Abstract

Descriptions of feeling states in nonhuman animals have relied on indirect evidence from empirical data. Assumptions that fish do not experience suffering lack evidence and in fact contradict a large body of indirect scientific evidence and ethical concern. Why should the burden of proof rest on those defending the hypothesis that fish feel pain and other discomfort? In this article I address this controversy and describe typical methods—and the problems associated with them—to identify animal welfare (feeling-based, physiological, and behavioral approaches intended to demonstrate feelings and welfare states). Then I urge a shift in scientific focus from efforts to either identify an internal state of well-being or determine whether an organism suffers, to efforts to identify conditions that promote a “good state” for an animal (i.e., a state it would choose). For this approach, I discuss preference tests and their implications for scientific research, teaching, aquarism, and fishing.

Key Words: aquarism; behavior; fish; fishing; physiology; sentience; stress; teaching; welfare; well-being

Introduction

Researchers concerned about animal welfare generally presume that animals are capable of suffering or discomfort (Dawkins 2006; Duncan 2006; FSBI 2002; Huntingford et al. 2006). Such an assumption, however, is not always evident from observations of nonhuman animals and is highly susceptible to the influence of the observer’s scientific, philosophical, and/or religious background. For these reasons animal welfare is a controversial topic. A brief historical review of studies of animal welfare may help to (1) explain why certain approaches have arisen for assessing fish welfare and (2) highlight the challenges associated with such studies.

Philosophers and scientists have, respectively, argued for or searched for evidence that nonhuman vertebrates are conscious, emotional, cognitive beings, even at the lowest level of sentience (Huntingford et al. 2006; Jennings 1998; Lehman 1998). But because of the empirical basis of scientific knowledge and the contrasting intangible nature of emotion, cognition, and consciousness, scientists have had difficulty providing clear evidence of such properties in nonhuman animals (Dawkins 2006; Duncan 2006; Sandoe et al. 2004; Volpato et al. 2007). In addition, economic interests have significantly hampered discussions of animal welfare (e.g., Arlinghaus et al. 2007). This review provides a brief description of these controversies and emphasizes fish wants as a criterion for assessing fish welfare.

Historical Roots

Until the Renaissance, commonsense observations of domestic animals as conscious beings were acceptable (Duncan 2006). But in the 17th century Descartes conceptualized the brain and the mind as two separate entities, and attributed the mind only to humans, thus portraying animals as creatures without emotions and feelings (Jennings 1998). Most western religions reinforced this anthropocentric view that humans are rational beings and nonhumans nonrational.

In the next century, however, the English social reformer Jeremy Bentham (1748-1832) proposed that nonhuman animals could experience pain and suffering (Duncan 2006). And in 1839, veterinarian William Youatt (1776-1847) averred that the difference between humans and other animals was mainly a matter of degree, not quality (Duncan 2006). A few decades later, Darwin’s theory of species evolution presented the notion that emotions could be an adaptive survival trait not exclusive to humans.

But by the early 20th century, behaviorists were arguing that the study of animal behavior should not involve subjective concepts such as sensation, perception, thinking, and emotion (Watson 1928 cited in Duncan 2006) but instead should rely exclusively on stimuli and responses. Ethologists partly accepted this view but continued to consider subjectively attributed emotions such as frustration, fear, and pain, among others (McFarland 1981).

Modern History: Developments in the United States and United Kingdom

After World War II, the need for prosperity and for rebuilding accompanied a growing economic interest in animal...
production technologies. These developments, and the concomitant belief that nonhuman animals do not experience the emotions that create expectations of suffering and discomfort and therefore do not deserve welfare attention, gave rise to practices that ignored animal suffering. Ruth Harrison (1964), in her book *Animal Machines*, dramatically exposed such practices, prompting the British government’s Brambell report1 in December of 1965, a report that provided important and insightful recommendations for animal welfare practices. The report stated that animals likely experience most human feelings, but at different intensities.

Also during this period, the United States passed two federal laws regulating the treatment of farm animals to promote livestock husbandry and care practices that generally prevent or minimize pain during all phases including transport to slaughter (see Mench 2008).

In December 1979 the United Kingdom’s Farm Animal Welfare Council (www.fawc.org.uk) identified the proper conditions (the “Five Freedoms”) for farm animals (cattle, pigs, sheep, and chickens): (1) freedom from thirst, hunger, or malnutrition; (2) freedom from discomfort (e.g., appropriate housing); (3) freedom from injury and disease (i.e., prevention or rapid diagnosis and treatment); (4) freedom to display most normal behaviors; and (5) freedom from fear.2 The statement defines rules concerning appropriate biological functioning (with respect to thirst, hunger, shelter, injury, and disease) and thus establishes the foundational criteria for basic captive animal welfare; but the definitions of comfort, normal behavior, and recognition and avoidance of fear in captive animals are unclear in the report. Definition of the criteria for emotional welfare is therefore the next, imperative step.

The UK Council also recognized a need for studies on (1) the physiological and behavioral needs of farm animals and (2) animal ethics.

### Conceptualizing Fish Welfare

Consideration of animal welfare entails acceptance of an animal’s consciousness of suffering or discomfort (Dawkins 2006; Duncan 2006; Huntingford et al. 2006). Yet, despite widespread acceptance among scientists that fish are capable of suffering (since the 1990s the number of animal welfare scientific studies has exceeded 1000 per year; see reviews in Dawkins 2006, 2008; Huntingford et al. 2006; Volpato et al. 2007, 2009), the balance between a fish’s quality of life and human interests (mostly economic) remains controversial (see Huntingford et al. 2007). Because fish are in a strategic phylogenetic position among the Vertebrata, from an evolutionary standpoint if they deserve welfare attention, the other vertebrates certainly do as well. However, fish welfare studies are less favored because understanding of invertebrate welfare is still very much an emerging area; if welfare concerns were recognized for invertebrates, it would be easier to deal with human conceptions of fish welfare.

Fish welfare is the focus of this review but because studies specific to fish are new and therefore limited in the animal welfare literature, I complement the discussion with welfare approaches common to other animals. In lieu of an extensive literature review, I summarize and update the main current ideas on animal welfare assessment, the general concepts of which are more thoroughly discussed in numerous recent reviews (e.g., Bekoff 2008; Broom 2008; Brydges and Braithwaite 2008; Dawkins 2008; Fraser 2008; Gómez-Laplaza and Gil-Carnicer 2008; Hogan and Phillips 2008; Jensen et al. 2008; Medina 2008; Mench 2008; Passantino 2008; Pelletier et al. 2007; Takahashi-Ohme and Omoe 2008; Van de Weerd and Sandilands 2008; Veissier and Forkman 2008; Veissier et al. 2008; Volpato et al. 2007, 2009). Also of interest is a 2006 issue of the *ILAR Journal* devoted to the use of mammals in research (ILAR 2006); the articles lacked general guidelines but described species-specific approaches that minimize adverse effects and uncontrolled causes of variation in data while improving animal welfare (Everitt and Scharpio 2006), and they made important recommendations for acclimation periods and conditions for baseline data.

Most interpretations of animal suffering are based on anthropomorphic approaches (Arlinghaus et al. 2007, and for a critical perspective Jennings 1998) and/or on the belief that emotions can be empirically demonstrated (Sandoe et al. 2004). Some alternative empirical methods use preference tests to determine conditions that promote animal well-being or a favorable state, rather than trying to empirically prove that the animals deserve welfare concerns. Studies of fish (and more generally animal) welfare usually follow one of three approaches: feeling-based, physiological, and behavioral. (The fish literature has focused on the second approach, in studies of suffering in terms of pain—see Sneddon 2009 in this issue—and stress, as discussed below.) I discuss these approaches and their implications for research.

### Feeling-Based Attempts

The feeling-based approach consists of investigating animals to scientifically prove, or disprove, that nonhuman animals are sentient beings (i.e., that they experience feelings and may suffer). This approach measures behavioral outcomes (e.g., willingness to “work” to achieve a desired condition) or signs (e.g., fear or avoidance of an aversive condition) (Hewson 2003). Data on homology between nonhuman and human vertebrate brains (Bermond 2001; Chandroo et al. 2004; Sneddon 2006), behavioral studies suggesting cognitive function in nonhuman vertebrates (Chervova 1997; Porteros et al. 1999; Sneddon 2003), and the evolutionary paradigm all have provided evidence of feelings in nonhuman vertebrates, including fish. Huntingford and colleagues

---

2. These originated with the 1965 Brambell Report, but also echo the “four essential human freedoms” that President Franklin D. Roosevelt articulated in 1941 (e.g., freedom from want and freedom from fear).
(2006) and I (Volpato et al. 2007) have examined the feeling-based approach and its logic and conclude that, in the absence of proof to the contrary, one should assume an ethical position concerning suffering in a nonhuman animal. If this is accepted, the next step is to determine how to assess fish welfare (more on this below).

**Physiologically Based Attempts**

Many scientists have attempted to identify morphological and physiological bases of suffering in nonhuman animals mainly by measuring pain. Although this approach is important, pain is but one aspect of all welfare concerns.

Lynne Sneddon (2003) found that when she subjected rainbow trout to potentially painful acetic acid and bee venom, the fish exhibited physiological (increased ventilatory rate) and behavioral reactions suggesting nociception, responses that were abolished when the fish received morphine in advance. Although this experiment suggested that fish feel pain, it did not identify the emotions associated with the pain; rather, it demonstrated pain anatomically and electrophysiologically in neural substrata (A-delta and C fibers) (Sneddon 2006, 2009). James Rose (2002) failed to detect any neural connection that would suggest nociception reaches superior brain areas in fish, although other anatomical studies have traced such neural pathways (reviewed in Sneddon 2006).

In a subsequent experiment Sneddon (2006) used functional magnetic resonance imaging (fMRI) of the common carp (Cyprinus carpio) brain to show significant activity in the forebrain, followed by activity in the midbrain and hindbrain, during noxious stimulation. She also supported this conclusion with enhanced gene expression in these regions after nociception stimulation in the carp and rainbow trout.3

These approaches, however, are suggestive but not sufficient to prove that emotions are associated with painful conditions (for more considerations, Volpato et al. 2007, 2009). The detection of brain activation alone is usually not sufficient to identify the mental state (e.g., suffering), hence the weakness of these studies.

Another line of physiological studies uses stress as a measure of animal welfare, with low stress equating to good welfare (FSBI 2002; Huntingford et al. 2006; Van de Nieuwegiessen et al. 2008). In fact, one can condition fish to stressors; a recent study (Moreira and Volpato 2004) demonstrated pavlovian conditioning of stress-induced hormone modulation in fish, a memory that persisted in trout for several weeks (Moreira et al. 2004).

But some stress might be part of the welfare state. Migratory species, for example, have high energetic demands during migration (Butler et al. 1998; Shmueli et al. 2000; Tudorache et al. 2008; Volpato and Trajano 2006), demands driven by evolutionarily selected genetic forces that may cause physiological stress that could be misinterpreted as a poor welfare state. Fish mating contests also provoke stress, but it may not be a sign of poor welfare. Moreover, cortisol, the main stress hormone measured in vertebrates, is reported to both (1) ameliorate (survival in wild rabbits, Cabez et al. 2007; memory in migratory fish, Carruth et al. 2002; survival in lizards, Comendant et al. 2003, Cote et al. 2006; learning in men, Duncko et al. 2007; motor tasks in mice, Pallarés et al. 2007; and social interaction in young men, Roney et al. 2007) and (2) impair life conditions (reviewed in Korte 2001). It is therefore appropriate to exercise caution in interpreting low cortisol levels because under stress the capacity of the interrenal tissue to produce cortisol might be exhausted (FSBI 2002). I have recently discussed these contradictions in detail (Volpato et al. 2009), emphasizing the weakness of using indices of stress and distress (as defined in Moberg 1999) as indicators of poor welfare, particularly when stress might be part of an animal’s well-being and, conversely, a healthy and unstressed animal might not be in a good state. Physiological standards without consideration of the environmental context are likely to be useless.

Another physiological approach for measuring fish welfare suggests that an internal state of welfare is associated with a standardized physiological pattern (similar to that which occurs during stress), and investigators have attempted to identify such a pattern (e.g., in hormone levels) (Cubitt et al. 2008; FSBI 2002; Øverli et al. 2007). But this pattern should comprise both energy-preserving and -demanding mechanisms, which are part of the welfare state. Evolution of a unique physiological pathway to indicate well-being is thus unlikely (Volpato et al. 2007, 2009).

**Behavioral Attempts**

To overcome the challenges described above, some researchers have used behavioral indicators of welfare, because they account for both internal and external conditions, to create what may be a preferable whole-organism approach. But scientists often do not completely understand the complex frameworks that produce behavior and so rely on behavioral analyses to infer emotions, cognition, learning, preference, and choice (reviewed in Brown et al. 2006). The usefulness of such inferences, however, depends on an assessment of underlying assumptions.

Scientists who study emotion, cognition, and learning sometimes assume a “black box” approach, based on imposed conditions (inputs) and resulting behaviors (outputs), to infer physiological and psychological mechanisms and properties, an approach that was significantly improved by the addition of invasive techniques that directly manipulate the animal’s control (i.e., nervous and endocrine) systems. Methods for this approach include ablation or lesion (Broglio et al. 2003; Rodríguez et al. 2005), hormone manipulation

---

3 In a comparative study of corvids and apes, Emery and Clayton (2004) corroborated that cognition might evolve through a process of divergent brain evolution with convergent mental evolution, thus supporting the hypothesis that intelligence (in this approach, a “superior” mental state) can have evolved even in the absence of a prefrontal cortex.
(Barreto et al. 2006), genetic selection and genomics (Jensen et al. 2008), physiological stimulation (Sneddon 2006), the use of individuals with different physiological baselines (Moreira et al. 2004), and correlation studies of behavior and physiological levels (Gonçalves et al. 2008; Oliveira et al. 2001). These methods provide credible evidence of emotions in animals (reviewed in Brown et al. 2006).

Yet, although these approaches are among the best choices, they are still incomplete.

Challenges in Assessing Fish Welfare

Attempts to determine the welfare state of nonhuman animals are far from solution. In hopes of enhancing such efforts, I change the focus from trying to identify an animal’s internal state of well-being or trying to demonstrate that organisms suffer, to searching for conditions in which an animal is in a “good state,” which I define as one that the animal would choose. The challenge is to define such conditions without inferring the internal states or feeling of animals.

Marion Dawkins (2006) calls on humans to consider what animals “tell” us:

> There is a danger that well-meaning people define animal welfare in terms of what they think animals want or what pleases them. But if we take animal sentience seriously, we must ensure that the animal voice is heard…. We now have…methods for “asking” animals what they want and we should…use this evidence…and ask the animals rather than automatically assuming that we know from our human standpoint. Animals are not…looking at the world through human eyes and science can help us…to look through those different eyes. Real respect for animals will come when we see them as sentient beings in their own right, with their own views and opinions, their own likes and dislikes. The animal voice should be heard. (Dawkins 2006, 4, 9)

Based on these ideas, my colleagues and I have defined fish welfare as “the internal state of a fish when it remains under conditions that were freely chosen” (Volpato et al. 2007, 170). More recently, Dawkins (2008, 943) added that “healthy animals that have what they want” can be said to enjoy good welfare.

There are reasons both for and against using the preferences of a fish as an indicator of conditions that improve the animal’s welfare (technical considerations for preference tests are described in Volpato et al. 2007).

It is important to begin by differentiating between choice and preference (although the literature uses both interchangeably). Choice designates the (potentially variable) selection of one or more possibilities, whereas preference refers to more stable and consistent choices that appear to reflect a predisposition in favor of something. Investigators detect choice operationally and may infer preference from repeated choice tests. During species evolution, choices might determine survival (e.g., a wrong time to forage might result in death), whereas preferences are more likely informed by genetics (Dadda et al. 2008; Houde and Endler 1990) and/or experience (Walling et al. 2008).

The use of preferences in studies of animal welfare presumes that keeping an animal in a place or condition that it wants or needs improves its welfare. But animals (like humans) may not choose what is beneficial—although satisfaction of an animal’s preferences should ameliorate the animal’s internal state, it may not promote success in future outcomes (Broom 2008).

The balance between risk and immediate needs or wants depends on the relative strength of countering forces (Dill 1983; Sumpter et al. 2008), whether biological and/or psychological. According to behavioral ecologists, genetic mechanisms that favor survival control these decisions. In decision-making studies, a fish facing a predator usually chooses to stay in a protected area, but as its hunger increases the fish chooses to leave the protection to get food despite the risk of predation (Jordão 2004). Thus even if emotion is a driver in the decision making (in primates, Rolls and Grabenhorst 2008; in humans, Cabanac 1999; in animals generally, Fraser and Duncan 1998), natural selection might favor the best decision in terms of increasing fitness. Conversely, although some feeling-based decisions at the individual level may impair future life, the animal may not have been in poor welfare when it made the decision. There has been progress in the identification of suffering states (e.g., pain, fear, frustration, and deprivation), but little effort to identify pleasure states through motivational and emotional studies (Duncan 2006). Pleasure seeking may make choices more labile in terms of survival; therefore, the association of preferences to longer-term health and survival seems inappropriate.

Although animal wants are easily detectable from choice tests, they are also identifiable through operant conditioning techniques, in which the animal performs an activity either to obtain something necessary or pleasant or to avoid something harmful or aversive. These techniques require more complex and more time-consuming experiments. But they are useful not only for studies of fish cognition (reviewed in Brown et al. 2006) but also for studies to determine how much an animal wants a condition—the more desirable the stimulus, the faster the learning acquisition or the greater the willingness to overcome an obstacle. Thus, for example, the measure of animal force to lift a door and get a reward indicates the strength of the animal’s desire for the stimulus or condition (see also Dawkins and Beardsley 1986; Duncan 2006; Mason et al. 1998, 2001). These techniques complement the choice/preference approach in assessments of animal welfare.

Applications and Implications of the Preference-Based Concept of Fish Welfare

If a fish has a choice between nature and confinement by humans, it may be logical to expect that the fish would prefer to live in nature. Yet it may also be logical to suppose
that the fish would be perfectly satisfied living safely in a protected area with ample food, rest, and mates (although perhaps not if only for a short time before its life-ending use by humans).

Human strategies to keep animals for use developed over the millennia during the cultural and biological evolution of human customs. But the human use of various animal species raises ethical concerns and therefore warrants an examination of welfare concepts. If humans use physiological standards to understand animal welfare (or well-being), those standards should be incorporated in the development of sophisticated and complex welfare plans. Thus, for example, a choice-based fish welfare plan should incorporate rearing activities tailored to fish preferences based on species, ontogenetic phase, and population origin.

In the following sections I consider the implications of fish welfare practices for scientific research, teaching, aquarism, and fishing.

Scientific Research

Humans, with the ability to control biological systems, use science to solve problems—for example, by using animals to study human diseases, a practice that is usually acceptable because of the human health value (such a use is similar to fishing for food given the human nutritional benefits). Similarly, the results of studies on fish may be generalizable to improve understanding of species of economic interest or to suggest possible future applications for fish and/or humans.

Whatever the motivation for the research, numerous studies have shown that fish are very sensitive to a wide range of cues—chemicals (Giaquinto and Volpato 2005; Jordão and Volpato 2000; Vavrek et al. 2008), sounds and other water vibrations (Bleckmann 2008), electrosensory stimulation (Hitschfeld et al. 2009, in this issue), light intensity (Migaud et al. 2007), background and light color (Van der Salm et al. 2004; Volpato and Barreto 2001), stocking density (Turnbull et al. 2005; Van de Nieuwegiessen 2008), social interaction (Alvarenga and Volpato 1995; Renn et al. 2008), and handling (Soso et al. 2008), among others. As these studies indicate that fish are highly sensitive animals and may therefore be capable of suffering, animal welfare committees in a variety of countries believe scientific research should abolish fish suffering or reduce it to a minimum.

Welfare guidelines recommend the use of anesthetics during fish handling practices (e.g., weighing and measuring, blood sampling, electrode implantation) and some studies are evaluating such drugs for potential hazardous effects (Barreto et al. 2007; Gontijo et al. 2003; Yoshimura et al. 1981; for a review, Neiffer and Stamper 2009, in this issue). Similarly, Johansen and colleagues (2006) have provided extensive guidelines for monitoring the health and welfare of fish used in research and described morphological, physiological, molecular, behavioral, and environmental methods for assessing fish welfare, integrating the three approaches discussed above to establish a comprehensive guideline for fish welfare in research. However, as I have explained, such standards are not particularly effective for indicating good welfare (although they might be useful to indicate poor welfare—i.e., when clear disease or distress is detected in a context that unquestionably indicates threatened welfare).

Based on a different approach, our research group recently tested the preferences and choices of commercially valuable Nile tilapia (Oreochromis niloticus) to establish guidelines for this species. We found that the fish have significant preferences for yellow light at low intensity (<80 lux), a water temperature zone near or above that recommended in fisheries, numerous shelters, and a specific gravel composition, among others (unpublished data). As these conditions may change with fish development and other conditions, this use of preference studies requires further research.

Given that the housing preferences of many animals are unknown, most animal research likely imposes some degree of discomfort on the subjects. Researchers should take responsibility for ensuring the least amount of discomfort possible and, in keeping with the Three Rs (Russell and Burch 1959), should design experiments with the lowest number of animals. And to justify the research cost to animal lives, findings should be published in high-level scientific journals that advocate such treatment and made widely available for the scientific community.

Teaching

One can advocate the use in teaching environments of well-defined experimental practices for live animals, including fish, based on the same philosophical reason for using animals as food and for scientific research: to improve the quality of human life (see comments in Wadman 2008). However, media coverage, sometimes with legislative support, has often inhibited such use, and some teaching institutions have either abolished laboratory classes or replaced live animals with inanimate models or computer simulations where possible. Such programs reduce the unnecessary use of animals in research and maintain it where it is unavoidable (e.g., medical and veterinary schools).

The incorporation of animal welfare in education programs is necessary to promote broad acceptance and discussion of this controversial subject (Hewson et al. 2005; Medina et al. 2007), and many academic courses have already adopted such content (reviewed in Mench 2008 for the United States), a development that may have profound effects on how humans treat animals in the future. However, despite the growing science of animal welfare, these concepts are penetrating schools slowly. A study of veterinary students at Cornell University’s College of Veterinary Medicine found inconsistent attitudes toward companion versus farm animal welfare; the findings reveal that the study of animal welfare science (including animal cognition and farm animal behavior) needs further development in veterinary schools (Levine et al. 2005).
Notwithstanding divergence over philosophical approaches to animal welfare, widespread discussion makes this topic more comprehensive and fosters education. Proponents of consilience advocate linking facts and theories across disciplines to build a coherent system of explanation, a more holistic approach that can be useful to allay controversy both in teaching and in fisheries science (mainly ocean fisheries; Sáenz-Arroyo and Roberts 2008). This holistic approach also applies to the welfare issue, as division between disciplines should be eliminated to improve understanding of the complex science of animal welfare, with an initial emphasis on education to promote a holistic (instead of reductionist) approach and to encourage consideration of the whole animal and its welfare (e.g., through preference testing).

Aquarium

Aquarium is an international activity, so there should be greater awareness of its impacts on fish welfare. In addition, in many countries there are also environmental impacts—unauthorized fishing has depleted many ornamental species. Customer demand stimulates both unauthorized and authorized fishing as well as the commercial reproduction of fish.

Although some observers consider aquarium a natural and valid human activity (Arlinghaus et al. 2007), the welfare of these fish is questionable. Many fish in relatively small crowded aquaria once swam long distances. Based on a physiological welfare approach, many aquarists keep these fish in very good physiological condition in which they feed, reproduce, and exhibit physiological traits similar to those of unstressed fish. Nonetheless, the fish are confined and the question may be whether the recreational needs justify confinement. A fish with quality of life should have the freedom to join or not with conspecifics or to swim to different places; therefore, fish in small aquaria may be in poor welfare states (at least at the emotional level), especially if a social fish is isolated (Galhardo and Oliveira 2009) or a high population density is imposed (Gornati et al. 2004). Keeping a fish for pleasure involves serious welfare impacts (similar to those of catch and release practices; more on this in the next section).

For all of these reasons it is important to take into account the welfare needs of fish that live in an aquarium.

Fishing

The production and harvesting of fish for food and other uses (e.g., research, teaching, and aquarism) can be done in a sustainable way that does not impose an excessive cost to nature (Conte 2004). In such pursuits (as well as during slaughter), activities should minimize suffering (Conte 2004) and maximize fish welfare (based on the preference approach) as much as possible (Volpato et al. 2007).

But the fishing industry has conflicting goals when addressing welfare concerns; caution is therefore appropriate in the development of solutions. The industry is of worldwide importance and necessity as a leading provider of human food (Håstein et al. 2006); its practitioners should incorporate welfare practices that prevent unnecessary suffering (with the understanding, again, that suffering reduced to a minimum is generally acceptable in practices related to human subsistence). Contradictions occur when humans use fish for nonsubsistence purposes; catch and release fishing, for example, is unacceptable since its main purpose is recreation.

Contrary to the popular misconception that fish have a 15-second memory (Huntingford et al. 2006), research has shown fish memory lasting weeks (Moreira et al. 2004) and even months (Miklósi et al. 1992). Anglers are less likely to catch a fish that they just caught and released than a fish that has never been caught (Askey et al. 2006), suggesting that the fish was aware of the unpleasantness of the experience (i.e., in operational terms, a negative reward that reduces response frequency). Indeed, a recent study showed that catch and release practices impair fish welfare (Fabrizio et al. 2008).

Arlinghaus and colleagues (2007) consider recreational fishing a legitimate interaction between humans and fish, and argue that animal welfare efforts should focus on ways to improve the conditions of fish held in captivity. They dismiss the feeling-based approach (because of uncertainties in the concept of suffering) in favor of objective measures of physiological, biochemical, and behavioral traits that indicate health and well-being, arguing that animal welfare standards “must be based on sound science, and balanced and dispassionate arguments” (p. 67). Thus the onus of proof is on scientists: where doubt exists, these observers argue, one should ignore concern for fish feelings until they are materially and scientifically proven.

Some defenders of recreational fishing nonetheless describe appropriate methods for reducing injury, stress, and mortality in fish without eliminating or curtailing recreational practice. For instance, Cooke and Suski (2005) suggest minimizing the duration of an angling event, minimizing or eliminating fish handling and exposure to air, refraining from angling in extreme water temperatures, using certain types of terminal tackle (e.g., barbless hooks) to reduce injury, stress, or mortality, and avoiding angling during the species’ reproductive period. Thompson and colleagues (2008) found physiological disturbances and behavioral impairments in largemouth bass exposed to angling, and highlight the need to minimize air exposure during catch and release fishing. Arlinghaus and colleagues (2008) also identify fishing practices that reduce the degree of injury (despite their rejection of the possibility that fish can consciously experience pain and distress).

Whatever the strength of the argument or evidence, however, belief in suffering is a necessary predicate for trying to minimize stress and injury in fish. One must first accept that fish are sentient beings, and therefore accept the feeling-based approach.

Even if recreational fishing adopts the above animal welfare practices, the fish still experience “partial suffering.” As discussed, there are compelling reasons to expect that
nonhuman animals, including fish, experience suffering; however, scientists that do not accept fish as sentient beings also do not accept the responsibility of scientifically proving that fish are nonsentient creatures. They, and others who ignore the suffering of creatures unable to defend themselves, may influence the opinions of others, particularly children, who as young and impressionable recreational fishers, for example, may learn that humans are entitled to get pleasure at the expense of others’ suffering.

Arlinghaus and colleagues (2007) argue that, in addition to food, recreational fishing satisfies human needs such as education and spirituality. However, as these and other authors do not believe fish have subjective experiences unless objectively proven (e.g., Arlinghaus et al. 2007; Rose 2002), these “needs” may be satisfied at the expense of fish suffering. Applied to humans, such a view implies that it is acceptable to tolerate discomfort in newborns, who cannot verbally communicate but have behavioral displays of feelings (for details, Dawkins 2006).

In short, justification of recreational fishing is based mainly on a lack of facts rather than on any compelling information or arguments. For all these reasons, fishing for recreational enjoyment should cease (Balon 2000; Huntingford et al. 2006; Volpato et al. 2007).

Concluding Remarks

In this review I have shown the importance of fish welfare concerns and of fish wants (established through preference/choice or learning tests) to determine fish welfare practices. Human use of fish for food production, teaching, and scientific research is acceptable, but these practices should always include consideration of fish requirements and should impose the least discomfort possible. The imposition of discomfort in activities solely for human pleasure (e.g., recreational fishing and aquarism) is unacceptable.

Acknowledgments

The author thanks the reviewers and editor for suggestions that improved the manuscript. The Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) provided financial support for writing this review (Proc. No. 302022/2006-6).

References


