



AAC Recommendation on increased funding to validate on- farm aquatic animal welfare indicators, including stunning at slaughter

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I. Background

The Aquaculture Advisory Council (AAC) recognises that while animal welfare is an increasing priority within the European Union, significant gaps remain in the practical application of welfare indicators, particularly in relation to effective slaughter practices for farmed aquatic animals. Current stunning methods do not always consistently render fish insensible prior to killing, with some species regaining consciousness within seconds following the procedure¹.

At the same time, substantial progress has been made in the development of operational welfare indicators (OWIs) for several major farmed fish species, including salmonids, seabream, and seabass^{2,3}. Recent scientific developments demonstrate that for several husbandry domains, the key challenge is increasingly the harmonisation, validation, and operational implementation of existing indicators under commercial conditions, rather than the development of entirely new frameworks.

While several husbandry welfare indicators are now relatively advanced for some major farmed species, practical validation of indicators for stunning effectiveness and sustained insensibility remains substantially less developed. A key challenge is the limited availability of reliable, species-specific indicators to verify effective stunning under commercial field conditions. At present, reliable confirmation of insensibility depends on laboratory-based electroencephalogram (EEG) measures paired with the assessment of visually evoked responses (VER), which require specialized equipment and expertise. While promising field-based technologies are emerging (e.g., portable EEG systems), practical, validated, species-specific methods suitable for routine commercial application, that can reliably demonstrate that fish remain insensible throughout slaughter, remain underdeveloped.

With the EU promoting the growth of sustainable aquaculture in the EU through the Strategic Aquaculture Guidelines for 2030 and Ocean Pact initiatives, it is critical that the Commission and Member States strive to remedy for these gaps, in order to drive truly sustainable aquaculture production in the EU, where animal welfare plays a key role.

This recommendation therefore highlights the urgent need for increased funding and targeted research to bridge the gap between experimental evidence and commercial practice. The AAC emphasises that consolidating and operationalising species-specific welfare indicators, alongside validating effective stunning methods under real-world conditions, are essential steps towards ensuring a competitive, ethical, and sustainable EU aquaculture sector.

¹ Lambert, H., Gräns, A., Sneddon, L. U., Tietge, K., & Sinclair, M. (2026). *Stunning methods in aquaculture slaughter and their implications for fish welfare: Literature review*. PeerJ. <https://peerj.com/articles/21258/>

² Noble, C., Abbink, W., Alvestad, R., et al. (2026). *Welfare Indicators for Aquaculture Research: Toolboxes for Five Farmed European Fish Species*. Reviews in Aquaculture. <https://doi.org/10.1111/raq.70109>

³ Mitropoulou, A., Mougiakou, E., Koumparelou, A., et al. (2026). *Developing Operational Welfare Indicators for European Sea Bass (*Dicentrarchus labrax*): Delphi-Informed Reflections on Advancing Farmed Fish Welfare*. Aquaculture. <https://doi.org/10.1016/j.aquaculture.2025.743474>

II. Justification

Scientific and technical roadblocks in stunning validation

Aquaculture slaughter systems present unique challenges due to high environmental variability, species-specific requirements, and the need for on-site slaughter systems. A primary technical barrier is that current stunning methods frequently fail to ensure insensibility before killing procedures are applied, and many species commonly regain consciousness within two minutes of the procedure (e.g., seabass, seabream)⁴. Recent evidence on electrical stunning in European finfish species further highlights substantial differences in effectiveness across species and production contexts. While findings for rainbow trout⁴ and salmon⁵ appear more promising under certain settings, percussive stunning, or electrical stunning followed by percussive stunning, may be more likely to achieve effective prolonged insensibility, as the electrical stun can facilitate a more accurate percussive application by preventing movement. However, evidence for species such as gilthead seabream, European seabass, turbot and common sole remains limited⁶, particularly under commercial conditions.

Laboratory validation methods such as EEG and VERs remain difficult to apply routinely under commercial field conditions, and consistent methodologies across species and countries are still lacking. In addition, although machine maintenance and calibration are critical to stunning effectiveness, these factors are not consistently monitored or validated in practice. **Variability in electrical field distribution, water conductivity, water temperature, fish orientation, stocking density during stunning, and operator-dependent settings** may all substantially influence the effectiveness and duration of insensibility achieved under commercial conditions.

The AAC notes that while welfare indicators for husbandry conditions have significantly progressed, important scientific and technical gaps remain regarding validation of stunning effectiveness under commercial conditions. In particular, further research is needed to **validate practical neurophysiological indicators of insensibility, improve calibration of electrical stunning systems, and ensure species- and size-specific optimisation of stunning parameters**.

A significant roadblock remains the limited availability of field-validated data on stunning effectiveness under commercial conditions. This limits the development of robust, harmonised, and evidence-based welfare assessment methodologies applicable across

⁴ Mendez, S., & Shah, S. K. (2026). Review: electrical stunning does not yet ensure prolonged insensibility in several European finfish species. Rethink Priorities. <https://rethinkpriorities.org/research-area/review-electrical-stunning-european-finfish/>

⁵ Espmark, Å.M.O., Grimsbø, E., Patel, S., et al. (2025). Assessment of welfare aspects of stunning and killing of farmed fish in Norway. Scientific Opinion of the Panel on Animal Health and Welfare of the Norwegian Scientific Committee for Food and Environment. [Link](#)

⁶ Daskalova, A.H., Bracke, M.B.M., van de Vis, J.W., et al. (2016). Effectiveness of tail-first dry electrical stunning, followed by immersion in ice water as a slaughter (killing) procedure for turbot (*Scophthalmus maximus*) and common sole (*Solea solea*). *Aquaculture*, 455, 22–31. <https://doi.org/10.1016/j.aquaculture.2015.12.023>

species and production systems. Additional funding is therefore needed for commercial-scale validation studies and practical field research aligned with the work of the EU Reference Centre on Aquatic Animal Welfare (EURCAW-Aqua) and the European Partnership on Animal Health and Welfare (EUPAHW).

Structural and financial constraints

The current institutional framework lacks the mandate to address these fundamental research gaps. Although EURCAW-Aqua plays an important role in research, guidance, coordination, and training of competent authorities, its current mandate does not extend to the large-scale validation research and consolidation of species-specific welfare indicators needed for direct operational use by industry.

There is currently insufficient funding for research institutes, NGOs, and businesses to run necessary validation trials, which results in limited industry engagement. Additionally, there is insufficient capacity within research institutes and competent authorities, not only in funding but also in available scientific expertise to undertake the necessary validation work at commercial scale.

Furthermore, initiatives such as EUPAHW, including its recent funding of multiple aquatic animal welfare research projects, and the DG SANTE-commissioned expert study on EU-level welfare indicators for farmed animals, including several aquaculture species, represent important progress. However, additional targeted funding is still needed for applied research to develop, validate, and test species-specific welfare indicators, effective slaughter methods, and stunning assessment tools under commercial conditions.

Existing funding mechanisms like the EMFAF also present constraints that make it difficult for SMEs and micro-enterprises to participate in welfare-related research or facility upgrades.

The AAC also considers that greater emphasis should be placed on supporting operators and companies in the practical implementation of welfare indicators. Operational uptake of welfare indicators depends not only on scientific validation but also on feasibility, staff training, standardisation, and integration into routine farm and slaughterhouse workflows.

Regulatory gaps and the role of EFSA

In 2021, the European Commission announced within the Farm to Fork Strategy roadmap that EFSA would develop scientific opinions on the welfare of the most commonly farmed fish species⁷. However, as highlighted by the AAC in its 2025 letter to the European Commission regarding delayed EFSA mandates and the revision of EU animal welfare legislation⁸, these mandates have not yet been delivered.

⁷ European Commission (2021). *Roadmap of future mandates to EFSA in the field of Animal Welfare*.

https://food.ec.europa.eu/system/files/2021-10/aw_eval_revision_roadmap_efsa.pdf

⁸ Aquaculture Advisory Council (2025). AAC letter on the delayed EFSA farmed finfish and invertebrate mandates and animal welfare revision. <https://aac-europe.org/en/publication/aac-letter-on-delayed-efsa-farmed-fish-and-invertebrate-mandates-and-animal-welfare-revision/>



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The AAC recognises the importance of effective implementation of existing legislation. However, the current EU legislative framework for farmed fish remains limited, including with regard to general welfare principles as well as species-specific requirements for welfare during farming, transport, and slaughter.

Additionally, inconsistent enforcement across Member States and a lack of harmonised data collection create an uneven playing field for EU producers. These challenges were also highlighted by the European Commission, which identified uneven implementation across Member States, limited species-specific legislation and welfare controls, lack of harmonised welfare indicators, limited expertise, and practical difficulties in inspecting remote aquaculture facilities⁹.

The AAC therefore considers that issuing the planned EFSA mandates from the Commission 2021 roadmap is critical to support consolidation of existing scientific knowledge, identification of remaining evidence gaps, and development of consistent approaches to welfare assessment and effective slaughter practices across the EU.

Research and data harmonisation

Research must transition from controlled laboratory settings to real commercial environments to ensure outcomes are implementable and scalable. Research and implementation efforts should include assessment of occupational health impacts and One Health considerations, particularly during slaughter validation studies and facility upgrades. For several husbandry domains, future efforts should prioritise consolidation, harmonisation, validation, and implementation of existing welfare indicator frameworks rather than duplication of existing work.

Future paths should include the development of practical field-based methods for assessing insensibility, including non-invasive EEG and VER technologies (e.g., Fishbox) suitable for commercial conditions¹⁰.

Furthermore, the EU should encourage the use of structured, digital, and interoperable data systems to enable consistent reporting, comparability, and cross-border alignment of welfare indicators. This is consistent with recent policy work identifying practical indicators suitable for harmonised welfare monitoring across EU aquaculture systems¹¹. Recent EU initiatives, including the Aquaculture Assistance Mechanism's "Code of good practices on fish welfare and fish welfare indicators", further support the development of practical and

⁹ European Commission (2025). Overview report: welfare of farmed fish in the European Union. Directorate-General for Health and Food Safety (DG SANTE). <https://ec.europa.eu/food/audits-analysis/news/details/164>

¹⁰ Bowman, J., Hjelmstedt, P., & Gräns, A. (2019). Non-invasive recording of brain function in rainbow trout: Evaluations of the effects of MS-222 anaesthesia induction. *Aquaculture Research*, 50(11), 3420–3428. <https://doi.org/10.1111/are.14300>

¹¹ Eurogroup for Animals (2026). *Policy indicators for fish welfare in European aquaculture*. <https://www.eurogroupforanimals.org/library/policy-indicators-fish-welfare-european-aquaculture>



harmonised welfare assessment approaches applicable across different aquaculture systems and life stages¹².

Different approaches are required for welfare assessment during farming and throughout the slaughter process. During production, indicators must be practical and scalable for use in live fish under commercial conditions, whereas slaughter assessment requires reliable confirmation of insensibility and stunning effectiveness. Additionally, certain indicators assessed at slaughter, such as lesions, fin damage, or malformations, may also provide retrospective insight into on-farm welfare conditions and handling practices during production.

Beyond stunning itself, research is also needed to determine optimal crowding times and densities prior to slaughter to reduce stress throughout the entire slaughter chain.

III. Recommendations

AAC Recommendations:

To the European Commission:

Increase targeted funding under EUPAHW, EMFAF, and the future MFF for the consolidation, harmonisation, validation, and implementation of species-specific welfare indicators, alongside applied research on effective slaughter methods and stunning effectiveness under commercial conditions, including systems suitable for SMEs.

Issue the planned EFSA mandates to assess the welfare of the most commonly farmed aquatic species, consolidating existing knowledge on species-specific welfare indicators, identifying remaining research gaps, and providing science-based recommendations on existing best practices to support timely EU legislation and harmonised welfare assessment.

Support harmonised implementation of species-specific welfare indicators across the EU, including through coordinated methodologies, interoperable data systems and welfare assessment frameworks involving EFSA, EURCAW-Aqua, EUPAHW, research initiatives, competent authorities, industry, NGOs, and civil society stakeholders.

Support the development and validation of practical field-based methods for assessing insensibility and stunning effectiveness under commercial conditions, including non-invasive electroencephalography (EEG) and visually evoked response (VER) technologies. Develop a science-based pathway towards future legislative requirements on effective stunning in aquaculture.

Introduce EU-level legislation to protect farmed aquatic animals, grounded in validated species-specific welfare indicators and proven best practices identified through the research and harmonisation work outlined above.

Require transparency from manufacturers on the validation and performance of stunning

¹² EU Aquaculture Assistance Mechanism (2025). Code of good practices on fish welfare and fish welfare indicators. . <https://aquaculture.ec.europa.eu/key-documents/code-good-practices-fish-welfare-and-fish-welfare-indicators>



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equipment under commercial conditions and integrate welfare effectiveness into approval and licensing processes, similarly to existing approaches used for terrestrial species where relevant.

Provide financial support for the transition towards high-welfare systems, including support for SMEs, and ensure trade frameworks reflect equivalent animal welfare standards for imported aquaculture products.

To the EU Member States:

1. Co-finance, with available EU and National funding, field trials and validation studies in collaboration with EU programmes, industry (including SME participation), research organisations, NGOs, and civil society. Additionally, provide direct funding to producer organisations (POs) and/or professional unions for welfare-related research and implementation, tailored to the specific farming conditions of their members.
2. Integrate validated welfare indicators and stunning effectiveness checks into national inspection, auditing, and licensing systems to ensure consistent enforcement and continuous improvement.
3. Integrate manufacturer transparency requirements and validated welfare effectiveness criteria for stunning equipment into national slaughterhouse approval and licensing procedures, consistent with the approach used for terrestrial species under Regulation (EC) 1099/2009¹³.

¹³ Council Regulation (EC) No 1099/2009 of 24 September 2009 on the protection of animals at the time of killing, Articles 14 and 16. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02009R1099-20191214>



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