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Fish resilience as an ethical issue

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Abstract

Fish resilience can be understood as the capacity of fish to successfully respond to a challenge so that they are able to function and flourish in much the same way as they did prior to the occurrence of the challenge. Resilience is a function not only of individual fish, but also of a whole fish population. Enhancing the resilience of fish requires both adapting the robustness of the animals and adapting the (production) environment to the specific needs of the fish. Rather than a mere biological capacity of fish, resilience also comes with ethical questions. These questions occur at four levels. First, in practice resilience often comes with a "rhetoric" of optimalization. The view that aquaculture that strives for resilient fish is good for both fish welfare and production is inherently normative. It assumes a 'win–win situation', but thereby makes certain normative assumptions. Second, especially when the win–win situation is not achievable, resilience means making trade-offs between preferred responses to challenges from the perspective of individual animals and groups or between individual housing and larger aquaculture systems. Third, the discussions on resilience and fish demonstrate the need to move beyond an animal welfare framework when discussing the treatment of fish in aquaculture. Recently, animal ethics has seen a turn towards centering animals' own agency. This means that we should not only focus on improving animal welfare, but also on asking what the animals themselves want and how they can be given more control over their situation. This may also impact the definition of resilience and how it is made operational. Finally, the use of the concept of resilience may reveal a certain moral outlook with regard to fish. On the one hand, resilience is portrayed as a positive characteristic of animals that enables improvement of the quality of life of fish. At the same time, it raises the question of how far we should stretch the "manufacturability" of fish. When we physically adapt animals so that they can cope with difficult circumstances we may be stretching moral boundaries. For example, this raises the objection that we are instrumentalizing animals. In this article, we reflect on these types of ethical issues and aim to show that the ethical dimensions of resilience need to be taken into account by professionals in

aquaculture in order to make resilience operational and to contribute to a responsible interaction with fish in aquaculture.

KEYWORDS
animal ethics, instrumentalization, sustainability, trade-off, welfare

1 | INTRODUCTION

Fish resilience is mostly discussed as the capacity of fish to successfully respond to a challenge so that they are able to function and flourish in much the same way as they did prior to the occurrence of the challenge. By a challenge we mean a broad set of internal and external stimuli, events, and conditions that influence the fish. It is often portrayed as something positive if a fish shows being resilient since being able to adapt to a new situation is considered to be an indication of good health or welfare (Fife-Cook & Franks, 2019; Martins et al., 2012). As such, focusing on or —if possible— improving the resilience of fish can be framed as a positive development. This latter assessment already indicates that resilience is more than a biological concept only. It comes with normative claims and assumptions. This is not to be evaluated as problematic, as our dealings with animals always link to moral assumptions and ethical decisions. However, it is important to understand the ethical dimensions of resilience to apply this concept in a careful way. In this article, we define and analyze four ethical dimensions: the rhetoric of optimalization, the link with making trade-offs, the need to go beyond animal welfare and the trend to instrumentalize fish. We suggest that the resilience of individual animals must always be assessed in the context of the husbandry system or ecosystem in which the animal finds itself, and question whether animals are necessarily better off if they are made more resilient, such as through breeding programs.

However, before elaborating these dimensions, we explore the concept of resilience because researchers from different disciplines tend to define the term in different ways, and policy makers and the general public have yet other uses of the term (Giersberg et al., 2022). Therefore, conceptual clarity is an important precondition for our analysis because it shows our working definition, but also reveals underlying views of why resilience is important and has added value in comparison to other concepts.

2 | MAPPING THE CONCEPT

Different definitions of resilience of animals are used, but all definitions include the factors disturbance, response, and outcome. Animals are resilient when they can respond to external challenges and return to "normal" functioning in a relatively short period of time (cf. Döring et al., 2010), although of course what constitutes normal functioning and how short this period should be can be interpreted in different ways. Fish resilience can be understood as the capacity of fish to successfully respond to an external challenge so that they are able to function in much the same way as they did prior to the occurrence of the challenge.

This concept can be defined in contrast to the concepts of adaptation and robustness. At a certain point, when animals are often exposed to disturbances and respond by changing their behavior permanently, we can speak of adaptation rather than resilience: "As one moves from rare high-impact events towards more frequent disturbance events of moderate impact levels, the concept of resilience can be seen gradually to transform into something more akin to general adaptation" (Döring et al., 2013, p. 456). Adaptation likely carries a higher biological cost than resilience (Colditz, 2022). On the other hand, Colditz and Hine (2016) define robustness as "the capacity to maintain productivity in a wide range of environments without compromising reproduction, health and wellbeing. Robustness is manifested in response to persistent or cyclical attributes of the environment and is effected via activity of innate regulatory pathways." This is different from resilience that "is manifested in response to episodic, sporadic or situation-specific attributes of the environment and can be optimized via facultative learning by the individual" (Colditz & Hine, 2016).

Next to the conceptual meaning of resilience, there are also different views on why resilience is important. That especially holds for its connections to health and welfare. Being resilient increasingly tends to be taken as one criterion for health, and thereby our understanding of health is broadened. As Döring et al. (2013, p. 460) argue: "Resilience is meaningful in a dynamic understanding where health is not a potential end-goal or target (a state), but an ability to respond and interact with the environment throughout life, involving the physical body, emotions, psychological and behavioral aspects." They further claim that "a healthy animal has the ability to react, balance and restore itself to a certain degree, given that the surroundings allow this." (Döring et al., 2013, p. 460) However, there is a limit to viewing resilience as a criterion for health: an individual who starts off with a suboptimal health condition but can bounce back easily to that condition would be considered healthy according to the resilience criterion. For example, a fish that suffers due to poor water quality but recovers quickly from temperature stress shows resilience, but could still not be considered healthy due to the effects of poor water quality. Resilience differs from robustness in the sense that it focuses more on short-term disturbances and speed of recovery.

Since health can be considered as a parameter of welfare, resilience is also considered to be important in the context of animal welfare. One can even argue that as a response to "shortcomings of production as an indicator of welfare" resilience gained attention in recent years as a measure to promote animal welfare (Colditz, 2022,

p. 1440). Rather than with static views on animal welfare that focus on the absence of discomfort (Brambell, 1965), resilience fits with the allostasis model of welfare, which focuses on "stability through change" (Korte et al., 2007) and the ability to cope with an environment (Broom, 1986). It is not easy to measure resilience directly, because it is a "multi-faceted construct" (Colditz, 2022) and different individuals have different levels of resilience, due to different "'personalities." However, Colditz (2022) suggests that the level of resilience of animals can be indirectly inferred from physiological, behavioral and performance indicators. He also argues that a focus on resilience shifts attention to positive welfare, both in a hedonistic meaning of the term (feeling well) and an eudamonic one. The latter refers to notions of functioning well and fulfilling one's biological potential, as measured over a longer period of time, or in other words, flourishing. This is in line with more dynamic welfare concepts that define a positive welfare state in terms of the ability and opportunity to react adequately to internal and external stimuli, events, and conditions in a way that enable the animal to respond and "adapt to the demands of the environmental circumstances and reach a state that it perceives as positive, i.e., that evokes positive emotions" (Arndt et al., 2022, p. 3). Finally, resilience is a function not only of individual fish, but it can also refer to a whole fish population and even the whole aquaculture production system.

This explorative conceptual analysis of resilience is not meant to provide a definitive correct definition of resilience, but to show where ethical issues start, such as in potential conflicts between individual and population or production system resilience, or how the choices at a conceptual level influence which ethical issues become most prominent, such as one's views on the relation between health, welfare, and resilience. Within this context and with focus on fish in aquaculture, we further discuss four ethical dimensions related to resilience.

3 | RHETORIC OF OPTIMALIZATION

The concept of resilience is often presented as a positive addition to the debate on the use of animals (e.g., Arieda, 2023; Berghof et al., 2019; De Young et al., 2012). In particular, in contrast to views of animal welfare that focus mainly on the prevention of discomfort, such as the Five Freedoms (Brambell, 1965), the concept of resilience emphasizes the importance of the animal's ability to respond to external challenges and disturbances in a way that results in a situation that it evaluates as positive (Arndt et al., 2022; Broom, 1986; Colditz, 2022). As a result, resilience can be based on the idea that the more resilient an animal is and the better it can respond to its circumstances, the better its welfare and production characteristics will be. The idea that the ability to respond appropriately to external challenges coincides with traits that are also relevant to production, such as growth and health, seems to create a win–win situation that benefits both the farmer and the animal (Healey, 2009). On the one hand, improving the resilience of the animal can be beneficial for the animal, since it enables it to have better welfare. On the other hand, resilient fish are in the interest of the farmer because the fish are easier to handle, more productive, or less vulnerable to diseases or behavioral problems. Furthermore, the prevention of all kinds of health and welfare risks is difficult and often implies (high-)tech interventions. When improving fish resilience could replace these interventions, it supports the farmer. This win–win frame, however, is a normative frame that starts in moral assumptions and this line of thinking betrays a rhetoric of optimalization, which can be called into question. As Giersberg et al. (2022, p. 515) argue, enhancing resilience is usually seen as having positive value for animals, but it could be countered that "under ideal conditions, enhancing resilience would not be needed." This raises the question of whether improving resilience is ultimately done in the interests of animals or of the farmer. Because in most cases we keep animals for reasons of production, this human goal already frames the discussion on resilience. For example, aggression in juvenile Atlantic salmon, *Salmo salar*, can be a problem in terms of both fish welfare (Braithwaite & Salvanes, 2010) and production loss. Selecting fish that are more adaptable to novel situations and are less aggressive will improve their welfare and reduce production losses. However, the addition of a number of larger fish to tanks containing smaller fish has also been shown to be effective (Adams et al., 2000) and shows interventions to make the animals more resilient to be unnecessary. The assumption that enhancing resilience is a win–win situation can therefore be challenged. Related to this, one seemingly self-evident assumption is that sustainability of fish production is desirable. Resilience can play a role in this because morbidity and mortality are decreased the more resilient animals are (Scheffer et al., 2018), leading to lower costs and a healthier aquaculture industry. Yet, from the viewpoint of the fish, perhaps it would be better if fish production was not sustained.

From an ethical perspective, resilience not only answers a moral question, it also raises new ones. Even if a win–win situation can be achieved, it is important to explain the underlying interests and values of humans and animals. This is also important for the next ethical dimension: trade-offs.

4 | TRADE-OFFS

Often the above-mentioned win–win situation is not achievable. In those situations, resilience means making trade-offs between preferred responses to challenges from the perspective of the individual animal and collectives of animals or between human and animal interests or environmental considerations. For example, African catfish (*Clarias gariepinus*) have the ability to cope with low water levels and high stocking densities (van de Nieuwegiessen, 2009) and with bad water quality (Schram et al., 2010). They can therefore be kept at high densities in aquaculture for production reasons. However, high stocking densities are also recommended for welfare reasons. At lower densities these fish can become quite aggressive as a result of competition for space or food (Boerrigter et al., 2016). Making catfish more resilient, in this case by making them better able to grow in a high-density system, limits the species-specific ability to thrive and interact with other fish. Similarly, resilience is likely to imply trade-offs

between animal welfare and environmental sustainability by making aquaculture more sustainable. Resilience can also be used to adapt animals to system changes that reduce the environmental impact of fish farming, for instance by making fish able to grow on alternative protein sources. For example, plant-based proteins make aquaculture more sustainable (Baruah et al., 2017; Gómez et al., 2019). However, this may come at the cost of health and welfare risks for individual animals, for instance by the risk of impaired metabolism (Kokou & Fountoulaki, 2018) or affecting foraging behavior, or the other way around, if you could make an animal able to cope with poor water quality. This would improve the welfare of the fish, but still leave the ecological problems associated with poor water quality unaddressed. These trade-offs call for ethical reflection because they require careful assessment and weighing of values, such as biodiversity, welfare, food safety, and economy.

5 | BEYOND ANIMAL WELFARE

A third dimension that shows that resilience is intrinsically related to ethics is its link to animal welfare and other concepts from animal ethics. Already above we showed that the concept of resilience can be used to take a critical stance towards static views on animal welfare and definitions of welfare in terms of the absence of pain or discomfort or with a focus on biological functioning of an animal (Fraser, 2003). Applied to fish, function-based views are about the ability of fish to cope with farming conditions. This view easily leaves out the importance of fish having subjective feelings that are constitutive of their welfare (Duncan, 1993) and the ability of fish to display natural or species-specific behavior. One's view of how to conceptualize and operationalize animal welfare in the context of aquaculture cannot be seen independently of one's basic ethical assumptions and the theoretical framework used. For example, a utilitarian perspective, which takes the maximization of total welfare as the main ethical goal, is likely to start from an affective view of welfare. On the other hand, welfare defined in terms of the ability of fish to exhibit natural or species-specific behavior will be supported by an ecocentric theory that sees fish —as well as other human and non-human animals— as part of a wider ecosystem (Bovenkerk & Meijboom, 2013).

Finally, the concept of resilience fits in a trend in animal ethics that argues that animal welfare is only one of the important concepts to discuss what we owe animals. Already for decades other concepts in animal ethics have been introduced, such as animal integrity (Rutgers & Heeger, 1999), telos (Hauskeller, 2005; Rollin, 1998), or care (Donovan & Adams, 2007). More recently, animal ethics has seen a turn towards centering animals' own agency. Agency can be defined as "the capability of a subject to influence the world in a way that expresses her desires and will" (Meijer & Bovenkerk, 2021, p. 54). This means that we should not only focus on improving animal welfare, but also ask what the animals themselves want and how they can be given more control over their situation (Meijer & Bovenkerk, 2021). Adopting this notion of agency may also affect the definition of resilience and how it is operationalized, i.e., asking what the animals themselves want and give them choices so they experience more control over their situation.

6 | MANUFACTURABILITY

Finally, the use of the concept of resilience may reveal a certain moral outlook with regard to fish. On the one hand, resilience is portrayed as a positive characteristic of animals that enables humans to improve the welfare of fish. At the same time, it raises the question of how far we should stretch the "manufacturability" of fish and whether we should make the aquaculture system more resilient or the animals? When we physically adapt animals so that they can cope with difficult circumstances we may be stretching moral boundaries. For example, this raises the objection that we are instrumentalizing animals. This is not only applicable if resilience entails changing fish in a way that functions better in a production system, but already when we start treating or seeing fish as mere instruments to human purposes (Brom, 1997). This is often perceived to be a risk for situations that aim for increased production, but it is also a point of attention in the context of making food systems more sustainable. This objective also easily leads to situations where animals are either seen as a source of sustainability problems, for example because of the environmental impact of wastes such as manure and wastewater, or because animals are perceived of as instrumental in addressing challenges, for instance because of their ability to process human waste (Meijboom et al., 2023).

It is also important to make the moral view on animals explicit when discussing how to arrive at a situation that can be defined as resilient. Adapting the animal is the more commonly used strategy, which again starts in the "manufacturability" of fish. In practice, this means that the regular choice is to breed animals for resilience rather than to achieve resilience through "improved management practices that provide emotional and cognitive enrichment and stress inoculation" (Colditz & Hine, 2016, p. 1961). This approach links to what is called the "technological fix", i.e., "an attempt to solve problems using technology that will ultimately prove to be counterproductive" (Scott, 2011, p. 208). In the case of fish resilience, this may mean that starting with the "manufacturability"' of fish only addresses symptoms, rather than contributing to system innovations, or overlooking the necessary environment for the technological intervention to work. For example, if breeding is used to make fish better able to adapt to their environment, there is still a need to reduce the risk of harms "by good management of animals of appropriate genetic background in well-designed environments." (Colditz, 2022, p. 1435).

7 | CONCLUSION

Resilience in the context of aquaculture is never morally neutral. This means that when developing and implementing measures to increase the resilience of fish or a farming system, it is important to make the ethical dimensions explicit and to discuss them carefully. As a way of

addressing animal welfare issues and finding more sustainable production methods, it can be an answer to moral problems. However, this article has shown that the concept of resilience and its application to aquaculture also raises moral issues. This does not automatically mean that steps to make fish or farming systems more resilient are by definition morally undesirable. It does mean that those involved in research, fish breeding, housing design, and fish farming have a responsibility to reflect on these ethical dimensions. In practice, this means that for each step in the development of resilient fish or housing systems, the following questions should be addressed: (a) What is the goal and what makes it valuable, i.e., what values are at stake?; (b) Who is involved and for whom is this development or step important (human, animal, ecosystem)?; (c) Who and what needs to be adapted or changed to achieve this preferred situation (management, housing or production system)?; (d) At what moral cost will the situation be achieved?; (e) What are the alternatives? Especially when asking about alternatives, it is important to take a broad perspective to make issues such as the "manufacturability" of fish explicit and subject to discussion.

Acknowledging and incorporating the ethical dimensions of fish resilience into the development and implementation process takes time, but it is not a detour. It helps to achieve a situation where all involved are taken into consideration, including fish and ecosystems, and contribute to food systems that have public support.

AUTHOR CONTRIBUTION

Conceptualization: FM and BB equally. Writing – original draft – BB and FM equally. Writing – review & editing – FM and BB.

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