Ghoti

Ghoti papers

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Etymology of Ghoti

George Bernard Shaw (1856-1950), polymath, playwright, Nobel prize winner, and the most prolific letter writer in history, was an advocate of English spelling reform. He was reportedly fond of pointing out its absurdities by proving that 'fish' could be spelt 'ghoti'. That is: 'gh' as in 'rough', 'o' as in 'women' and 'ti' as in palatial.

Fish welfare: a challenge to the feelings-based approach, with implications for recreational fishing

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Abstract

Fish welfare issues are increasingly appearing on social and political agendas and have recently gained prominence in fisheries literature. By focusing on examples from recreational fishing, this paper challenges some of the previous accounts of fish welfare. Issues of concern encompass: (1) the feelings-based approach to fish welfare; (2) the artificial divide between human beings and nature; and (3) ways in which stakeholders can address fish welfare issues. The different approaches to characterizing the interaction of humans with animals are animal welfare, animal liberation and animal rights. We show that the suffering-centred approaches to fish welfare and the extension of the moral domain to fish – characteristic of the concepts of animal liberation and animal rights – are not the cornerstone of animal welfare. This, however, does not question the need of fisheries stakeholders to consider the well-being of fish when interacting with them. There are many ways in which recreational fishing stakeholders can modify standard practices to improve the welfare of fish, without questioning fishing as an activity *per se*. Examples are choice of gear and handling techniques. Previous accounts have failed to include discussions of the

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Received 21 Jul 2006
Accepted 13 Dec 2006

many efforts – voluntary or mandated – pursued by fisheries stakeholders to reduce fish stress, injury and mortality. Progress towards addressing fish welfare issues will be enhanced by avoiding the viewing of humans as 'non-natural' disturbance to fishes and keeping three types of crucial question in separate compartments. The three questions cover the symptoms of good and poor welfare, the conscious experience of suffering, and the ethical attitudes towards animals. Fish biologists should focus on the first question – objective measurement of biochemical, physiological and behavioural indicators – to evaluate whether human interactions with fish impair the latters' health or prevent them from receiving what they need, if held in captivity.

Keywords angling, animal welfare, catch-and-release, environmental ethics, recreational fisheries

Introduction

Animal welfare issues are gaining prominence in social and political agendas (Dawkins 2006). Traditionally, animal welfare embraces a range of disciplines including behavioural ecology, evolution, neuroscience, genetics, cognitive science and even consciousness studies (Dawkins 2006). Animal welfare has recently moved towards commercial and recreational activities that exploit fish populations (Håstein *et al.* 2005; Huntingford *et al.* 2006).

Animal welfare science is among the most comprehensive of biological sciences (Dawkins 2006). It remains an enigmatic topic within the life sciences, particularly in relation to fish-human interactions. In an attempt to reach a consensus over the welfare of fish balanced against the various benefits accruing to humans from the use of fish, Huntingford *et al.* (2006) presented 'a broad overview of the current understanding of a number of issues relating to fish welfare.' Their aim was to 'address what welfare means, why it matters and how welfare science relates to the philosophical discipline of ethics, before considering human activities that may compromise fish welfare and how welfare might be measured.' We contend that Huntingford *et al.* (2006) missed the opportunity for an objective review by focusing on feelings in evaluating fish welfare. They were also inconclusive about how stakeholders who interact with fish, directly or indirectly, can resolve contentious issues without renouncing the sustainable exploitation of fish.

The objective of this contribution is to stimulate discussion about how to view and address issues in fish welfare. We raise philosophical questions that challenge the main assumptions and working positions presented by Huntingford *et al.* (2006), particularly their 'feelings-based approach to fish welfare,' and offer an alternative perspective that focuses on scientific facts. Moreover, we draw attention to concerns over fish welfare and the ways that fisheries stakeholders already strive to mitigate potential welfare impacts, with specific reference to recreational fisheries. Of particular interest in the context of fish welfare is catch-and-release recreational fishing (Aas *et al.* 2002; Policansky 2002), which is one of the topics raised by Huntingford *et al.* (2006) and others, such as de Leeuw (1996) and Balon (2000).

A critique of feelings-based approaches

An alternative to the feelings-based view of fish welfare

Animal welfare, and therefore fish welfare, is as difficult to define as human welfare (Dawkins 1998). Welfare relating to humans usually means that a person is in good health and that emotions are generally positive, or simply that he or she is fit and feeling good (Dawkins 2006). Welfare in non-humans can also imply that animals have positive

emotions such as pleasure and contentment or negative ones such as fear, pain and frustration, which humans might label as suffering (Dawkins 2006). Huntingford *et al.* (2006) adopted such an emotion-centred feelings-based approach when evaluating fish welfare, suggesting that 'animal suffering is more-or-less intense unpleasant mental or physical states felt by the animal'; suffering was defined as 'prolonged experience of unpleasant mental states', and fish welfare was outlined as '…to focus on welfare as the absence of suffering.' Given these views, a crucial question that needs to be addressed is whether fish are capable of a conscious experience and thus of experiencing pain and suffering.

The question of consciousness is among the hardest to answer, even in humans (Dawkins 1998; Chalmers 2002; Blackmore 2006; Dawkins 2006). There is no universally accepted definition of consciousness applicable across the spectrum of vertebrate phyla (Searle 2000). Consciousness in humans exists in a primary or extended form (Lindahl 1997). Primary consciousness might be defined as the ability to generate a mental scene in which diverse information is integrated for the purpose of directing one's own behaviour (Edelman and Tononi 2000). Extended consciousness is thought to involve 'higher-order', advanced cognitive abilities that involve, for example, a linguistic capability or self-consciousness as self-knowledge (Zeman 2001). Ignorance as to how our own consciousness arises makes it difficult to provide conclusive evidence of it in other taxa, particularly in evolutionarily distant species such as fish (Marmeli and Bortolotti 2006). Simply observing fish behaviour in response to potentially noxious stimuli that might be labelled by humans as a response to pain, as done, for example, by Sneddon *et al.* (2003), is premature (Rose 2003). Such a value judgement should be avoided (Chandroo *et al.* 2004). This is partly because human and fish brains are not the same, hence consciousness, pain perception and suffering in humans and fish are unlikely to be similar (Rose 2002; Huntingford *et al.* 2006). Rose (2002) argued on Darwinian grounds that the lack of the neocortex in the brains of fish suggests that they are consciously unable to experience pain and suffering. This perspective was challenged by Chandroo *et al.* (2004) who, based on neurobiological and fish ethological literature, suggested that primary consciousness is at least 'a plausible concept' in fish. However, exactly how or why certain brain areas are associated with consciousness or pain perception remains unclear (Dennett 2001), as is understanding a fish's abilities for pain perception and suffering (Chandroo *et al.* 2004). Consequently, taking a feelings-based approach to assessing fish welfare – which relies on scientifically poorly understood concepts such as suffering – constitutes a weak foundation; anthropomorphising human feelings to fish cannot offer a constructive basis for resolving fish welfare issues (compare Wynne 2004).

The scientific uncertainty regarding pain perception and suffering in fish is acknowledged by Huntingford *et al.* (2006) and also by Sneddon (2006). This – theoretically at least – leaves readers the option of drawing their own conclusions about the assumptions underlying the views expressed (Sandøe *et al.* 2004), but, nevertheless, provides misleading signals. A sound assessment of the probability that conscious states occur in fish will require extended knowledge of their forebrain neuroanatomy, an understanding of how such structures mediate behavioural responses to environmental challenges and an analysis of that information within the context of contemporary theory on the evolution of consciousness (Chandroo *et al.* 2004).

Avoiding feelings-based definitions of fish welfare does not question the importance of paying attention to fish welfare and well-being. However, an approach supported by scientific fact is preferred to one based on an anthropomorphic perspective. In this vein, we propose an alternative approach to fish welfare; good welfare means that the fish is in good health, with its biological system functioning properly and not being forced to respond beyond its capacity. This function-based approach to fish welfare can take into account physiological, ethological and ecological data that are relatively easy to observe and measure, as acknowledged by Huntingford *et al.* (2006). Dawkins (1998) proposed a similar approach, keeping three types of crucial questions in separate compartments when assessing animal welfare:

1 the symptoms of good and poor welfare;
2 the conscious experience of suffering; and
3 the ethical attitudes towards animals.

Fish biologists should focus on the first question – the objective measurement of biochemical, physiological and behavioural indicators – to evaluate whether human interactions with fish impair the latters' health or prevent them from receiving what they need, if held in captivity.

Implications of feelings-based approaches for recreational fisheries

It is tempting to counter the perspective put forward in the previous section by pointing to the moral superiority of the suffering-centred, feelings-based approach in dealing with fish welfare issues, but the immediate implications for fisheries and fisheries management may not be obvious. This is why we discuss the consequences here.

Sneddon (2006) claimed that 'it is virtually impossible to get inside the animal mind and know what they experience or how they are feeling, therefore, I believe we should give fish the benefit of the doubt and treat them as if they are capable of pain perception.' This shifts the issue away from the scientific level to the moral level. By doing so, it indirectly transfers the burden of proof about the existence of pain perception to fisheries stakeholders in the full knowledge that it is virtually impossible to reconcile the issue. By focusing on pain and suffering in the discussion of fish welfare issues, uninformed stakeholders, certain non-governmental organizations, many politicians and the public at large might confuse animal welfare concepts with suffering-centred animal liberation and animal rights philosophies. However, animal welfare, animal liberation and animal rights concepts must be clearly distinguished because each originates in a different philosophical domain (see Box 1 for details). Each has different implications for the context of human relationships with animals on a day-to-day basis, and for commercial and recreational fishing. For example, unlike in the animal welfare domain, animal liberation and animal rights philosophies do not allow any interaction with fish (Table 1); the existence of sentience in fish already qualifies fish and humans for equal consideration, irrespective of the consequences that, for example, a ban on fishing would have for human communities and human well-being.

Sooner or later these values and attitudes transform into social norms influencing fisheries management and fisheries practices. Development of anti-fisheries norms is promoted by stakeholders encouraged by feelings-based approaches that do not see a good reason for a fishing activity that supposedly inflicts pain and suffering on animals (Aas *et al.* 2002). There is evidence that suffering-centred, feelings-based approaches to animal welfare issues in general, and fish welfare in particular, and the extension of the moral domain to fish – characteristic of animal liberation and rights philosophies (Box 1; Table 1) – have substantially altered the way in which stakeholders are allowed to interact with fish in some jurisdictions. Germany and Switzerland, for example, have constitutional obligations towards animals, and the draft of the European constitution contains a clause specifying that the rights of animals must be taken into account by all Member States of the European Union in all their activities. In Germany, one has to have a 'reasonable reason' for inflicting pain, suffering and damage to an individual animal. Typically, only fishing for food is acceptable as a good reason for all types of fishing, with catch-and-

Box 1 Summary of animal welfare, animal liberation and animal rights philosophies and their implications for the acceptance of human use of fish.

Broadly speaking, *Animal Welfare* is the notion that humans have a moral duty to care for animals and to look critically at how they are used and treated (Dawkins 2006). However, the obligations that animal welfare entails do not originate in a right of the animal (Table 1). This is because animals cannot participate either in the human moral or legal culture since they cannot claim rights or fulfil obligations. Animal welfare philosophies generally allow interaction with, and use of, fish (Table 1).

In *Animal Liberation*, Singer (1990) argued that animals enter the moral theatre because they can suffer, and there is no doubt about that. Suffering-centred perspectives, such as the one put forward by Huntingford *et al.* (2006) and others (e.g. Braithwaite and Huntingford 2004 and Sneddon 2006), are examples of applied animal liberation philosophy – suffering qualifies animals for equal consideration. This has critical consequences for fish and fisheries (Table 1). On the strength of *Animal Liberation* (Singer 1990), all fishing should cease.

The *Animal Rights* concept is expounded in *The Case for Animal Rights* (Regan 1983). Regan draws a distinction between moral agents and moral patients. Moral agents require a degree of self-consciousness and rationality so they can understand the concepts involved in moral reasoning; moral patients, such as animals and babies, cannot perform moral acts themselves and are on 'the receiving end of the right and wrong acts of moral agents (Regan 1983).' Moral agents and moral patients are, however, united in that 'the principal moral right possessed by all moral agents and patients is the right to respectful treatment (Regan 1983).' The source of this moral right is the postulate of inherent value (Regan 1983), such that all animals (human and non-human) are equal. In practical terms, this means morally compulsory veganism and the end of all animal use everywhere regardless of consequence. This hails the end of any fishing (Table 1; Regan 1983, pp. 330–398).

Table 1 Implications of animal welfare, animal liberation and animal rights concepts for the socially accepted interaction of humans with fish.

	Animal welfare	Animal liberation	Animal rights
Fish have intrinsic value	Yes/no	No	Yes
Fish have rights	No	No	Yes
Duties towards fish	Yes	Yes	Yes
Catch, kill and eat	Yes	No	No
Regulatory catch-and-release	Yes	No	No
Voluntary catch-and-release	Yes	No	No
Recreational fishing	Yes	No	No
Fishery management	Yes	No	No
Use of animals (food, work, manufacture, recreation and science)	Yes	No	No

release of legally sized fish falling outside the range permitted, and live baiting and competitive fishing being prohibited (Arlinghaus 2007). In this context, the fish's ability to perceive pain and experience suffering, as advocated by Sneddon (2006), are taken for granted, rather than being reviewed critically, by some judges and many stakeholders (Drossé 2003). In this environment, it becomes extremely difficult to discuss objectively the advantages and disadvantages of stock-conserving management approaches such as selective harvest through partial catch-and-release of selected fish sizes and species. This limits the alternatives available to fisheries managers.

By focusing on feelings and emotions, researchers such as Huntingford *et al.* (2006), de Leeuw (1996) and Balon (2000) implicitly or explicitly argue against most human interactions with fish that are not primarily driven by the need to consume fish as food. It seems that most fish welfare research, and certain segments of the general public, often fail to appreciate the multitude of economic, social and ecological benefits generated through the interaction between humans and fish (reviewed by Arlinghaus *et al.* 2002). By implication, this leads to denial of all fishing practices that do not provide 'essential' benefits for human survival such as nutrition. To counterbalance the equation 'acceptable fishing = fishing for food only', one could argue that nutrition satisfies just one of the many needs of human beings who enjoy fishing and that catching fish for consumption is only part of the benefits that society and individual recreational anglers receive (Arlinghaus *et al.* 2002; Arlinghaus 2006a). Maslow (1971) described human needs as a hierarchy in terms of their potency. Although all needs are instinctive and innate, some are more powerful than others through being important for human survival. The lower the need in the hierarchy of needs, the more powerful it is. The base of the hierarchy is formed by physiological needs, including the biological requirements for food, water, air and sleep. Once these physiological needs are met, an individual can concentrate on the second level which covers the need for safety and security, the third level consisting of love and belonging, the forth level which deals with self-esteem, and so on. Recreational fishing satisfies a multitude of human needs in addition to offering the opportunity to appropriate food, for example social needs of belonging and friendship, and self-esteem needs gained through having self-respect, personal worth and autonomy (Arlinghaus 2006a). Some of these benefits are more important for human survival than others, but all are of immediate relevance for human well-being (Maslow 1971). The feelings-based approach to fish welfare disregards non-consumptive, or harvest-independent, needs that fishing fulfils for the individual practitioner. It also overlooks the fact that consumptive and non-consumptive needs work in concert for most people engaged in fishing, where fish harvesting to fulfil consumptive needs and the non-consumptive dimensions associated with recreational fishing, which includes educational and spiritual dimensions, are intrinsically interrelated (Arlinghaus 2006a).

The consequence of discounting the importance of both consumptive and non-consumptive needs for recreational anglers and fisheries management can be radical. For example, Håstein *et al.* (2005)

stated that in the context of fish welfare 'fishing for subsistence might be acceptable, while angling, including 'catch and release' may not be.' This statement implies that (1) 'angling' does not involve subsistence, which is not true given that many recreational anglers also eat their catch or part of it; and (2) stock-conserving practices and management tools such as minimum size limits and the associated regulatory catch-and-release have no moral legitimisation. With world-wide angling pressure mounting (Post *et al.* 2002; Coleman *et al.* 2004; Lewin *et al.* 2006), this might lead to overexploitation through total catch-and-kill practices, which, in turn, would impact not only on individual fish, but on entire populations and ecosystems (Cooke and Cowx 2006; Lewin *et al.* 2006). Sustainability demands that society find ways to better manage and conserve natural populations, while providing benefits to society, without questioning the use of fish populations and angling activity *per se* because the use of fish is part of human culture (Arlinghaus *et al.* 2002). Selective harvest, which involves catch-and-release, is a good way to reconcile human use of fish with conservation, but the arguments in, for example, Huntingford *et al.* (2006) and Håstein *et al.* (2005) already established in German law, prohibit this management practice. To conclude, feelings-based fish welfare can radically change the nature of accepted fishing practices and fisheries management, particularly if suffering-centred animal liberation and animal rights philosophies flourish (see Box 1; Table 1). We contend that avoiding an emphasis on suffering and instead focusing on objectively measurable variables of impaired fish well-being, such as distress or health impairment, can minimize misunderstanding and emotionally driven value judgement, particularly among the broader public.

Avoiding the human-fish divide

Another important issue prevalent in the fish welfare literature, and considered counterproductive when addressing fish welfare issues, is the origin of stressors. Huntingford *et al.* (2006) drew a clear divide between the concepts of 'human' and 'non-human', with non-human, so-called natural stressors, being acceptable and 'natural [being] good.' They also assumed that natural stressors on fish 'tend to be brief and/or avoidable'; 'in contrast those stressors that are imposed upon fish by anthropogenic agents may be unavoidable and prolonged or repetitive.' Huntingford *et al.* (2006) also intimate in the abstract to their paper that it is unacceptable for humans to act as predators, through recreational angling or commercial fishing, if these practices impose adverse conditions on the fish. This reasoning pre-supposes that humans are excluded from their position in the food web as a top predator. In reality, humans are part of the social-ecological system that they inhabit and any natural water body that they exploit. They cannot, and should not, be treated as separate from nature: they are part of an interdependent web of life and the material world (Evans 2005). The rational and realistic course to take is to participate in 'nature' in meaningful ways (Evans 2005). This can involve aspects other than killing, such as wildlife watching, animal husbandry or voluntary catch-and-release fishing (compare Evans 2005). In the fish welfare context, these viewpoints are valid as long as the well-being of the animal is not compromised through health impairments and if potential impacts are minimized or appropriately weighed against the benefits of the activity to humans and society at large. However, classifying humans as an unacceptable cause of suffering to fish is to deny humans their place in nature and to advocate the impossible, namely to abstain from interacting with nature and wildlife altogether. Moreover, for the individual fish there is no differences whatsoever between fish welfare impacts originating from human or non-human sources. In this context, fish welfare arguments could be raised over natural impacts on fish, such as those resulting from injury through fish eating birds or resulting from floods or other 'natural' events such as climate change.

The philosophical question of fish welfare is part of the wider debate on environmental ethics. This is hinted at when, for example, Huntingford *et al.* (2006) say that the experience of pain in fish is 'cause for concern not just in terms of responsible stewardship of fish populations (Rose 2002), but also in terms of the welfare of individuals.' 'Stewardship', broadly speaking, means 'wise use' in the interaction with nature or sustainable use, whereas 'welfare of individuals' (of whatever species) might imply minimal or no interference whatsoever because fish or other animals or even plants are individuals, and their intrinsic value has to be respected, particularly if one subscribes to animal liberation or animal

rights philosophies (Box 1; Table 1). These perspectives intimate a ban on human interference with fish, through activities such as recreational fishing, because an individual fish might experience a single 'unpleasant, non-natural' impact. However, this does not recognize the fundamental principles of, for example, aquaculture or recreational fisheries; it is in the best interests of most practitioners and managers to implement good husbandry or handling of fish as their livelihoods and leisure activities are dependent thereon. Humans cannot be removed from their position in nature, and in the case of commercial and recreational fisheries, both should be viewed as integrated or coupled social-ecological systems (Gunderson and Holling 2002; Evans 2005; Hughes *et al.* 2005). The questions that should be addressed by policy-makers, not scientists, through an emerging shift in perspective are the following. How much and what kind of human impact on natural fish populations is tolerated? What is an acceptable impact on an individual fish in contrast to the impact of an activity on entire fish populations by way of a potentially cumulative impact on individuals? The role of scientists is to help identify the measures available to minimize welfare impacts, without questioning the use of fish *per se*. We contend that for certain fisheries practices, such as catch-and-release recreational fishing, there is sufficient information available, published in several hundred papers (Arlinghaus *et al.* 2007), to address this latter question, as we shall discuss below. We think that similar cases could be made for aquaculture or ornamental fish keeping, but due to space limitations we shall focus on catch-and-release fishing. We proceed from the assumption that the use of fish is part of human evolution and therefore, in principle, a morally justified practice to satisfy consumptive and non-consumptive needs, both of which are important to varying degree for different fisheries stakeholders represented by commercial and recreational users.

Addressing fish welfare in recreational fisheries practices

There is a little doubt that all fishing results in some level of stress and injury (Cooke and Sneddon 2007), but this does not necessarily mean that fish suffer tremendously from these activities or that the potential for suffering grants rights to fish, which would call for banning of fishing activities such as catch-and-release or competitive fishing. Instead, we advocate addressing the issues and improving the situation by reducing the level of stress and injury experienced by the fish and thereby reconciling use of fish populations by humans which promotes human welfare with conservation of life and protection of the well-being of the fish serving fish welfare.

To address welfare issues that occur in the process of fishing, the most appropriate way forward is to find ways to reduce potential impairments on the well-being of fish. Consequently, any fair review of the impacts of recreational fishing or other human impacts on fish welfare should provide information on how the issues are being, or could be, addressed. Huntingford *et al.* (2006) reviewed the effects of angling, aquaculture and ornamental fish-keeping on fish welfare, but there are concerns over the comprehensiveness of their analysis of recreational fishing, particularly catch-and-release (Table 2). Their review only illustrated the effects of these activities on fish welfare and failed to accommodate how the various sectors, either personally motivated or supported by regulations or codes of conduct, have addressed many of the issues raised (e.g. Muoneke and Childress 1994; Hickley 1998; The National Code of Practice for Recreational and Sport Fishing 2001; Bartholomew and Bohnsack 2005; CEC 2005; Cooke and Suski 2005; Cooke and Cowx 2006; Lewin *et al.* 2006; Arlinghaus *et al.* 2007 for reviews on recreational fisheries, including issues concerning fish welfare, e.g. Cooke and Sneddon 2007). Some, but not all, of the concerns raised over the scope of the work on recreational fisheries and catch-and-release fishing are summarized in Table 2. This includes imprecision identified in Huntingford *et al.* (2006) and the mechanisms that fisheries stakeholders can use to address fish welfare impairments. Table 2 also presents a compilation of the manifold social and economic benefits of recreational fishing not discussed by Huntingford *et al.* (2006). This extends beyond the immediate economic impacts on national economies and other so-called essential benefits, such as nutrition, to wider issues that need to be considered when balancing fish welfare against human interests. This perspective does not question whether fishing can and does negatively impact on fish populations (e.g. Post *et al.* 2002; Lewin *et al.* 2006) and individual fish (Cooke and Sneddon 2007; Table 2) but offers a broader perspective with which to address contentious issues. A full appreciation of all

Table 2 Concerns over the review of the effects of recreational fishing activities on fish welfare by Huntingford *et al.* (2006) and specific examples of how the issues identified can be remedied. The table includes several additional issues not raised by Huntingford *et al.* (2006).

Issue	Perspective of Huntingford *et al.* (2006)	Current concerns over the perspective of Huntingford *et al.* (2006)	Opportunities for dealing with the identified issue
Capture – playing and landing	The emphasis was on identifying the magnitude of stress and mortality that was associated with angling. They cited Gustaveson *et al.* (1991) as indicating that angling '…elicits a stress response that is of short duration' and cited Cooke and Philipp (2004) as stating that the 'heart rate of largemouth bass increases when captured and played during angling'	In general, the authors failed to recognize the many opportunities for minimizing stress and mortality from capture and only focused on the consequences of playing and landing. In addition, they failed to consider the environmental factors and fishing site considerations which can affect the outcome of the angling event (discussed as a new section below). A number of misleading citations were given. Gustaveson *et al.* (1991) did not conduct time-course recovery with the resolution to detect short-term recovery (they noted recovery times of approximately 8 h). In addition, experiments by Cooke and Philipp (2004) did not examine the cardiac responses of largemouth bass (*Micropterus salmoides* Lacepède, Centrarchidae; instead, they studied the behaviour and mortality of bonefish, *Albula* spp.), although such data exists (e.g. Cooke *et al.* 2003; Suski *et al.* 2004). Furthermore, there was no discussion of the injury caused by angling and the potential to minimize injury through gear selection (see section on *Capture gear* below)	Codes of practice and guides to angling all stress the importance of proper hooking, playing and landing of fish to minimize negative effects. It is well established in the literature that stress of capture can be minimized by using appropriately matched equipment so as to minimize the duration of the angling event (Schreer *et al.* 2001; Meka and McCormick 2005). In addition, anglers have a choice of gear to assist with landing fish. Research suggests that use of knotless nylon or rubber nets (or no net at all) is less harmful than other net types (Barthel *et al.* 2003)
Capture – environmental factors and fishing site	Not discussed	This is problematic as there are many environmental factors which influence fish physiology and thus the effects of angling on fish (Arlinghaus *et al.* 2007)	Water temperature influences the physiology and behaviour of all fish. In a catch-and-release context, it is well established that there is a strong relationship between temperature and both mortality (Wilde *et al.* 2000; Thorstad *et al.* 2003) and stress (Wilkie *et al.* 1997). Anglers can avoid fishing during periods when water temperatures are approaching lethal levels or minimize other angling stressors during those times. The characteristics of the capture site can also influence the effects of angling on fish such as predator burdens. When predator burdens are high, anglers can relocate to other areas or release fish in sites where they are afforded some protection (Cooke and Philipp 2004). Depth of capture can also dramatically influence the outcome of the angling event on fish, as capture from deep water can result in decompression (Morrissey *et al.* 2005; St John and Syers 2005). Anglers can limit angling to shallow waters, release fish rapidly, or use techniques for minimizing decompression such as venting or depth return devices

Capture gear	Not discussed	This is problematic considering that simple gear choices can promote survival and minimize injury	There are several gear choices available to anglers, all of which have the potential to affect the outcome of the angling event for the fish. For example, the hook is the primary piece of equipment that 'connects' the angler to the fish. Anglers can select barbless hooks, which not only reduce tissue damage (and bleeding) but also provide the opportunity to reduce handling time through rapid hook removal (Cooke *et al.* 2001). Hook type can also influence the outcome for the fish. For example, circle hooks tend to promote shallow hooking as opposed to J-style hooks, thus leading to reduced injury and mortality (reviewed in Cooke and Suski 2004). Finally, the type of bait or lure can also influence injury and mortality, with non-organic lures or flies preferable to live or organic bait (see arguments in Cooke and Suski 2005)
Capture – handling	Discusses air exposure and suggests that the effect may be magnified in larger individuals referenced using Ferguson *et al.* (1993)	The paper cited (Ferguson *et al.* 1993) did not involve exposing fish to air. No research has systematically evaluated whether the size of fish influences the magnitude of disturbance from air exposure. In addition to causing stress, air exposure can result in the collapse and adhesion of gill filaments (Ferguson and Tufts 1992) as well as death, but this occurrence is species specific and dependent on a context-specific time threshold	Codes of practice provide guidelines on how to reduce the impact of air exposure. Schreer *et al.* (2005) identified specific thresholds for air exposure of brook trout *Salvelinus fontinalis* (Mitchell), Salmonidae and encouraged the development of thresholds for a variety of taxa. Anglers can be encouraged to minimize or eliminate air exposure through education campaigns. In addition, gear choice (e.g. barbless hooks) can also minimize air exposure by facilitating rapid hook removal (Cooke *et al.* 2001)
Retention, constraint and release	The emphasis was on the deleterious consequences of retention. Suski *et al.* (2005) are cited as saying that 'livewell confinement increased mortality in walleye and largemouth bass used in live release tournaments.' They correctly stated that the retention of fish in keepnets induces physiological stress responses, but recovery following release can be rapid (Raat *et al.* 1997; Pottinger 1998; Wedekind and Schreckenbach 2003). Here, the authors cited a paper on electrofishing (Mesa and Schreck 1989) and a paper on aquaculture (Olla and Davis 1989) supporting the contention that behavioural modification can occur after release from angling	Suski *et al.* (2005) reported no mortality and simulated various wave conditions experienced in tournaments (without actually running a tournament). There is no evidence that livewell retention in itself increases mortality provided that fish are held with adequate water quality (Suski *et al.* 2004, 2006). There are studies that have quantified mortality after tournaments and documented high mortality for both walleye (*Sander vitreus* Mitchell, Percidae) and largemouth bass, but typically there were no control fish for comparison. There are papers that have documented post-release behavioural alterations (e.g. Whoriskey *et al.* 2000; Cooke and Philipp 2004) but these were not cited	Codes of practice provide ways of reducing the impact of holding fish following capture and before release. Specifically, fish can be provided with adequate water quality (Suski *et al.* 2006) and not retained on stringers (Cooke and Hogle 2000). Research indicates that the fate of fish following release is strongly influenced by the handling procedures and fish's condition at the time of release (Cooke and Suski 2005). As such, there are opportunities to emphasize that anglers use gear and practices that promote 'normal' post-release behaviour

Table 2 Continued.

Issue	Perspective of Huntingford *et al.* (2006)	Current concerns over the perspective of Huntingford *et al.* (2006)	Opportunities for dealing with the identified issue
Fish response to previous capture	They cited Beukema (1970) for evidence of bait avoidance behaviour in carp (*Cyprinus carpio* L., Cyprinidae) for up to 3 years following a hooking event	Beukema (1970) stated that carp may be able to remember a single hooking event for 1 year not 3 years; the sample size was low, and the experiment was conducted in ponds. Huntingford *et al.* (2006) failed to cite any of the literature that shows that individual fish can be caught many times throughout the year by anglers (e.g. Burkett *et al.* 1986, Cowx and Broughton 1986; Hickley *et al.* 1995)	The research on this topic supports the contention that fish that are angled and handled properly and efficiently, and released in good condition, are likely to survive, to reproduce and be recaptured. This message can be used to help convince anglers of the importance of maintaining the welfare status of fish (i.e. even if an angler has a little interest in fish handling from a welfare perspective, they must recognize the potential value in being able to recapture released fish; see detailed argument to this effect in Cooke and Sneddon 2007)
Ecological benefits, fish conserved and enhanced through recreational fishing	Not considered	There is considerable evidence to show that recreational fishing activities are pivotal in environmental protection, habitat improvement and conservation of biodiversity (reviewed by Bate 2001, Arlinghaus *et al.* 2002; Kearney 2002). These, in turn, can lead to improved living standards within society (e.g. Weithman 1999)	Instead of polarizing fisheries stakeholders, there is a need for more interdisciplinary cooperation and co-management to facilitate capacity building and to create win–win situations (Arlinghaus *et al.* 2002). For example, conserving fish through proper management of fish stocks is preferred over conservation of fish by excluding stakeholders from their use. Without the possibility to benefit from fish by way their use, there is limited interest in conservation in the long term because it is in fisheries stakeholders' interest to conserve good fishing quality (Arlinghaus 2006b)
Social benefits, social capital and pro-environmental concern	Not considered	Fishing provides numerous social benefits to society – such as cultural, psychological, physiological and educational – and promotes environmental responsibility (e.g. Weithman 1999; Kearney 2002). Encouraging youth into recreational fishing has, for example, reduced crime and social disruption in deprived areas of the UK (Environment Agency 2006). Through angling, part of society remains in contact with nature; pedagogics suggest a high potential for aquatic stewardship and pro-environmental behaviour among anglers; interacting with nature can generate respect for nature (Evans 2005)	Research has shown that the various social benefits generated by fishing are paramount to the quality of life of many people. It is necessary to broaden the horizon by accepting humans as part of nature and by integrating insights and perspectives that go beyond the personal discipline: there is more to fishing than food and income. Accepting this is amongst the hardest challenges to achieve among those not trained in the social sciences. As a facilitator of wise management and behaviour on site, it would be helpful to promote development of a new form of fisheries management advisor recruited directly among the most specialised and emotionally involved anglers and supported by public bodies (compare Arlinghaus 2006b)
Economic benefits	Summary of participation and revenues in commercial and recreational fisheries	Huntingford *et al.* (2006) failed to recognize the importance of fishing in terms of livelihoods, poverty reduction and food security as well as the worldwide socio-economic importance of recreational fisheries; the economic importance extends the domain of economic impact to society and includes the economic value of the activity for the individual angler and fisher (see Arlinghaus *et al.* 2002 for review)	Each environmental policy necessarily transfers into trade-off decisions. Fish welfare decisions must be based on a sound cost-benefit analysis that incorporates all stakeholder interests. Otherwise, conflict and discomfort are very likely. There are economic methods available to achieve this aim

the benefits and costs associated with fishing improves our evaluation of fish welfare issues and provides a more balanced perspective.

The main message of Table 2 is that most welfare impacts on fish resulting from catch-and-release can be addressed by changing handling practices and gear used, and by adapting human behaviour to the specifics of the species that is to be exploited. Acknowledging the immense variation among species and fisheries, there are some general principles that can be applied and that are standard practice in many recreational fisheries worldwide to increase the welfare status of caught and released fish. Cooke and Suski (2005), for example, developed a list of generalized guidelines that should be relevant to enhancing the welfare status of fish by reducing injury, stress and mortality without ceasing recreational angling or any component of it, such as catch-and-release angling, as advocated, for example, by de Leeuw (1996) and Håstein *et al.* (2005). The list includes, but is not limited to

1 minimizing the duration of the angling event;
2 minimizing or eliminating handling and exposure to air;
3 restricting angling at extreme water temperatures;
4 using terminal tackle that reduces injury, stress, or mortality, for example lures or flies vs. organic bait, barbless hooks vs. barbed hooks, circle hooks vs. J hooks;
5 avoiding angling during the reproductive period.

There are many more ways in which anglers can improve the welfare of individual fish, and large-scale educational programmes are in place to promote fish welfare practices among anglers. This is very different from simply asserting that recreational angling, or fishing in general, compromises the welfare of fish (compare Huntingford *et al.* 2006). The message that must be disseminated to anglers is that strategies that reduce injury and stress, and hence increase the chance that the fish will survive to reproduce or be caught in the future, are the same strategies that one would adopt to enhance the welfare status of angled fish (Cooke and Sneddon 2007). Such a message provides anglers and other stakeholders with sound advice on how to enhance fish welfare and offers a constructive atmosphere for a cooperative dialogue concerning areas where recreational fishing could be, and is, harmful to the welfare status of fish (Table 2). It also facilitates capacity-building and self-empowerment within the angler community, which is a necessary pre-requisite for resolving contentious issues 'from the bottom up'.

Conclusions

An alternative perspective to the feelings-based approach to fish welfare is one that defines good welfare as the preservation or enhancement of fish health and well-being in the interaction between humans and fish, which is of ongoing concern. Such a perspective is superior to the feelings-based approach because it defines fish welfare positively, avoids the scientifically uncertain concept of suffering and rests instead on facts from fish biology. It also reduces the potential for interpreting the feelings of fish in human terms. Our position does not question the human use of fish *per se* and is driven by the sustainability norm of reconciling the use of fish resources with conservation. It is also open to new scientific insights from fish welfare research and calls for recommendations for improved welfare to be derived from new research. By contrast, the science underlying the feelings-based approach to fish welfare appears to be ideologically driven, striving to 'prove' what has to be the case, namely suffering in the interaction of fish with the 'non-natural' human. We contend that dogmatic positions do not offer a constructive scientific atmosphere. The basic role of scientists should be to provide knowledge and to document advances in knowledge. There is an ongoing debate about whether scientists, as members of society, should take on an advocacy role as well. If such a role is adopted, it must be based on sound science, and balanced and dispassionate arguments. We have tried to achieve this for fish welfare research and considerations drawing on examples from recreational fishing and catch-and-release.

We have argued that in the context of fish welfare and recreational fishing, humans cannot be separated from nature; they are part of nature and not a 'non-natural' disturbance to be avoided. If we, in principle, accept fishing to be a legitimate interaction between human and fish, including recreational fishing, ways can and have to be found to mitigate and better avoid health and fitness impairments and deprivation of the needs of fish held in captivity. This can be done without focusing on feelings, through the avoidance of a feelings-based approach to fish welfare and instead focusing on the objective measurement of biochemical, physiological and behavioural indicators to evalu-

ate whether human interactions with fish impair the latters' health and well-being. Catch-and-release recreational angling exemplifies various possibilities to reconcile exploitation with conservation, management and fish welfare. Our analysis showed that most of the same strategies to enhance fish welfare are the same as those demanded and pursued for effective conservation and management of fish stocks. It is also important to remember that most of these strategies were developed by anglers or fisheries managers in their own interest to ameliorate contentious issues. Portraying recreational anglers, or the fishing community as a whole, as causing unnecessary harm to individual fish without offering practical solutions to reconcile contentious issues may create discomfort within fishing communities; it may deepen the rift between supporters of fishing on the one side and supporters of fish welfare on the other, but is ultimately detrimental to the conservation of fish populations and the social-ecological fisheries system as a whole. The perspective on fish welfare described in this paper offers an alternative to address important issues of fish welfare in fishing practice and avoids feelings and emotions that have a tendency to blur scientific facts.

Acknowledgements

We thank four anonymous reviewers for providing insightful comments on an earlier version of this manuscript and Tanya Harvey Ciampi for a very constructive technical edit. SJC was supported by the Canadian Foundation for Innovation, the Ontario Research Fund, and the Natural Sciences and Engineering Research Council of Canada.

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