

Fish Welfare in Aquaculture: Explicating the Chain of Interactions Between Science and Ethics

Bernice Bovenkerk · Franck L. B. Meijboom

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Abstract Aquaculture is the fastest growing animal-production sector in the world. This leads to the question how we should guarantee fish welfare. Implementing welfare standards presupposes that we know how to weigh, define, and measure welfare. While at first glance these seem empirical questions, they cannot be answered without ethical reflection. Normative assumptions are made when weighing, defining, and measuring welfare. Moreover, the focus on welfare presupposes that welfare is a morally important concept. This in turn presupposes that we can define the capacities of fish, which is an empirical undertaking that informs and is informed by ethical theories about the moral status of animals. In this article we want to illustrate the need for a constant interaction between empirical scientific research and ethics, in which both fields of research make their own contribution. This is not a novel claim. However, the case of fish sheds new light on this claim, because regarding fish there is still much empirical uncertainty and there is a plurality of moral views on all levels. Therefore, we do not only want to show the necessity of this interaction, but also the added value of a cooperation between ethicists and empirical scientists, such as biologists, physiologists, and ethologists. We demonstrate this by considering the different steps in the process of reflection about and implementation of fish welfare.

Keywords Fish welfare · Moral status · Ethics · Empirical science

Introduction

In his novel *Saturday*, about 1 day in the life of neurosurgeon Perowne, Ian McEwan writes an interesting passage. Perowne is buying fish at the market, leading to the following reflections:

B. Bovenkerk (✉) · F. L. B. Meijboom
Ethics Institute, Janskerkhof 13A, 3512 BL Utrecht, The Netherlands
e-mail: b.bovenkerk@uu.nl

Naturally, Perowne, the fly-fisherman has seen the recent literature: scores of polymodal nociceptor sites just like ours in the head and neck of rainbow trout. It was once convenient to think biblically, to believe we're surrounded for our benefit by edible automata on land and sea. Now it turns out that even fish feel pain. This is the growing complication of the modern condition, the expanding circle of moral sympathy. Not only distant peoples are our brothers and sisters, but foxes too, and laboratory mice, and now the fish. Perowne goes on eating them... The trick, as always, the key to human success and domination, is to be selective in your mercies (McEwan 2005, p. 127).

This passage, to our mind, shows in a nutshell how people commonly think about fish. On the one hand it is acknowledged that animals feel pain and that this may be a reason not to eat them, but on the other hand, an exception is often made when it concerns fish. How often do vegetarians not have to answer the question: "oh, you are vegetarian? But do you eat fish?" As McEwan says, people tend to be selective in their mercies. But then again, maybe they have good reason to be. Perhaps there is a morally relevant difference between fish and other animals, in particular mammals, that warrants differential treatment. From an ethical point of view, fish form an interesting case. They form a borderline case, between on the one hand mammals—about which broad consensus exists, both on the basis of common sense and scientific research, that they are sentient—and on the other hand other natural entities, such as rocks, about which we are certain that they are not sentient. While most people now assume that mammals experience pain, not everyone is convinced that fish do. This leads them to treat fish differently than other animals. Whether or not fish indeed suffer less than mammals is in the first place an empirical question and we need scientific research in the fields of biology, physiology, and ethology to answer it. At the same time, as this article will make clear, it is a question that cannot be answered without ethical reflection. This is, firstly, because scientific research is value-laden (Longino 1990). Secondly, this is because the empirical evidence requires a normative framework in order to become action guiding in practices of aquaculture.

In this article, we reflect on the interplay between science and ethics in the context of fish welfare and the ethical treatment of fish. We start at the level of the current problems of implementation. We show how these practical problems are interrelated to a chain of questions and problems that cannot be addressed without a genuine interplay between science and ethics. This is not a completely novel point of view. Therefore, we build on prior research that has shown and analyzed the interaction between ethics and animal welfare (e.g., Fraser 2003; Haynes 2011; Rollin 2006; DeGrazia 1996). However, in this article we try to explicate and unravel the chain of questions and problems that show the interplay between science and ethics, because the mentioned authors often emphasize a specific part of the chain of questions. Furthermore, we will claim that in thinking about fish welfare there is no single or general interaction between science and ethics, but that it requires a process of continuous specific interactions. Finally, by analyzing the different levels of the interplay between science and ethics, and by pointing out

some of the challenges encountered at different points in the chain of questions, we aim to take the analysis of animal welfare a step further.

Seven Steps that Underlie the Problems of How to Improve Fish Welfare

In daily life fish welfare is often discussed in terms of problems of implementation, i.e., “humane” slaughter methods or housing systems that reduce aggressive behavior (e.g., Van de Vis et al. 2003). At face value these are mainly empirical questions that ask for evidence based decisions. Nonetheless, moral considerations often play an important role too. For example, how should we balance values related to animal welfare to other legitimate values that play a role in aquaculture? And why is welfare a morally relevant concept in the first place? To unravel the chain of questions surrounding the interplay between science and ethics we distinguish seven steps that underlie the applied question of how to improve fish welfare. First, when one wonders how to implement fish welfare standards one is not merely confronted with empirical questions. It also raises the question how we should weigh welfare vis-à-vis other values in aquaculture. This is primarily a normative question.

Second, this normative process of weighing welfare shows another cluster of science-ethics interactions. Weighing welfare already presupposes that we know what welfare means, in other words how we should define and measure welfare. Both defining and measuring welfare have empirical as well as normative aspects. Defining, measuring, and weighing welfare presupposes that welfare is an important concept, but from a moral point of view we can ask why? In other words, how to define the moral importance of welfare?

Third, although raising the question why welfare has moral relevance is primarily a normative undertaking, it relies on empirical research about the capacities of fish (and other animals).

Fourth, empirical research about these capacities is evidence based, but not neutral from a normative stance. The question what capacities of animals scientists should examine, is influenced by the normative and conceptual assumptions of one’s theoretical ethical framework.

Finally, even these normative theories about what capacities are relevant for attributing moral status do not only inform empirical research, but at the same time rely on empirical input.

This shows that the applied question of how to implement fish welfare in aquaculture is linked, via a chain of science-ethics interactions to rather fundamental considerations on moral status. This is not a novel claim. However, the case of fish sheds new light on this claim, because regarding fish there is still much empirical uncertainty and there is a plurality of moral views on all levels. There is, for instance, discussion on whether or not fish have moral status (cf. Bovenkerk and Meijboom 2012); there is uncertainty about actual cognitive or emotional capacities of fish (Braithwaite 2010; Rose 2002), and there are different views on the moral importance of welfare. Therefore, it is relevant to distinguish the different levels of interaction between science and ethics in order to get a grip on the (applied) questions of fish welfare. We have schematically depicted these different

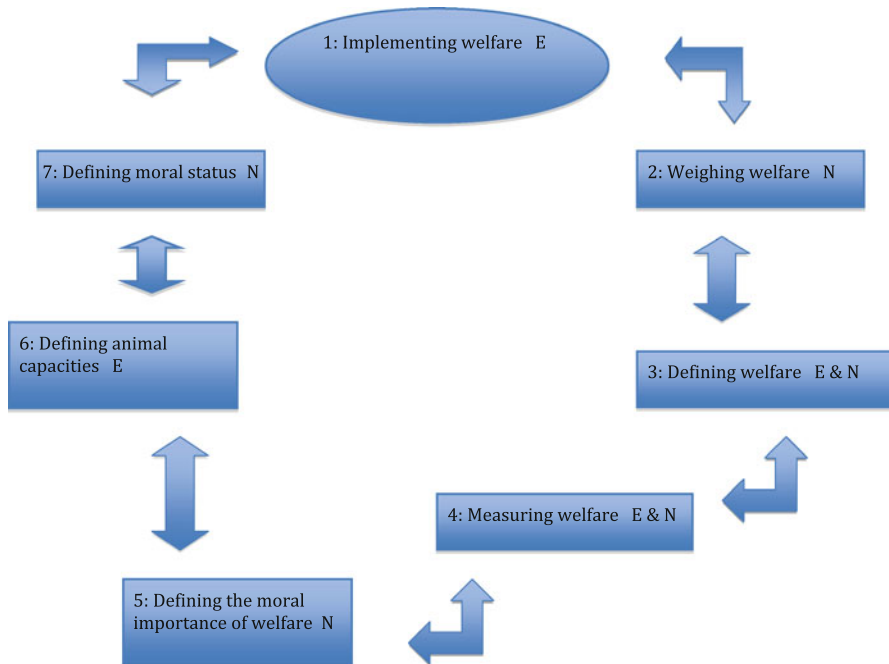


Fig. 1 Welfare Interaction (Statements marked with E are primarily empirical in nature and those marked with N are primarily normative in nature)

steps in Fig. 1. In this article the main focus will be on steps three till six of this figure.¹

Implementing and Weighing Fish Welfare

Though relatively new, aquaculture is the fastest growing animal production sector in the world (Bostock et al. 2010; FAO 2010). We are aware that aquaculture operates in an international context—in particular Asian countries dominate the aquacultural landscape, with 89 percent of production, and this makes the discussion about fish welfare even more complex—(Subasinghe 2009; FAO 2010). We have chosen to focus our discussion on Western countries, however, because this is where most work on the ethics/science interaction has thus far taken place. The sheer increase in numbers of fish being farmed, as well as lessons from more traditional animal production sectors, raises the question of how to guarantee the welfare of farmed

¹ We will focus on defining and measuring welfare, defining the moral importance of welfare, and defining animal capacities. Elsewhere we have already elaborated on defining moral status (Bovenkerk and Meijboom 2012). Moreover, the steps of weighing and implementing welfare are at the end of the chain, so to speak, and presuppose more clarity on the other steps. Therefore, we think it is important to focus on these other steps first.

fish.² Indeed, in Europe social concern for fish welfare and improvement of farming practices is increasing and this is picked up by researchers and the sector (Huntingford and Kadri 2009). For example, in the United Kingdom the Royal Society for the Prevention of Cruelty to Animals (RSPCA) has signed a covenant together with fish farmers in which they commit to a certifying scheme defining welfare standards for farmed Atlantic salmon, under the Freedom Food label.³ In practice, then, fish welfare is being taken more and more seriously. Special conferences are even organized about the welfare of fish.⁴ In all these activities that are part of increasing attention for fish welfare, it becomes clear that the practical implementation of this concept raises questions that are not limited to empirical facts only. This is the first indication that fish welfare, like animal welfare in general, is not a purely biological concept, but one that also has normative connotations.

Improving aquaculture practices by paying attention to fish welfare can be done in a number of ways. It requires decisions that are based on more than facts only, as the following examples make clear. In order to slaughter fish from fish farms it is common practice to transport the fish to specialized slaughter facilities. In order to keep the fish fresh—and comply with the value of public health—the fish have to be transported alive. To make transport manageable and efficient, the water is often drained out of the tanks, and the fish are transferred to other tanks with water, before they are loaded onto a truck. Both this loading and the transport itself can cause stress for the fish (Dalla Villa et al. 2009). The fish could be killed on site, but this is not cost-effective and may not meet strict hygiene standards. A trade-off therefore has to be made between the values of fish welfare, public health, efficiency, and cost-effectiveness. This example shows that the implementation of welfare measures implies that the value of welfare has to be weighed against other values.⁵

But even if the implementation of welfare does not directly conflict with other values, we still need to make normative decisions. For example, the European Food Safety Authority (2008) has developed a method for weighing welfare-impairing aspects of eel-farming. It has asked experts to score these aspects in a risk-analysis. According to the EFSA report, poor water quality is the most welfare-impairing problem in eel farming. For NGO's, on the other hand, slaughter of fish without prior stunning is on top of the list of welfare problems. ESFA regards this as less of a problem, in part because slaughter practices already fall under strict guidelines. This example shows that the stakeholders value different aspects of fish welfare differently. Both groups acknowledge the importance of the value, but they weigh welfare aspects differently. This cannot only be understood in terms of empirical knowledge of the eel and the practice of keeping and slaughtering, but is linked to normative choices.

² In terrestrial animal farming problems that have occurred include soil erosion, water pollution, green house gas emissions, deforestation, biodiversity loss, and animal health and welfare problems. See for example Barrett 2001.

³ See <http://www.rspca.org.uk/allaboutanimals/farm/fish>.

⁴ Besides the expert meeting that inspired this special issue, in February 2011 the Wellfish conference was held in Madrid, for example. At this conference all different aspects of fish welfare research were discussed.

⁵ Moreover, it needs to be noted that the implementation of welfare standards in aquaculture takes place in a political- and marketcontext. However, in this article we confine ourselves to ethical aspects.

Such differences have direct impact on the preferred way to deal with fish in aquaculture. This can be illustrated with the help of an example regarding the farming of naturally aggressive fish species. Placing these fish in high-density conditions could lead to attacks and hence to welfare problems. If all would agree on the importance of the value of welfare and agree that this kind of housing leads to welfare problems, then it is not directly evident how one should deal with this problem. First, scientists could try to select and cross less aggressive specimens, in fact changing the species to become less aggressive. Second, they could also examine what stocking density of these fish would lead to less aggression and change the density accordingly. A third option could be the claim that given these welfare problems these fish should not be kept under farming conditions.

This plurality of views on how to proceed with such aggressive fish is not a mere result of a lack of scientific consensus or ignorance, but it also shows that different normative choices can be made. Moreover, this plurality is increased because other issues than only animal welfare play a role, as will become clear later in this article. The divergence of views is linked to an underlying question, namely whether we should adjust the animal to its farming surroundings or whether we should adjust the farm to the animal. This question cannot simply be answered by doing more scientific research. For example, the habitat of fish that naturally live in sediment may not be easily mimicked in a farming system. Keeping them in a closed recirculation system may create welfare problems. While not much is known yet about what behavior is essential for fish and how these behavioral needs may be accommodated, the ethical question can be raised whether you should keep these fish at all. Being able to answer this question assumes that we have a view about the moral status of fish; it presupposes a standpoint on whether and to what extent fish matter. Also, it assumes that one knows what animal welfare means—how it should be defined and how it can be measured. These questions, while difficult enough regarding commonly kept terrestrial animals, are highly complex in the context of fish, as we still encounter uncertainty and dissensus regarding fish capabilities and, consequently regarding the moral status of fish. We will first deal with the matter of definition. While the concept of animal welfare may have the semblance of being an objective, scientific term, it is a term that in fact combines biology and moral norms. As Haynes (2011, p. 112) argues, “animal welfare is an evaluative concept, like product quality and building safety.” In other words, the discussion about the welfare of animals cannot be seen independently from normative assumptions. The question on which aspects of welfare one focuses is related to normative assumptions and is not theory-neutral. By this we mean that the way we think about welfare is framed by our theoretical background. In what follows we will point out such normative and conceptual aspects, both in the definition of welfare as well as in welfare assessment.

Defining Welfare

The definition of animal welfare has changed over time. This concept used to be defined as balanced biological functioning, but later subjective experiences of animals became the focal point. Early definitions that did focus on subjective

experiences emphasized the absence of negative experiences, disregarding the presence of positive experiences (Ohl and van der Staay 2011). Marian Dawkins' (2008) well-known definition that good welfare is achieved when animals are healthy and have what they want is a deceptively simple one. Having what one wants is limited by one's lack of imagination. If our everyday existence is boring and we do not know what we are missing, we never have frustrations either.⁶ However, then we miss positive experiences as well and these are as much part of animal welfare as the mere absence of negative ones (Duncan 2006). An emphasis on the negative aspects is found in the authoritative definitions of animal welfare. For example, in the field of animal agriculture it has become common to refer to the five freedoms of the Farm Animal Welfare Council (freedom from hunger and thirst, freedom from discomfort, freedom from pain, injury or disease, freedom from fear and distress, and the freedom to express normal behavior) in order to establish whether an animal's welfare is in jeopardy.⁷ Only the last freedom potentially entails positive experiences.

Some of these freedoms may in reality conflict with each other. For example, exploring a new environment may cause an animal stress, but it may voluntarily expose itself to this stress and it is debatable whether this stress should be considered a negative emotion (Ohl and van der Staay 2011). If we cannot guarantee all the freedoms at the same time, then we have to prioritize and how we do this will be based on normative assumptions. An example in aquaculture makes this clear: Piscivorous fish—who predate on other fish—often become cannibalistic in farming conditions. It could be argued that since aggression is a natural trait of these fish aggression should simply be tolerated. In other words, aggression in this view falls within the adaptive capacities of the animals and does in that sense not generate welfare problems. As noted before, one can also try to avoid cannibalism by reducing the fish's aggression, for example by sorting for and breeding with the less aggressive individuals. This in effect means that less aggressive fish will be bred and this increases their welfare in terms of freedom from pain and injury. However, it also means that they cannot express a part of their normal behavioral repertoire. A question the five freedoms concept gives rise to, of course, is what is meant by normal behavior. What is the standard by which to measure what is normal? Does this refer to the behavior that an animal displays in the environment in which it evolved? But what if the animal has been substantially changed through selective breeding? One could wonder what should define what. Does natural behavior define good welfare or is good subjective welfare the way to show what conforms to natural behavior? Moreover, one can wonder if it is an infringement on the animal's nature in itself to selectively breed certain key characteristics out of the animal.

⁶ Thanks to Peter Sandøe for pointing this out.

⁷ "The concept of Five Freedoms originated with the Report of the Technical Committee to Enquire into the Welfare of Animals kept under Intensive Livestock Husbandry Systems, the Brambell Report, December 1965 (HMSO London, ISBN 0 10 850286 4). This stated that farm animals should have freedom 'to stand up, lie down, turn around, groom themselves and stretch their limbs,' a list that is still sometimes referred to as Brambell's Five Freedoms." See <http://www.fawc.org.uk/freedoms.htm> (accessed on April 29, 2011).

The five-freedoms concept has been criticized for basing welfare on homeostasis, for being too static in its application of the freedoms (Korte et al. 2007). A more refined version of this concept focuses not on constancy, but on stability through change, which is termed *allostasis* (McEwen and Wingfield 2003). Adaptation and capacity to change are important determinants of welfare in this view. These developments in welfare research appear to be an improvement in the sense that they can overcome problems that are related to, for instance, the Brambell definition. Nonetheless, normative assumptions are still present and normative choices still have to be made. If we would emphasize positive welfare and the ability to adapt, rather than freedom from suffering, we would have to approach welfare differently; we would have to focus on realizing a positive state of being. As noted before, a certain amount of stress could be part of such a state. But how does one weigh the level of stress against positive welfare? In other words, how far does the adaptive ability of animals stretch? A stress-free life does not constitute welfare, but at what point do we decide that stress does impair welfare? The *allostasis* concept needs to be interpreted. In this concept a distinction is made between *eustress* and *distress*; the former still falls in the range of adaptive capacities of animals, and the latter does not (McEwen and Wingfield 2003). This implies that we have to determine what level of stress we deem acceptable and this is not merely a biological question. Deciding what is an acceptable level of stress is complicated in the context of fish, because we still lack a lot of relevant information. We do not know how to interpret data and what parameters to use, because we do not sufficiently know what capacities fish have. This, in turn, leads to normative dissensus, and this complicates the welfare definition even further. Another complicating factor is the enormous variety of different fish species; some fish species can adapt much better to novel objects, for example, than others.

In discussions about animal welfare, generally, three different groups of views can be distinguished: *function-based*, *feeling-based*, and *nature-based* views (Fraser 2003). If we apply this to fish, we could say that in the first group of *function-based* views the central question is whether fish can cope with farming conditions. The second group of *feeling-based* views works from the presumption that fish have feelings and that these are constitutive of their welfare (Duncan 1991). The third group of *nature-based* views presumes that welfare depends on the ability of fish to display their natural behavior. While these views are not necessarily mutually exclusive, they can certainly conflict in specific situations. For example, a fish may be able to cope well with stress caused by handling, because it happens to belong to a very robust species. This does not mean that it does not experience negative emotions associated with handling. Which of the three views one emphasizes depends on one's theoretical ethical background. A utilitarian that focuses on sentience and strives for maximizing overall welfare, would be more likely to hold the second view. Someone who argues from a holistic or *ecocentric* theory, in which nature is central, would more likely hold the third view on welfare. Even though many welfare definitions contain elements of two or even all three of these views, they usually emphasize one, and which one this is, is based on one's normative framework and is linked to broader normative ideas about how animals should live and about our relationship to animals.

An example not related to fish farming can make this last point clearer. In 2009, Wageningen UR Livestock Research designed a new type of dairy farm as part of a systems innovation strategy (Bos et al. 2009). The ideal behind this project was to combine the interests and needs of the farmer, the cows, the environment, and citizens. To this end they aimed to create a type of farm that would be cost-effective, that improved cow welfare, that was environmentally sustainable, and that conformed to citizen views about how cows should live. After citizen consultations it became clear that many citizens think cows should spend most of their time outside in the pasture. This seems to be based on a view of animal welfare that emphasizes natural behavior. However, animal welfare specialists argue that it is not necessary for cows to be outside in order to express their natural behavior. In fact, in some respects it may be better for them to spend more time inside, because then they are protected from the elements and pathogens. Moreover, cows are domesticated animals and one can wonder whether spending most of their time outside is still part and parcel of their “natural” behavioral repertoire. It appears that citizens’ views on how cows should be housed are not only based on considerations about how the cows feel, but also on an ideal picture of the cow in the pasture and perhaps ultimately on an archaic picture of nature as a big open pasture. This touches on cultural meanings of farming and shows that the welfare discussion takes place within a broader normative framework.

A similar discussion takes place between proponents of organic and proponents of “conventional” animal husbandry systems (van Niekerk et al. 2011). While the first operate from a view that animals should be able to display their natural behavior in a natural environment the latter argue that it is not necessarily conducive to the animals’ welfare to spend most of their time roaming around in nature, as this leads to increased health and welfare problems. Organically raised free-range chickens tend to have more parasites and to become ill more often than chickens that spend most of their lives inside a barn. Here we do not only see that a trade-off is made between protecting health or protecting welfare, but that it is contested already when welfare is best protected. From within a feeling-based view one could already wonder what the chicken would prefer: to be parasite-free or to roam around outside? Nature-based theories seem to suggest that regardless of the chickens’ own experience, freedom to move around outside is the best path to chicken welfare, because it is what wild chickens would naturally do. How one determines this question depends ultimately on one’s larger framework, on one’s worldview even. It is about how we think animals should be and about how much value we attach to notions such as wildness.

A final point showing the normative aspects of the concept of animal welfare becomes clear if we focus on what is excluded in definitions of welfare, rather than to look at what is included. Haynes (2011) describes the history of the concept of animal welfare and argues that this concept was appropriated by scientists who, while eager to make practices of animal use more animal-friendly, had an interest in the continued use of animals in science and for food. Pivotal to this definition is the assumption that an animal’s welfare is not harmed by killing it, as long as this is done as painlessly as possible: “a humane death was not a harm for animals that lacked a concept of their own death, so prolonged life was not to be considered a benefit” (Haynes 2011, p. 108).

If we relate our comments about defining welfare to fish again, we could say that regarding fish even more uncertainty exists than regarding the definition of mammalian welfare. Recent developments such as the allostasis concept appear to be applicable to fish as well (e.g., Schreck 2010, Varsamos et al. 2006, Van de Vis et al. 2012). However, less is known about fish capacities and preferences than about mammalian capacities and preferences, and this—as we shall see shortly—in turn is due to difficulties in measuring fish welfare. Moreover, regarding fish welfare we still encounter a higher plurality of moral views, due to the higher level of dissensus between moral philosophers about the moral status of fish than about the moral status of mammals. This dissensus, as we shall see, is (at least partly) based on the uncertainty about fish capacities and complicates the definition of fish welfare.

Measuring Welfare

Up until now we have argued that the question how to implement welfare leads to the questions how one weighs welfare vis-à-vis other values and how we can define it. The question of how to guarantee fish welfare in aquaculture assumes not only that we know what welfare is, but also that we know how to measure it. At first sight this appears to be a purely empirical undertaking, but here again an interaction between empirical science and ethics is present from the start. At many different moments in a scientific study value assumptions and judgments are made. Fraser (2003) shows how the three above-mentioned views on welfare influence welfare assessment up to the point where two groups of scientists that review the same research literature can come to opposite conclusions regarding the welfare of animals in specific housing conditions. In the particular case he discusses one group held the view that welfare constituted biological functioning, while the other group thought welfare was defined by how the animals felt and by how well they could display natural behavior. The animals did not show abnormalities in growth and reproduction and were generally healthy. On the other hand they exhibited fear, frustration, and lack of control and could not explore and root. This shows that what view of welfare one emphasises will determine the criteria and results of welfare assessment. Moreover, the first group only focused on those criteria that they thought could be objectively measured, and these were limited to quantifiable variables such as growth rate and incidence of disease. However, as Fraser argues, while these variables may be applied in an objective way the choice for these variables as such, leaving out others, includes some value judgment.

Moreover, some have argued that qualitative variables can and should also play a role in animal welfare assessment. Wemelsfelder (2007) has developed so-called qualitative behavior assessment (QBA) as a tool to determine the quality of life of farm animals. This method rests on the idea that people who work in close proximity to animals, such as animal caretakers, and that have observed specific animals over a long period of time can create qualitative welfare scales that go beyond subjective judgments. These scales are based on an assessment of the expressive body language of farm animals by experts. While some scientists argue that the affective states of animals cannot be assessed except by quantitative

measures, Wemelsfelder (2007) argues that quantitative measures (such as measuring cortisol levels) can only go so far in determining animal welfare and that they need to be supplemented with qualitative assessments.

Many scientists who do emphasize the feeling-based view on animal welfare also only use objectively measurable variables, such as preferences. They design preference tests where an animal is given the choice of several options, where they may have to work harder to achieve some options. The assumption is that if they are prepared to do the work for one particular choice, this shows their preference. If the animals have many of their preferences fulfilled this leads to better welfare. For example, Galhardo et al. (2009) developed a special push-door for measuring motivation in a cichlid fish; a fish with a strong enough snout to open the door and go after what it wants. If the fish chooses a particular type of substrate it is assumed that its welfare would improve if the fish were given this substrate in the fish farm. In practice, however, it is difficult to determine what an animal's welfare is. One can design preference tests, but it is unclear what one in fact measures by these. Haynes (2011) points out several problems with preference tests. Firstly, the fundamental assumption behind preference tests seems to be that the choices animals make in fact reflect their welfare or their best interests. Depending on the amount of choice the animal is presented with, it may be "simply choosing the lesser of two evils" (Haynes 2011, p. 111). Perhaps a third option, that is not tested, would much better reflect the animal's welfare. Moreover, it may just be choosing whatever it is familiar with; if it is exposed to different choices over a longer period of time its preferences may change. Finally, the animal may choose its short-term interests over its long-term interests, but it is not self-evident, to say the least, that it will thereby choose what is most constitutive of its welfare. This shows that solely focusing on the affective state of an animal at a specific point in time may be too limited a view of welfare. If an animal is given a choice between, for example, good tasting but unhealthy food and healthy food that does not taste as good, it may very well choose the unhealthy food. Here the functioning view conflicts with the feeling-based view on welfare (unless a long-term perspective of feeling-based welfare is taken) and it may be better in this case to let the functioning view prevail.

Apart from the fact that value-judgments are made when scientists decide what measures are important and what measures are deemed to be objectively scorable, two other steps in scientific welfare research include value-judgments; interpreting research results and applying them. As Fraser (2003) points out, sometimes scientific data do not generate clear-cut results and we have to make a choice in the absence of consensus. Such choices will reveal who we give the benefit of the doubt. Sometimes, however, it will be inherently impossible to generate clear-cut results and no amount of additional research will generate it. This may happen when we are dealing with incommensurable variables (do we focus on freedom of disease or freedom of movement, for example?) or when we need to balance the interests of different animals when we try to measure the welfare of a group of animals. Do we attach priority to the weakest animals or to juveniles, or to the most productive animals, for example? Some would argue that we should be impartial between different animals, and simply look at either the mean welfare or at some external

standard, such as benefit to us.⁸ Impartiality may be mandatory from the point of view of specific moral theories, such as utilitarianism, but is not self-evident from the perspective of other moral theories, such as relational ethics. This, again, underlines that there is no way of measuring welfare that is neutral. Moreover, even if we were to follow the requirement of impartiality, we could still disagree on whether we should also be impartial between fish and pigs, for example. This would suggest that the interests of fish and pigs should be weighed equally, but not all animal ethicists would agree. This disagreement goes back to a lack of consensus about the moral importance of fish. We will come back to this later, save to say here that one reason for this disagreement is that in the case of fish, measuring welfare is even more complex than in the case of mammals. Little is known yet about preferences and experiences of fish. Moreover, there are many different species of fish and if we found out what preferences one species has this would not automatically translate to other fish species.

So far, we have argued that in defining and assessing welfare an interaction between scientific methods and value-judgments is at play. We have also argued that assessing welfare is complicated by the facts that (1) scientific uncertainty exists about how to carry out and interpret welfare measurements, and (2) moral dissensus exists about what theoretical perspective should steer such measurements, and about the moral importance of fish. This moral dissensus is greater in the case of fish than in the case of mammals. An assumption that is made here is that animal welfare is morally relevant. But from a moral point of view we can ask why this would be the case. In the following section we will clarify this moral question and argue that it also relies on scientific input. However, this scientific input is itself not value-free.

Defining the Moral Importance of Welfare

Concerning ourselves with fish welfare assumes that their welfare is relevant and important for our moral decisions. It assumes that animals can experience pain and suffering and pleasure and enjoyment and that they have an interest in avoiding the first and experiencing the latter. This assumption, and the idea that we should take animal interests into account, is based on certain theoretical premises. For example, it fits within ethical theories that argue from the starting point of interests. Some theories, such as virtue ethical theories, however, do not give such a central place to interests.⁹ Some theories are more hierarchical and do not agree that the interests of all individuals count equally.¹⁰ Other theories do not focus on individual interests at

⁸ For an argument that impartiality is ultimately the right moral principle, see Ng (2000), Appendix 2, section 2.

⁹ While some virtue ethicists do assign an important role to interests, it is not their starting point and neither are interests used to assign moral status. According to Gruen (2010), animals get moral relevance in virtue ethical theories because we recognize them as part of our moral community.

¹⁰ For example, VandeVeer's (1979) theory of Interspecific Justice argues that the interests of beings with higher psychosocial complexity should override similar interests of beings with lower psychosocial complexity.

all, but rather on collectives, such as ecosystems or species.¹¹ From such a viewpoint, the avoidance of suffering is not what counts, but the survival of an ecosystem or species. The argument that is sometimes put forward in this context is that suffering is simply part of life and is one of the ingredients that gives life meaning, or at least that suffering has a function (Ohl and van der Staay 2011).

The focus on welfare also fits within theories that assume that the intrinsic characteristics of animals are what matters. It matters in these theories whether animals can experience pain or pleasure. However, some theories argue that extrinsic characteristics are definitive of our duties towards animals. In particular, relational ethical or care-ethical views in animal ethics suggest that we have obligations towards animals because we are in a specific relationship to them (Swart 2005). This means, for instance, that we have different obligations to different types of animal. We have more responsibility towards a farm- or a laboratory animal than towards an animal in the wild, for example. Before we claim that we need to implement, weigh, define, and measure welfare, therefore, we have already made the assumption that welfare matters and we have made certain theoretical ethical decisions.

In order to justify certain of these theoretical ethical decisions we need empirical input. In particular, the assumption that it is in the interest of individual animals to avoid suffering and experience enjoyment is based on the view that animals are sentient and that they have certain cognitive abilities. What specific capacities animals possess and how we can examine this is a question that has occupied biologists, physiologists, cognitive scientists, and ethologists for a long time. While these are primarily empirical questions, an interaction with ethics is necessary here again. This is because the methodologies used to investigate animal characteristics are not value-free and undisputed.

Defining Animal Capacities

As became clear above, we encounter a continuous interaction between views on the moral relevance of welfare on the one hand and empirical input on the other. What one investigates empirically, how one interprets it, and how one applies the resulting knowledge, is determined by one's moral starting point. At several points in the examination of animal capacities moral assumptions are made. In order to show how values enter into research methodologies regarding animal capacities, we want to have a look at a paradigmatic example; research into the question whether animals, and fish in particular, are sentient.

Sentience means more than just the capacity to feel pain, but for simplicity's sake we will here focus on the question whether fish can feel pain. The concept of pain seems straightforward, as everyone who has ever felt pain, knows what it is. Yet, when we want to operationalize pain research, we need to be clear on what we mean by pain. Pain can be defined in many different ways and even established definitions are subject to conflicting philosophical interpretations.¹² The International Association

¹¹ These are primarily ecocentric theories, such as that of Lawrence Johnson (1991).

¹² This section draws on a presentation made by Colin Allen at the expert meeting about fish welfare.

for the Study of Pain (IASP 1986, p. 217), for example, defines pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.” This definition includes both subjective experience and self-report on the one hand and objective damage on the other. This has led to conflicting interpretations by philosophers. DeGrazia (1998), for example, thinks that the reference in this definition to tissue damage clearly connects pain with nociception. Nociceptors are receptors that detect damaging stimuli and that cause a reflex response to damage. It has been established that teleost fish, such as the trout, have nociceptors (Sneddon 2002; see also Braithwaite et al. in this volume). However, nociception on its own, without conscious awareness of the damage, is not regarded by most as enough to establish pain. For the conscious experience of pain a signal would have to be sent through the spine to the brain (Braithwaite 2010). So we can distinguish between two phases of pain: nociception and conscious awareness of pain. The first phase is in effect the physiological basis of pain perception and the first and the second phase together combine to produce the experience of pain. Contrary to DeGrazia, according to Hardcastle (1997), the IASP definition completely discounts nociception in its definition of pain, as it mentions the experience irrespective of actual damage.

Not only the definition of pain is under dispute, but in order to establish sentience in an animal, pain researchers need to make assumptions about consciousness, assumptions that are not self-evident and that often involve value judgments. What exactly do we count as conscious awareness of pain? As Allen (this issue) also notes, we can distinguish between different types of consciousness, such as access consciousness, phenomenal consciousness, and self consciousness (see also Braithwaite 2010). It is generally thought that phenomenal consciousness is associated with being able to subjectively experience pain. But how can we establish whether an animal has phenomenal consciousness? As described in the first contribution to this special issue, Braithwaite (2010) designed a research strategy to test this in rainbow trout. Her assumption was that if the fish experience pain they cannot concentrate as well as usually, leading them to respond differently to novel objects. One central assumption was made in this ground-breaking research: fish will respond similarly to humans to a conscious experience of pain, namely by becoming less concentrated. This is an assumption that could be debated, of course. Much research into pain perception relies on a comparison with the way human beings experience pain, but it is quite possible that animals experience pain in a very different way, and that fish experience pain differently than pigs, for example. In fact, Braithwaite suggests herself that fish are “unlikely to perceive pain in the same way that humans do” (Braithwaite and Huntingford 2004, p. 87). Yet, in arguing that fish can experience pain she does rely on analogies between humans and fish. What does this example make clear? In order to determine whether animal welfare matters, we need to find out whether they have certain capacities, such as pain. Since animals cannot tell us that they experience pain, we need to devise experiments to find out. However, in the set-up of these experiments we need to make certain assumptions and these assumptions are not value-neutral; they are often influenced by our broader views and values.

Defining Moral Status

Defining the capacities of animals is an empirical undertaking in which certain assumptions are made, but it is also an undertaking that informs and is informed by theories of moral status. When we consider how to implement and weigh welfare measures in aquaculture we are making an implicit assumption, namely that the interests of fish should be taken into account in our moral deliberations, or in other words that fish are members of our moral community. Ethicists tend to translate the question of how we should treat specific animals into the question whether these animals have moral status. As we discuss elsewhere in more detail (Bovenkerk and Meijboom 2012) moral status is comprised of moral considerability—which means that an animal deserves consideration; it's interests should be taken into account—and moral significance—which says something about the extent to which its interests should count (see also Gruen 2010 and Goodpaster 1987).

It is important to make the distinction between considerability and significance, because an answer to the first does not lead to an unequivocal answer to the second. Even if two animal ethicists were to grant moral status to an animal on the same basis, say the fact that the animal can suffer, they could still reach different conclusions about how to treat the animal, because their argumentation is derived from different normative theories. So, for example, if two animal ethicists argue that salmon are members of the moral community because they have the ability to feel pain, for one this can mean that we can genetically modify the salmon as long as this does not cause welfare problems, while for the other this can mean that we cannot modify it, because this would not show it proper respect. The opposite is also possible: Two ethicists who both argue that welfare is important may have very different reasons for attributing moral considerability to animals. One might attribute moral status because animals are sentient and argue that only the suffering or enjoyment of animals matter in our moral deliberations. The other might argue that animals should be attributed moral status if they are self-conscious, but nevertheless argue that we should primarily take into account the welfare of the animals. This illustrates that while one cannot make statements about the moral importance of animal welfare without assuming the moral considerability of animals, the two steps in our figure “defining the moral importance of welfare” and “defining moral status” are different.

Different reasons have been brought forward by animal ethicists as to why animals would be morally considerable. According to most animals ethicists moral status depends on the possession of certain characteristics or properties. Here we focus on intrinsic properties, which are internal to the being whose moral status is in question (rather than external “properties,” which focus on relations, for example)—since intrinsic accounts are dominant in animal ethics. Empirical research is necessary to establish whether fish possess any of these properties. These internal property accounts start from the assumption that in order to be morally considerable a being has to have interests, and moreover, the being has to be able to experience this interest. If a being has interests it matters to it how we treat it. Different animal ethicists put forward different properties an animal must possess to be able to experience interests. The most basic property is the capacity to suffer and

enjoy, but additionally required properties may be awareness, self-awareness, self-reflective agency, or autonomous activity, for example. Animal ethicists may write about the moral relevance of certain properties as if these were simple observable facts about the creatures under discussion. However, these views need to be translated into empirically measurable parameters if they are going to do the work they are meant to. But how does one establish self-reflective agency or autonomous activity, for example? These are concepts that are pre-structured by certain normative frameworks.

In order to explain what we mean by this pre-structuring by normative frameworks, we need to make a short detour into ethical theory. We will only discuss two examples of theories of action, a utilitarian and a deontological one. First, in the view of Peter Singer (1975) entities deserve moral status because, and in as far as, they have the ability to feel pain and pleasure. As a utilitarian he argues that we need to maximize the good for all involved. While his basis for including entities in the moral community is that they have interests—and they can only have interests if they are sentient—the good that needs to be maximized according to him is not pleasure, but preferences (Singer 2011). As a representative of preference utilitarianism he, therefore, argues that we have an obligation to weigh the preferences of different entities against one another and choose the course of action that maximizes the fulfilment of preferences. Second, in the deontological view of Tom Regan (1983), entities deserve moral status if they are subjects-of-a-life, which could be taken to mean that they can experience their life subjectively. In order to experience one's life as a subject of it, one needs certain characteristics, which include sensitivity, but also self-awareness, memory, beliefs, perception of the future, and preference-autonomy. Regan, therefore, places stronger demands on entities' characteristics that confer moral considerability than Singer; for him it is not just about the capacity to feel pain and pleasure, but also about certain cognitive capacities.

The answer to the question of what entities possess moral status depends, therefore, on empirical input regarding these entities' capacities, and the question why these capacities are morally relevant is influenced by one's theoretical ethical framework. Deontological theories could be defined as theories that take something specific as valuable in and of itself; they take a specific *moral value* as a starting point. For Kant (2002) this was autonomy; in his eyes there would always be a link between autonomy and morality. This starting point of morality pre-structured his thinking and appears to also have pre-structured Regan's thinking. While for Kant it meant that nonhumans could not possess moral status, for Regan it means that they can in as far as they have certain characteristics related to autonomy. It explains why he focuses more than Singer on cognitive capacities and even takes some sort of autonomy as a defining characteristic of being a subject-of-a-life. Utilitarian theories, on the other hand, assume that we have to promote a specific *non-moral value*, such as happiness (Düwell 2008, Chap. 3). This explains why Singer focuses on the capability to suffer; the absence of suffering is a non-moral value that should be promoted. He does not want to take any moral starting point, like Kant does with autonomy.

So what exactly do empirical scientists need to research before they can answer the question if an animal, such as a particular species of fish, is morally considerable? This question cannot be answered independently of one's moral and

conceptual framework. If ethicists want to establish whether certain species of animal have moral status, they need scientific input, but this input itself needs to be the product of the interaction between science and ethics. If not, then scientists might examine characteristics of animals that are not deemed relevant by ethicists. An example is the research by Michel Cabanac, also mentioned in other contributions to this special issue. Cabanac argues that fish do not experience emotions and he came to this conclusion after examining two signs of emotion, emotional fever and emotional tachycardia—increased heart-rate and temperature—and these were not affected in fish after negative or positive stimuli.¹³ Apart from the fact that one can question the relevance of these criteria for a mainly cold-blooded species, animal ethicists may simply not be interested in increased heart-rate or temperature and these criteria may not be morally relevant. At the same time animal ethicists might demand that an animal has certain capacities to be morally considerable, but this demand may not be realistic from a scientific point of view, because it would be impossible to examine—an example could be self-reflective agency—or because it flies in the face of well-established scientific views.

Conclusion

The implementation of welfare measures in aquaculture could be seen as the endpoint of a line of reasoning in which an interaction between ethics and empirical sciences is necessary. We have pointed out seven steps in which the ethics/science interaction is present (see Fig. 1). First, when implementing welfare measures in aquaculture priorities have to be set; farmers can choose to put more emphasis on some rather than other measures and they will base this choice on a combination of moral values and empirical reasoning. Second, implementing welfare standards presupposes that we know how to weigh animal welfare in relation to other values, such as hygiene or public health. Third, in order to be able to weigh animal welfare with other values, we need to have a clear idea about what we consider to constitute animal welfare. Welfare can be defined in a number of different ways, and how one does this depends on moral commitments as well as scientific assumptions. Fourth, implementing welfare does not only assume that we can weigh and define it, but also that we can measure it. While at first glance this seem an empirical undertaking, it certainly has an ethical component. In short, normative assumptions are made when weighing, defining, and measuring welfare. Fifth, the focus on welfare presupposes that welfare is a morally important concept. Holding that animal welfare matters in our moral decision-making assumes that animals can experience pain and suffering and pleasure and enjoyment and that they have an interest in avoiding the first and experiencing the latter. This in turn, sixth, presupposes that we can define the capacities of animals, which is an empirical undertaking that both informs and is informed by ethical theories about the moral status of animals. Seventh, then, implementing fish welfare presupposes that fish have moral status; it

¹³ This was the main argument Cabanac put forward during the expert meeting in Utrecht. See also Cabanac et al. (2009).

presupposes that they are morally considerable, and it is dependent on which moral theory one embraces how significant fish interests are deemed to be. Empirical research is necessary to establish whether fish possess any of the properties that animal ethicists deem relevant for establishing moral status. At the same time, the questions asked in empirical research into animal capacities are driven by what is relevant according to ethical theories. In this constant interaction between empirical and normative questions and assumptions, both ethics and the sciences make their own contributions. Scientific research can provide new conceptualizations of animals, because new evidence comes to light, it can examine what capacities animals have, it can devise experiments to measure the welfare of animals, and it can devise tools to improve animal welfare, such as stunners to render animals unconscious before slaughter. Ethics can introduce new concepts, can consider the broader context of concepts such as welfare, can point out value assumptions in scientific research and in definitions of welfare, and can provide theoretical background considerations, for example regarding moral status.

Even more fundamentally, the questions which animals are morally considerable and how we should treat them presuppose that we have reasons to behave morally in the first place. This gives rise to a deeper question, namely “why be moral?” Even though we cannot go into this here, in the context of this paper it is interesting to note that for some philosophers, answering this question means that we look at biology. In their eyes it presupposes a story about the evolution of altruism in our species and they base this view on the results of biological and ethological research.¹⁴ Even at the most fundamental level, then, the interaction between science and ethics could be at play.¹⁵

We hope to have shown that the discussion about the welfare of fish in aquaculture, and more broadly the animal welfare discussion, can benefit from more cooperation between the different disciplines of ethics, biology, physiology, cognitive science, and ethology. Yet, we have argued that implementing fish welfare is even more challenging than implementing welfare standards of the mammals we farm, for two reasons. Firstly, in all the steps of the interaction we are dealing with scientific dissensus or uncertainty. While the consensus amongst scientists increasingly seems to be that fish can suffer, not much is known yet about what exactly makes them suffer or about what their preferences are. Research is complicated by the fact that fish seem so different to us; we cannot read their facial expressions, or hear their vocalizations, if they have them at all. Their brain structures are quite different to ours, even though functional similarities may certainly be present. Finally, there are so many different

¹⁴ For example the work of famous primatologist Frans de Waal (for example, 2006), who sees evidence for empathy as the basis of morality in non-human primates and the work of Boyd and Richerson (2009), who argue that human morality is a result of the fact that cooperation gave humans an evolutionary advantage and that this could come about through the process of cultural adaptation.

¹⁵ Of course, if we can explain to a certain extent on the basis of biological or ethological research why we behave morally, this does not yet explain why we should. Most normative theorists do, therefore, not think this biological or evolutionary explanation is sufficient, or even relevant. We merely wish to point out here that the interaction between science and ethics even plays a role at this level, even if only in a descriptive ethical sense.

fish species and such great variability between them, that research done in one species does not unproblematically translate to another species.

Secondly, moral dissensus complicates each step that we have described. The theoretical ethical perspective one embraces is formative for many of the moral questions that play a role in implementing fish welfare. It influences how one defines welfare—with more focus on functioning, affective state, or natural behavior, for example. It also influences what research questions are relevant and how research results should be interpreted. Moral disagreement permeates discussions on moral status and this disagreement goes back to fundamental, even meta-ethical assumptions.

A standard response to the existence of uncertainty about fish welfare is that more research should be carried out. While we certainly support more research, we do want to point out that such research is never value-neutral. Considering the moral pluralism that we sketched, this could lead to a paralyzing conclusion. We do not think this is necessary, however. In practice, we can still strive for consensus on how to implement welfare measures. In this process, it is crucial to be aware of normative presuppositions and to ensure interaction between ethics and science. Pluralism regarding the moral status of fish and uncertainty about fish capabilities and preferences should not stun us into taking no action at all. In pluralistic and uncertain circumstances a precautionary approach can be invoked. In the absence of absolute certainty, if we still have good reasons to believe that certain measures improve fish welfare, we should give them the benefit of the doubt.

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