

Editorial

Welfare of Fish—No Longer the Elephant in the Room

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The concept of fish welfare is fairly recent and was overlooked for many years, based on a popular misconception that fish were “stupid” creatures devoid of any kind of sentience or mental capability. However, a growing body of research on fish behaviour, cognition, learning and neuroscience made clear that this is evidently not the case—fish are indeed socially complex [1], have developed cognitive and learning abilities with the neural substrate to support them [2,3] and are sentient [4]. As the evidence for fish mental competences grew larger, the uncomfortable questions regarding the welfare state of fish and the ethical implications of fish farming became an elephant in the room that nobody would address. However, there are recent indications that things are changing, and the present collection of excellent contributions suggests that all the interested parties (scientists, farmers, retailers, NGOs and consumers) are now directly approaching the subject. Ladies and gentlemen, the elephant has left the building.

In fact, these papers are a fantastic example of the many perspectives that may be used when tackling fish welfare. In a pilot study regarding fisheries of catshark (*Scyliorhinus canicular*), Barragán-Méndez et al. [5] demonstrate that the standard practices of exposing the wild-caught animals to air are not only extremely harmful for the fish but also modify muscle texture properties and reduce the quality of the meat. This study demonstrates the urgency of improving the welfare of wild-caught fish and indicates the road ahead regarding the assessment of humane practices in fisheries. The paper by Strauch et al. [6] also highlights how a common practice of adding phosphate to integrated aquaponic systems as a fertilizer can have negative effects in African catfish (*Clarias gariepinus*), not only on their welfare but also on the meat quality. These two studies emphasize a correlation that should be clear for the fish industry: when the welfare of animals is improved, both the quality of the product and its value increase—a rare case when the interest of the industry and the ethical standards underlying its activity walk hand in hand.

The study by Moreira et al. [7] takes an ontogenic approach into amyloodiniosis, a well-known health problem in white seabream (*Diplodus sargus*) farmed in Southern Europe. Focusing on fish health is not new in welfare research. After all, health is one of the key components for conceptual framework of welfare, together with the mental and natural components. The novelty of this paper is to search for a non-veterinary approach to deal with a health issue, using one of Tinbergen’s Four Questions that is so often overlooked: development. The results show that young fish are far more susceptible to infection by *Amyloodinium ocellatum* because they lack immune and physiological responses that only appear later in ontogeny. This study highlights the need to take into account the age of the individuals when designing prevention and treatment plans as well as rearing routines.

Zebrafish welfare was another surprisingly ignored issue until recent times. The number of cultured individuals arguably rivals any other commercially farmed species, yet even when the subject of welfare in aquaculture started to be addressed, zebrafish were apparently left behind. Say no more because two studies by Woodward et al. [8] and Deakin et al. [9] focus on two important topics that impact zebrafish welfare: the first shows that environmental enrichment in zebrafish housing promotes aggression and risk-taking behaviours in zebrafish [8], and the authors explain this with the

social and territorial behaviour of the species, in which the enrichment structures provide resources to monopolise; the second suggests a novel method to analyse pain responses to standard experimental procedures in this species. Using fractal analysis of behaviour, the authors create (and validate) a pain intensity scale for zebrafish, and propose that variations in complexity of movement should be a good indicator of welfare in this species [9]. This paper also adds compelling evidence that fish are sentient and able to feel pain. Both studies dive into the biology of welfare in zebrafish, using basic behavioural variables and knowledge on the ethology of the species to highlight the importance of the natural (in the case of Woodward et al.) and mental (in the case of Deakin et al.) dimensions of welfare.

The importance of understanding the ethology of reared species is further explored in the review by Gonçalves-de-Freitas et al. [10], where the social behaviour of Nile tilapia (*Oreochromis niloticus*) is proposed as a key component in the welfare of this fish. In this study, the authors thoroughly review the social ethology of tilapia, elegantly addressing both proximate and ultimate mechanisms to provide operational insights that may improve its welfare. The social environment is demonstrated to have impacts on stress levels, growth and aggression, and the authors offer solutions to mitigate the effects of rearing conditions: lighting, environment colour and enrichment structures are pinpointed as simple ways to reduce the detrimental effects of human-induced social disturbance [10].

The review by Fife-Cook and Franks [11] picks up where Gonçalves-de-Freitas et al. left off. In their paper, the authors propose a framework for positive welfare in fish (i.e., mental and physical states that exceed what is necessary for immediate survival), which would replace the traditional paradigms that focus on mitigating the negative impacts of rearing. The positive welfare approach requires a deep understanding of the species' behaviour and biology and would demand taxa-specific standards. However, the knowledge already available from fish and other taxa allows both the identification of positive welfare states in fish and the suggestion of active measures: species-specific housing (including ambient colour and appropriate social environment, as already suggested in [10]) and the promotion of cognitive engagement (visual stimulation, novel objects, play, etc.). The authors conclude that the positive class of experiences are currently being neglected in fish and urge for more research in this area.

Finally, Saraiva et al. [12] propose a framework to assess the welfare of farmed fishes at a species level: the FishEthoBase. This open-access database on fish ethology and welfare aims to provide a tool to evaluate the welfare state of (ultimately) all farmed species worldwide. In that sense, the authors have built the portal www.fishethobase.net where an impressive amount of data concerning the biology of farmed species and the impacts of aquaculture on their welfare is scrutinised, organised and summarised. Using the data on 41 species already available, the authors analyse their welfare state and conclude that (i) the general welfare state of farmed fishes is poor, (ii) there is some potential for improvement, and (iii) this potential is related to research on species' needs, but (iv) there are many remaining knowledge gaps, and (v) current fish farming technologies do not seem to fully address welfare issues.

As editors of this Special Issue, we could not be more thankful and proud of its contents, not only because of the quality of the contributions but also because of their broad approach, their interconnection and the multiple doors that have opened, letting us see future lines of knowledge. Fish welfare seems to have gained a considerable momentum and, although there is yet much work ahead, we can optimistically say that the wind is blowing in a favourable direction.

Conflicts of Interest: The authors declare no conflict of interest

References

1. Oliveira, R.F. Social plasticity in fish: Integrating mechanisms and function. *J. Fish Biol.* **2012**, *81*, 2127–2150. [[CrossRef](#)] [[PubMed](#)]
2. Bshary, R.; Gingsins, S.; Vail, A.L. Social cognition in fishes. *Trends Cogn. Sci.* **2014**, *18*, 465–471. [[CrossRef](#)] [[PubMed](#)]

3. Oliveira, R.F. Mind the fish: Zebrafish as a model in cognitive social neuroscience. *Front. Neural Circuits* **2013**, *7*. [[CrossRef](#)] [[PubMed](#)]
4. Brown, C. Fish intelligence, sentience and ethics. *Anim. Cogn.* **2015**, *18*, 1–17. [[CrossRef](#)] [[PubMed](#)]
5. Barragán-Méndez, C.; Sánchez-García, F.; Sobrino, I.; Mancera, J.M.; Ruiz-Jarabo, I. Air Exposure in Catshark (*Scyliorhinus canicula*) Modify Muscle Texture Properties: A Pilot Study. *Fishes* **2018**, *3*, 34. [[CrossRef](#)]
6. Strauch, S.M.; Bahr, J.; Baßmann, B.; Bischoff, A.A.; Oster, M.; Wasenitz, B.; Palm, H.W. Effects of Ortho-Phosphate on Growth Performance, Welfare and Product Quality of Juvenile African Catfish (*Clarias gariepinus*). *Fishes* **2019**, *4*, 3. [[CrossRef](#)]
7. Moreira, M.; Cordeiro-Silva, A.; Barata, M.; Pousão-Ferreira, P.; Soares, F. Influence of Age on Stress Responses of White Seabream to Amyloidinosis. *Fishes* **2019**, *4*, 26. [[CrossRef](#)]
8. Woodward, M.A.; Winder, L.A.; Watt, P.J. Enrichment Increases Aggression in Zebrafish. *Fishes* **2019**, *4*, 22. [[CrossRef](#)]
9. Deakin, A.G.; Spencer, J.W.; Cossins, A.R.; Young, I.S.; Sneddon, L.U. Welfare Challenges Influence the Complexity of Movement: Fractal Analysis of Behaviour in Zebrafish. *Fishes* **2019**, *4*, 8. [[CrossRef](#)]
10. Gonçalves-de-Freitas, E.; Bolognesi, M.C.; dos Santos Gauy, A.C.; Brandão, M.L.; Giaquinto, P.C.; Fernandes-Castilho, M. Social Behavior and Welfare in Nile Tilapia. *Fishes* **2019**, *4*, 23. [[CrossRef](#)]
11. Fife-Cook, I.; Franks, B. Positive Welfare for Fishes: Rationale and Areas for Future Study. *Fishes* **2019**, *4*, 31. [[CrossRef](#)]
12. Saraiva, J.L.; Arechavala-Lopez, P.; Castanheira, M.F.; Volstorf, J.; Heinzpeter Studer, B. A Global Assessment of Welfare in Farmed Fishes: The FishEthoBase. *Fishes* **2019**, *4*, 30. [[CrossRef](#)]



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