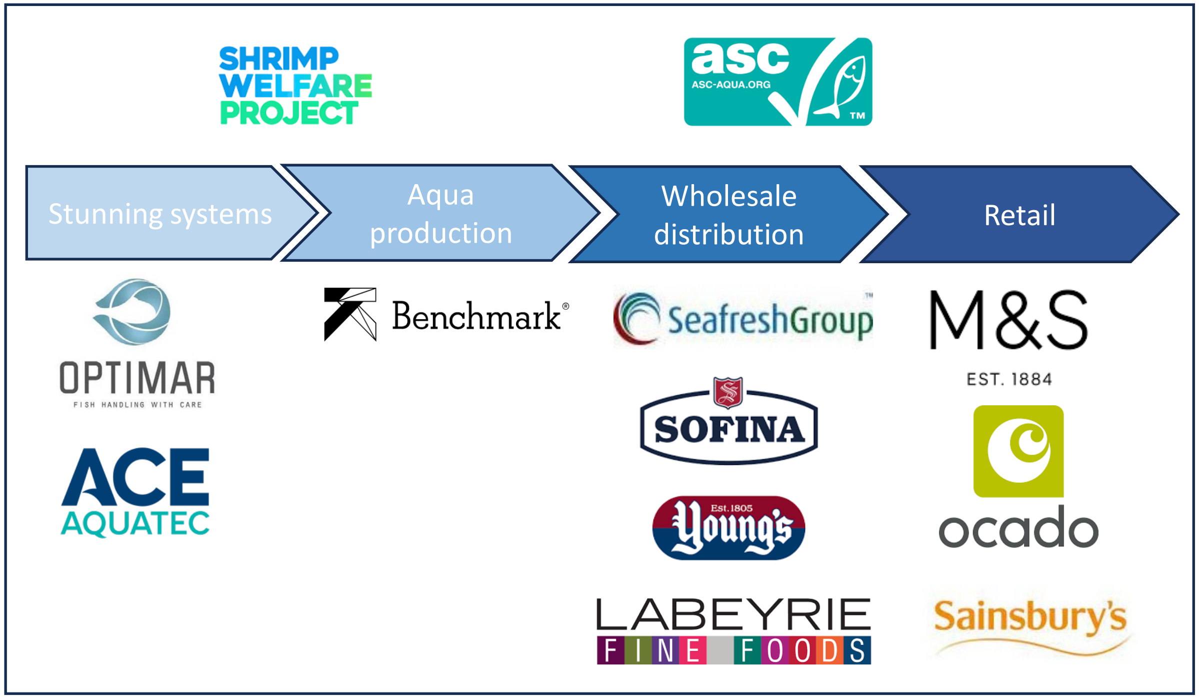


Summary of results field trials Honduras case study

O1 Effectiveness of the stun	• **ES** effective in rendering the animals less sensitive to the external environment • Room for improvement in the **ES** protocol as some animals respond to cold-exposure by tail-flipping • Data indicates that colder temperatures in the **ICE** protocol could reduce the tail flipping responses observed
O2 Welfare mapping	• Damage overall increased with harvest; no differences between groups albeit slightly higher for the **ES** group • Stress-related parameters increased more in the **ES** group • Time taken to harvest is currently similar between protocols • Harvest time is important, L-lactate levels higher in the afternoon
O3 Quality	• No differences in defects, quality and microbiology observed between groups • Burn marks were observed in some cases, currently not being recorded at the processing plant

Main conclusions

- Behaviourally, the aversive response observed in cold-shock can be suppressed by electrical stunning BUT data highlights consistency issues.
- Further work required to understand the neurological perception of the animals exposed to cold shock and electrical stunning.
- Data suggests lower temperatures being beneficial in terms of reducing aversive response time and neurological activity faster.
- Welfare mapping should be done in different farm types to ensure that the stunning method is selected based on best data available.



Team at Stirling

Current team

Dr J Somerville

Dr M Ellis

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Prof S Rey Planellas

Previous members involved

Dr Endre Putyora

Dr Nasser Ayaril

Open Philanthropy

TCRS
The Center for Responsible Seafood

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