

Application of the general welfare index for Pacific white shrimp during pond grow-out

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Study builds on the state-of-the-art assessment of sentience, consciousness, stress, distress, pain perception and welfare to adapt the GWI for farmed *P. vannamei*



This study applies the general welfare index (GWI) for Pacific white shrimp during pond grow-out, building on the state-of-the-art assessment of sentience, consciousness, stress, distress, pain perception and welfare to adapt the GWI for farmed *P. vannamei*. Results suggest that the GWI is a practical, quantifiable tool for aquaculture welfare assessment, encouraging the industry to enhance animal welfare through more responsible, sustainable practices. Photo by Darryl Jory.

The **estimated number** (<https://doi.org/10.1002/aff2.23>), of Pacific white shrimp (*Penaeus vannamei*) produced annually range from 383 to 977 billion animals, which does not include the shrimp that die during the larval and post-larval stages during production to market size. Shrimp are numerically among the **most farmed organisms** (<file:///C:/Users/DEJ/Downloads/Insects%20Raised%20for%20Food%20and%20Feed%20%E2%80%94%20Global%20Scale,%20Practices,%20and%20Policy.pdf>) for human food worldwide, second only to insects, whose annual production is expected to exceed 1.2 trillion organisms, with a total biomass of 0.6 million tons. However, this comparison involves just one shrimp species (*P. vannamei*) vs. several species of edible insects.

In light of these figures, inevitable questions arise about the scientific advancements concerning the potential sentience of shrimps and how such findings might necessitate **substantial reforms** (<https://doi.org/10.31219/osf.io/b8n3t>), in one of the most significant and influential food industries worldwide. The acknowledgement of sentience in these crustaceans challenges traditional viewpoints and spurs a profound reflection on the necessity of reassessing our relationship with species cultivated for consumption. This turning point in the debate emphasizes the importance of animal welfare in aquaculture, highlighting the urgent need to value and respect non-human life.

This article – **summarized** (<https://creativecommons.org/licenses/by/4.0/>), from the **original publication** (<https://doi.org/10.3390/fishes9110440>), (Pedrazzani, A.S. et al. 2024. Insights into Decapod Sentience: Applying the General Welfare Index (GWI) for Whiteleg Shrimp (*Penaeus vannamei*—Boone, 1931) Reared in Aquaculture Grow-Out Ponds. *Fishes* 2024, 9(11), 440) – presents the results of a study on essential concepts about sentience, consciousness, stress, distress, pain perception, and the welfare of decapod crustaceans, focusing on farmed shrimp, and the General Welfare Index (GWI) developed in this research.

Study setup

A **systematic literature review** (<https://doi.org/10.1136/bmj.n71>), guided by the PRISMA guidelines – Preferred Reporting Items for Systematic Reviews and Meta-Analyse, designed to help systematic reviewers transparently report why the review was done, what the authors did, and what they found – was conducted to identify quantitative welfare indices developed or adapted for aquatic animals farmed in aquaculture.



(<https://link.chnl.com/aquapod>).

The comprehensive search, encompassing scientific articles, technical reports, books, book chapters, case studies, dissertations, and theses, was conducted on Google Scholar and Semantic Scholar platforms from February 2023 to January 2024. Studies were evaluated and selected based on the relevance of their title, abstract, and subsequently, their whole content, adhering to the structure of the PRISMA framework for identifying methods and strategies for calculating the welfare level of animals farmed in aquaculture,

The General Welfare Index (**GWI** (<https://doi.org/10.1111/are.16105>)) was initially developed for grass carp cultivated in earthen ponds. However, it was designed to apply to animals and aquaculture systems after the necessary adjustments of applicable indicators. To exemplify the application of the GWI and the assessment of the welfare of shrimp cultivated in ponds, we used a **hypothetical scenario** (<https://doi.org/10.1111/raq.12373>). This scenario was constructed from a comprehensive literature review on the structural characteristics and typical management of a modal marine shrimp farm in Brazil. Using 31 specific and measurable indicators across various welfare domains, it is adapted to *P. vannamei*, offering a comprehensive assessment framework. The inclusion of quantitative welfare indicators promises to improve living conditions in alignment with legislation adopted on decapods' sentience and contemporary scientific advances.

For detailed information on the experimental design, data collection and analyses, refer to the original publication.



Can providing free electrical stunners move the needle on shrimp welfare practices?

The UK-based Shrimp Welfare Project is offering free electrical stunners to qualifying producers as part of new shrimp welfare initiative.

Results and discussion

The debate over invertebrate sentience, especially in decapods (crustaceans like crabs, lobsters, crayfish, shrimp, and prawns) like *P. vannamei*, raises ethical concerns in aquaculture and emphasizes the need for better welfare management practices. In this context, some authors contend that, while the **evidence of sentience** (<https://doi.org/10.3389/fvets.2022.973376>) is pivotal to ethical discussions, it should not detract from the urgent need to implement practices that promote welfare in shrimp farming.

Fostering a cultivation environment tailored to the needs of shrimp goes beyond “mere” ethical compliance, reflecting concrete enhancements in animal welfare, shrimp health, and, consequently, the productive efficiency and profitability of the aquaculture operation. Implementing management practices that address these crustaceans’ behavioral, health, and physiological needs improves productivity and reduces stress. These practices include optimized feeding, proper stocking density, supportive structures for molting, and maintaining ideal environmental conditions.

Given the complexity of factors affecting shrimp welfare, applying integrated and holistic management in cultivation systems is pivotal for achieving success and sustainability in aquaculture. Therefore, the adoption and implementation of measures that improve the welfare degree of these entities are imperative not only for enhancing production in terms of quality and quantity but also as an expression of more responsible, sustainable aquaculture in line with ethical standards.

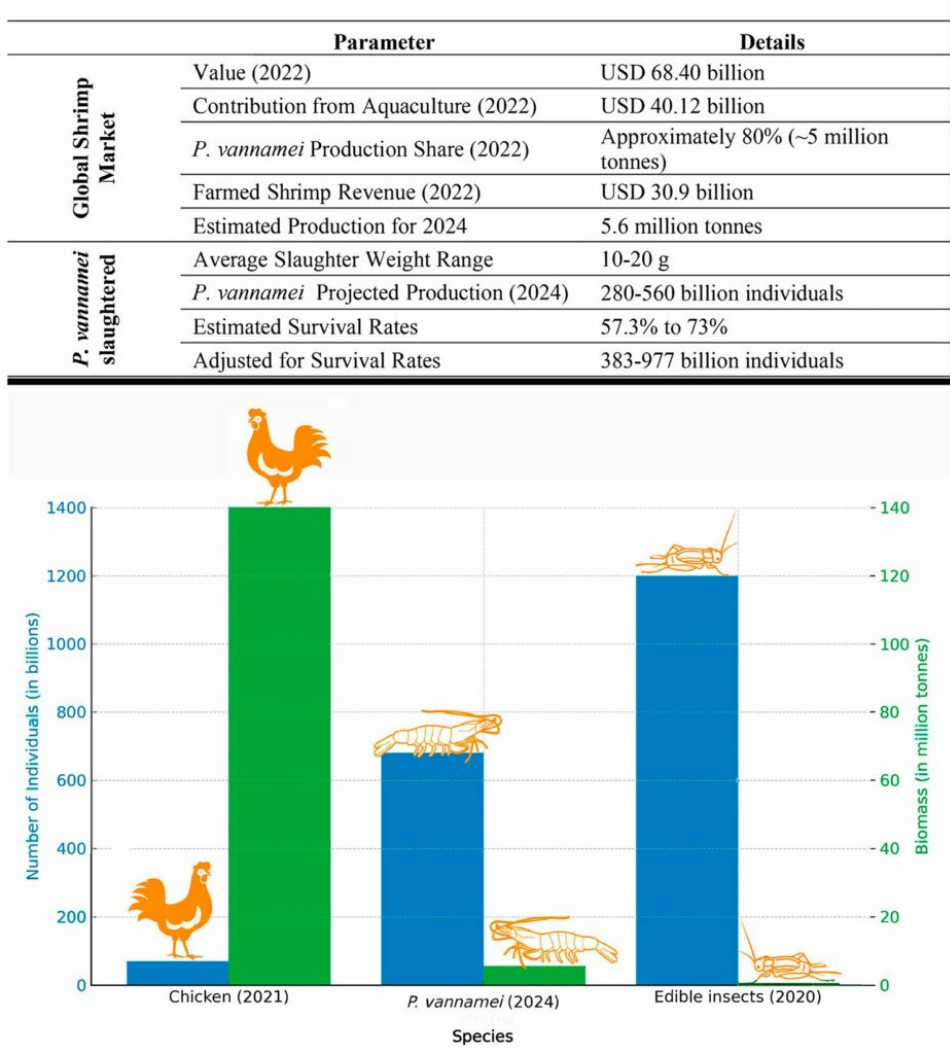


Fig. 1: Assessment and comparison of farmed *Penaeus vannamei* shrimp quantities and biomass to other farmed organisms. Adapted from the original publication.

Farmed shrimp face several welfare threats, including diseases, poor water quality, challenges in nutrition and feeding, and heightened stress, which are especially noticeable during the harvesting and slaughtering phases. These welfare critical points, which vary according to the intensity of farm production, highlight the need for **accurate welfare measurement** (<https://doi.org/10.1007/s10539-022-09862-1>) to ensure practices are sustainable, ethical and profitable, even though current methods are often subjective and ineffective.

Fig. 2: Graphical summary of the General Welfare Index (GWI). Adapted from the original.

The General Welfare Index (GWI) was developed in close alignment with the animal welfare concept proposed by the World Organisation for Animal Health. The development of the GWI adopted the perspective of **Nilsson et al.** (<http://www.nofima.no/fishwell/english>), acknowledging the impossibility of directly asking shrimps about their perceptions and, thus, using welfare indicators to gauge their conditions. These indicators are divided into direct health, physical condition, behavior indicators, and indirect indicators connected to management, resources, and the environment provided. Direct indicators accurately reflect the shrimps' welfare, while indirect indicators identify potential risks before they visibly impact the animal. The integrated use of these indicators is vital for a comprehensive welfare assessment in aquaculture, encouraging ethical and sustainable management practices. This approach promotes consistent cultivation conditions and highlights the need for proper management practices.

Fig. 3: The outcome of applying the General Welfare Index (GWI) for *Penaeus vannamei* shrimp cultivated in ponds during the grow-out phase under conditions representing the modal practices in a Latin American country. The red color indicates a low degree of welfare, and the green color indicates a high Confidence Level (CL).

Our study adapts the GWI specifically for *P. vannamei*, offering a new approach to address the complex needs of commercial shrimp farming. It also sets a distinct milestone when compared to indices traditionally employed for the welfare assessment of other cultivated aquatic species, such as fish and cephalopods. This novel approach, encompassing up to 30 specific indicators for the cultivation of shrimps in earthen ponds that can be directly measured within the aquaculture farm environment without resorting to complex or invasive laboratory techniques, coupled with the meticulous weighting of these indicators, the incorporation of an exclusion factor (kl) based on mortality rates, and the creation of specific indices to evaluate different welfare domains culminating in a general index, represents a significant methodological development.

The GWI is versatile and adaptable to various shrimp species and a broad array of cultivation systems, with plans for periodic updates of its indicators to mirror the scientific and technological progress within the sector. This strategy facilitates highly reliable comparative studies, enabling temporal analyses within a single operation and comparisons across different enterprises and cultivation systems. Ultimately, it ensures that the welfare of farmed shrimp remains in step with the latest scientific advances and sustainable practices, reinforcing the significance and effectiveness of the GWI in fostering responsible and ethically committed aquaculture management.

Perspectives

This study marks a significant advance in the interface between shrimp aquaculture and animal welfare, introducing the General Welfare Index (GWI) as an innovative tool to monitor and enhance the cultivation conditions of *P. vannamei*. The development and application of the GWI extend beyond the scientific debate on crustacean sentience, offering a practical, evidence-based methodology that drives tangible improvements in cultivation practices. GWI implementation addresses discussions about decapod sensory capacities and also adopts a pragmatic approach, acknowledging that the aquaculture industry bears both an ethical responsibility and an economic interest in adopting practices that optimize the welfare of these organisms.

Also, this research also points to promising avenues for future research, including the continuous refinement of welfare indicators, investigations into the correlations between GWI scores and production outcomes, and the development of automated real-time welfare monitoring technologies. The widespread adoption of the GWI can potentially redefine aquaculture standards, fostering a more holistic and ethically defensible approach.

By aligning cultivation practices with the growing demands for sustainability and ethical responsibility, the GWI objectively assesses animal welfare across different systems and species. This enables aquaculture to become more resilient to global challenges such as climate change and food security. Its potential to drive innovation and optimize productivity places animal welfare at the forefront of aquaculture's future.

With the adoption of the GWI, the industry can achieve greater competitiveness and market acceptance and more responsible and sustainable practices, ensuring better living conditions for billions of shrimp cultivated annually worldwide.

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