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Fish welfare #5

What should we aim for?

Resources are, as always, limited. Should we then invest in improving some details in the lives of over 500 farmed aquatic animal species, most of which are known not being able to experience welfare in captivity anyway? Or should we rather focus on the few species that possibly may thrive under improved farming conditions?

Critical notes on Caroline Marques Maia et al. (2024), Fish welfare in farms: potential, knowledge gaps and other insights from the fair-fish database [1].

As the founder and former director of FishEthoBase (later renamed fair-fish-database [2]), I would like to offer a critical commentary on the purpose of the study conducted by my former colleagues.

Currently, more than 500 aquatic animal species are farmed, which is at about 18 times the number of terrestrial animal species kept under farming conditions [2]. It is noteworthy that many of the farmed aquatic species prey on other animals, whereas none of the farmed terrestrial species is carnivorous, for good reasons. When we started work on the FishEthoBase in 2012 and obtained funding for it, our aim was to identify those aquatic species that feel well in captivity under best possible farming conditions, in order to focus the efforts on improving fish welfare where it is possible to make a difference — and to advise the aquaculture industry to refrain from farming other species. However, the wide range of a species, most of which are only partially understood in terms of their natural needs and behaviours, may prevent science and practice from making truly significant advances in welfare.

A species' potential to experience welfare

It is the *potential score* of a species that has added a further level of rigour to the fair-fish database: it directly answers the initial question of which species to focus in aquaculture if fish welfare is the goal. This goal is well reflected in the authors' note (in 1.4 Objective) that *'lower potential [scores] should indicate criteria with little chance for future welfare improvement'*. Consequently, low total potential scores should indicate species with little chance for experiencing welfare, even under improved conditions.

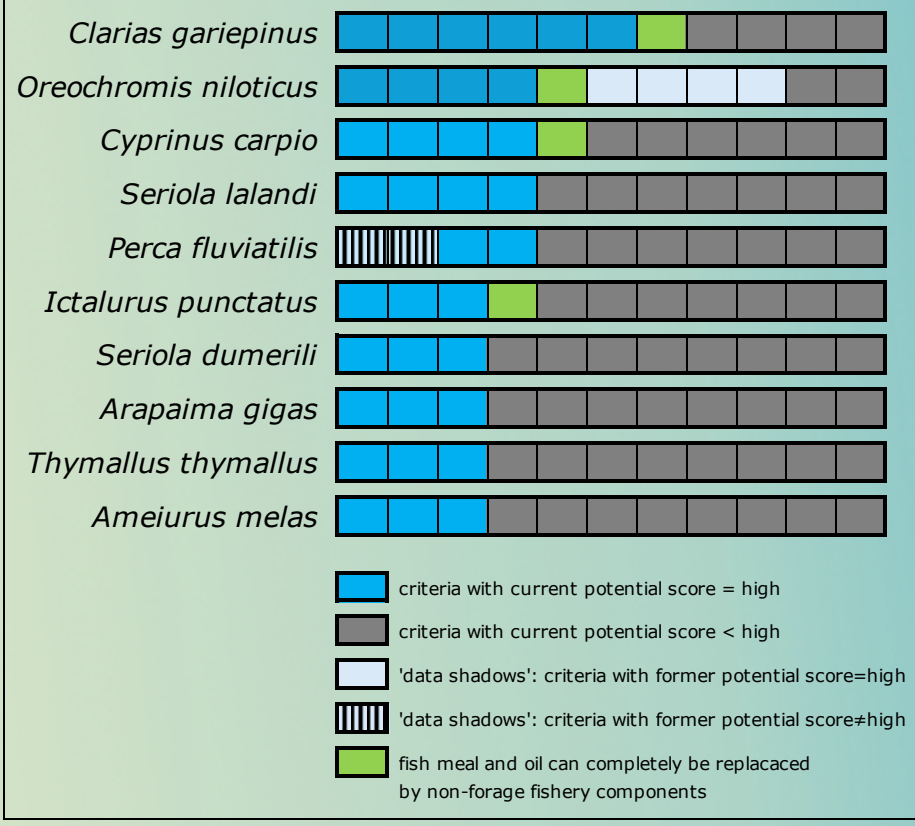
However, this is in stark contrast to the authors' conclusion that '*currently, the best opportunities for achieving a high level of welfare for aquatic species in aquaculture lie in improving their breeding conditions, the slaughtering process, and substrate availability, which often exhibit a high potential for good welfare across all species profiles*'. This would mean to strive for fish welfare in species of which we already know that the chances of achieving it are slim.

While the authors do come to some interesting results in their cross-analysis of the 83 species profiles published in the fair-fish database at the time of publication of their article, they seem to lose sight of the primary goal of the database. The results of their study are driven by the overwhelming majority of species with very low potential scores, leading to the idea that it might make sense to improve, even if only a little bit, the welfare of any species, when in reality the efforts will at best reduce one cause of suffering or another.

Few species with a halfway promising welfare potential: what can be done?

The rapid decline of the total potential score across the species profiled so far has been demonstrated in various publications about the fair-fish database [2] [4, page 10]. Figure 1 presents the few species with an above-average total potential score. Here, an 11th criterion has been added: the question of whether forage fish in the diet of the species can be substituted, currently reported in a side note in the fair-fish database. However, this is a meaningful indicator of animal welfare in fisheries (and at the same time of the extent to which feeding a species contributes to the depletion of wild fish stocks). Criterion 11 can also be understood as a placeholder for other possibly distinctive welfare criteria, such as the species' swimming behaviour or its tolerance to a certain stocking density. – As for the score of Nile tilapia, see the box 'The case of *Oreochromis niloticus*'.

Fig. 1: Species with an above-average total potential score in the fair-fish database (max score = 11)



Now, what are the criteria for which the top-scoring species lack welfare potential?

If we focus on the two species with the highest total potential score (Table 1), the African catfish (*Clarias gariepinus*, score=7 of max 11) and the Nile tilapia (*Oreochromis niloticus*, score=9 or new 5, see box), only to 4 out of 11 criteria show poor potential:

- aggression, in both species (as in many others as well)
- stress, in both species (as in most others)
- aggregation in *C. gariepinus* (and possibly *in O. niloticus*)
- malformation in *C. gariepinus*
- (and possibly home range, depth range, and migration in *O. niloticus*)

If we add the third-best species, the Common carp (*Cyprinus carpio*, score=5 of max 11), high potential scores are missing in three further criteria:

- home range
- depth range
- migration.

If we add the two species with total potential score=4, the Yellowtail amberjack (*Seriola lalandi*) and the European perch (*Perca fluviatilis*), the five species with the highest potential together already lack high potential scores in 10 out of 11 criteria, except of reproduction, a problematic criterion for many species with an even lower total potential score.

So, when we look for the species with the lowest possible number of criteria lacking high potential, there is a clear indication to focus on *C. gariepinus* and *O. niloticus* to develop practices to exploit the welfare potential already indicated by science, and to advance research and development in criteria with lower welfare potential based on the findings so far.

Table 1: Species with an above-average total potential score in the fair-fish database

Criteria with high welfare potential

	Clarias gariepinus	***Oreochromis niloticus***			***Cyprinus carpio***	***Perca fluviatilis***		***Seriola lalandi***
Last publication date**	**2022**	**2017**	**2023°**	**2024**	**2024**	**2023°**	**2024**	**2024**
Total likelihood (max 11*)	0	5	3	1+1	1	0	0	4
Total potential (max 11*)	6+1		8+1	4+1	4	2	4	4
Total certainty (max 11*)	5		6	3+1	2	4	3	4
Home range	L/H/M	?	?/H/M	?/M/M	L/M/M	?/M/L	L/M/M	L/L/H
Depth range	L/H/H	L	L/H/H	L/M/H	L/M/M	?/M/H	L/M/H	?/M/H
Migration	L/H/H	H	H/H/H	L/M/M	L/M/M	?/?/L	L/H/M	L/L/H
Reproduction	L/H/H	H	H/H/H	L/H/M	L/H/H	L/H/M	L/H/M	H/H/M
Aggregation	?/M/M	?	?/H/M	L/M/H	L/M/M	?/M/L	L/H/M	H/H/M
Aggression	L/L/L	L	L/M/M	L/M/M	H/H/L	?/M/M	L/M/H	L/M/L
Substrate	L/H/H	L	L/H/H	L/H/M	L/H/H	?/H/H	L/H/H	H/H/H
Stress	L/M/M	L	L/M/M	L/M/H	L/M/M	L/M/H	L/M/M	?/M/L
Malformations	L/M/M	H	H/H/H	H/H/M	L/L/L/	?/M/H	L/M/M	L/M/M
Slaughter	?/H/H	H	L/H/H	L/H/M	L/H/M	-/-/-	?/?/L	H/H/M
* added: Forage fish	L/H/M	L	L/H/M	L/H/H	M/H/M	L	L	L
Domestication		5						

** year of last publication:

2017 the final version of the 'farmability' index published on 03.03.2017 (personal archive)
2022, 2024 date of the last update as currently published on the fair-fish database
2023° date of the penultimate update as previously published on the fair-fish database

The case of *Oreochromis niloticus*

Initially, FishEthoBase contained species profiles covering a wide range of ethological and welfare criteria (now called 'Dossier' in the fair-fish database). We had to realise, though, that it would last years to create at least 100 profiles, a threshold for being accepted as a consortium member at the world-leading FishBase. In 2016, at the suggestion of FishBase co-founder Rainer Froese, we decided to create short profiles (now called 'Welfare Check' in the fair-fish database), by which we assessed the 'farmability' of a species, i.e. its likeliness to experience welfare in captivity, on the basis of then 12 core criteria, which were evalutated with 3 values: likely, not likely, and unclear. The results were submitted to a stakeholder round in 2017 and finally discussed in a one-day meeting of the database team with external experts in Zurich.

During this meeting, Andreas Graber, a Swiss expert in aquaponics and tilapia farming, criticised the fact that the 'farmability' index was too static and did not reflect better welfare achieved through a farmer's efforts. In fact, the outcome of 'farmability' for *O. niloticus* was rather poor, with score=likely in only 5 out of 12 criteria (see Table 1). At the suggestion of Pablo Arechavala, then a member of the team, we introduced a risk analysis model. Since then, the short profiles, i.e. the current WelfareChecks, assess the welfare of a species in 3 dimensions: likelihood of welfare under basic farming conditions, potential for welfare under improved conditions, and certainty of underlying findings. At the same time, the 12 criteria were reduced to the current 10, with the remaining two criteria being relegated to side notes (domes-tication and forage fish in the feed).

As a result, *O. niloticus* became the star of the scene, along-side *Clarias gariepinus*. Starting from a low score for likeli-hood=3, *O. niloticus* achieved a high score for potential=8, and a satisfying score for certainty=6 (see Table 1, values published up to 2023). A similar situation applies for *C. ga-riepinus* with corresponding scores of 0, 6, and 5. The two species were well ahead of the rest, followed by just two species with a potential score of 4 and another three with a potential score of 3. These results have since been widely published [3] [4] and presented at several scientific congresses.

The fair-fish database team reviewed the profile of *O. nilo-ticus* in 2024, based on more than double the number of findings and applying the scoring rules that were changed back in 2018. The total scores for *O. niloticus* changed strikingly: likelihood=1 (previously 3), potential=4 (prev. 8), and certainty=3 (prev. 6), see Table 1. For no other species so far did a review and the application of changed scoring rules lead to such significant changes. (The only other notable change occurred in *Perca fluviatilis,* whose total potential score doubled to 4, see Table 1.) This suggests that further discussion is needed, not least to limit changes in the WelfareScore, in particular, to the potential scores. A drama-tic change in scores, as in the case of *O. niloticus,* can jeopardise all efforts to move the industry to the most suitable species. Therefore, Fig. 1 and Table 1 illustrate these 'data shadows'.

O. niloticus is the third most farmed fish species in tonnage [5] and second by number of individuals [6], and tilapia farming is now growing rapidly in Africa [7], where the species originates. It's all the more important and urgent, therefore, to clarify the species' full welfare potential and, if it is high, to find ways to realise it in practice.

Conclusion

While FishEthoBase was designed to identify the few aquatic species that can experience welfare under improved farming conditions, the authors seem to be turning the idea upside down by looking for any improvements in fish welfare in all currently farmed aquatic species, however small the chance may be. Despite all efforts in research and development, it is highly unlikely to achieve general welfare improvements in species with a low total potential score of just 2, such as Atlantic salmon and 21 [5] other species, with an even lower total potential score of 1, such as Rainbow trout and 18 other species, and with the lowest total potential score of 0, such as for Atlantic halibut and 32 other species.

When the welfare potential of 74 out of the 83 profiled species in the fair-fish database is below 3, either there is a problem with the assessment method or most fish farmers have bet on species with which they will never achieve high welfare standards. Either way, the aquaculture industry — similar as in terrestrial husbandry — will have no choice but to reduce the number of farmed species to the those that perform best and for which extensive knowledge and experience is available. The diversity of species on offer is a task for the fishing industry.

The science of fish welfare must be careful to not lead to greenwashing. Improving farming conditions for species with very low welfare potential, such as the overwhelming majority of species, may alleviate some of the discomfort of farmed fishes, but cannot make them experience welfare. The research that started the fair-fish database is not done in a vacuum, but to influence fish farmers. Is that agenda setting in science? To put it in Popper's words: The hypothesis that some species are able to experience welfare under improved farming conditions has been falsified for all species examined, with a benefit of doubt for a few of them.

References:

[1] Caroline Marques Maia, João Luis Saraiva, and Eliane Gonçalves-de_Freitas (2024 Oct), Fish welfare in farms: potential, knowledge gaps and other insights from the fair-fish database. Front Vet Sci, DOI: 10.3389/fvets.2024.1450087

[2] https://fair-fish-database.net

[3] Billo Heinzpeter Studer (2020), Farmed fishes: Why so many? Fish welfare: why so late?, in: Studer (Ed.), Fish welfare in aquaculture — Problems and approaches, page 5, http://www.ign-nutztierhaltung.ch/sites/default/files/PDF/IGN_FOKUS_20_Aquakultur_en.pdf

[4] Caroline Marques Maia, João Luis Saraiva, Jenny Volstorf, and Eliane Gonçalves-de_Freitas (2024 Sep), Surveying the welfare of farmed fish species on a global scale through the fair-fish database. J Fish Biol, 2024 Sep;105(3):960-974. DOI: 10.1111/jfb.15846.

[5] The State of World Fisheries and Aquaculture (SOFIA, 2024), FAO, Rome (page 11, Fig, 6)

[6] Fishcount (2017), https://fishcount.org.uk/studydatascreens2/2017/numbers-of-farmed-fish-A0-2017.php?sort2/full

[7] The Fish Site (2024) https://thefishsite.com/articles/african-tilapia-the-fastest-growth-segment-of-the-aquaculture-world