TROY VETTESE, BECCA FRANKS, AND JENNIFER JACQUET

The Great Fish Pain Debate

What happens when scientists get hooked on a question that could be argued forever?

Do fish feel pain? For over 50 years, this question has been the focus of multiple scientific careers and consumed countless hours of research, debate, and reflection. But a different and related question has received far less attention: how and why did fish pain come to be a contentious scientific question in the first place? The experience of feeling pain has an inescapably subjective dimension for all organisms. Such an experience might be correlated with certain neurophysiological phenomena, but it cannot be fully reduced to such phenomena, nor is it possible to access the interior cognitive state of another individual (human or otherwise) to ascertain how the phenomena might be subjectively perceived. Moreover, fish are an extraordinarily broad category; shark species today are about as evolutionarily close to halibut as humans are. So we want to ask not just what science is telling us about fish pain, but what is the fish pain debate telling us about science?

To try to answer this question, we have peered into the history of the great fish pain debate and examined who has been involved, the events that spurred their efforts, and the ways that human values and competing interests have shaped the terms of the debate and the lines of research.

Our history begins with anti-angling campaigns in South Africa in the 1960s. It then moves to West Germany, where animal-rights groups won several battles over the legal standing of fish from the 1980s onward, with a focus on catch-and-release fishing. Arguments about fish pain reached the global stage in the 2000s, as a larger community of researchers began to apply a more diverse set of methods and scientific advances to the question of when and how fish feel pain. Yet for those scientists and advocates who argue that fish cannot feel pain, the reasoning has remained the same for decades: fish do not have a neocortex. The neocortex, which is the outer layer of the cerebral cortex in mammalian brains, is thought to be involved in several processes including sensory perception, consciousness, spatial reasoning, language, and motor commands. The significance and particularities of this singular and persistent criterion for pain in fish can be understood only by a return to the origin of the debate and its links to the recreational fishing sector.

In the beginning

Fish pain was first politicized in South Africa during the 1960s, in response to animal-rights groups' opposition to angling. J. L. B. Smith, a South African ichthyologist and avid angler, observed that "there is widespread interest in the matter of pain in fishes, which stems largely from a queer antagonism directed against anglers." Smith is best known for his codiscovery of a species of living coelacanth—a marine fish previously thought to be long extinct—and later for writing the popular book *Our Fishes,* published posthumously in 1968, in which he dedicated a chapter to the debate about pain in fish.

The starting place for Smith's scientific argument was to distinguish between evolutionarily stagnant, "primitive" animal species, and advanced ones. In *Our Fishes* he argued, "If you feel sentimental about fishes, stop and realise that while man has changed life on the land, in the water he has no influence; life is as primitive as it has always been." Indeed, Smith even applied this fallacious logic racially. Although humans putatively had the most "highly developed pain sense," he ventured that there was an evolutionary divide within humanity as well. "Negroid and primitive peoples generally feel comparably less pain than Whites," Smith claimed. His explanation for why fish could not feel pain was purely mechanical: their brains lacked the "frontal lobes" of the mammalian neocortex. Smith's interpretation

structured the ensuing debate over fish pain, one where the neocortex, angling, and animal rights would continue to figure prominently.

In 1972, the center of the fish pain debate moved from South Africa to West Germany, in part due to the passage of that country's Animal Welfare Act, which stated that "no one may cause an animal pain, suffering or harm without good reason." In 1976, West Germany's Federal Ministry for Nutrition, Agriculture, and Forestry asked Dorothea Schulz of the Institute for Veterinary Medicine to write a report on how the new law would affect the slaughtering practices in the commercial eel fishery, which she completed that year. Two years later, she relayed her findings directly to West German animal-rights activists in an essay in the movement's magazine, *du und das tier* ("You and Animals"). Titled "On the Sensation of Pain in Fish" (*Zum Schmerzempfinden des Fisches*), Schulz outlined a genealogy of the debate, tying together an older German and Dutch scientific literature, including a paper published in 1907. Schulz noted that scientists studying fish neurophysiology had long since concluded that fish were not mere "pure reflex machines," but were creatures that exhibited complex behaviors and warranted consideration for their welfare. In her experiments, she measured eels' stress when undergoing standard slaughtering procedures with and without anesthetic, and concluded that eels did feel pain. On this basis Schulz recommended that eels should be stunned or anesthetized before slaughter.

Other West German scientists followed Schulz's lead through research on fishes' physical pain, intelligence, suffering caused by pollution, experience of fear, and the physiology of pain. A 1984 report on angling coauthored by the neurobiologist O. Hunrich Spieser concluded that "there is absolutely no doubt that angling causes fish to suffer extreme agony (*schwerste Qualen*). In the light of evidence from neurology, ethology, social psychology, and veterinary medicine, angling is a barbaric practice (*eine Barbarei*) in all the ways bullfighting is." In a sweeping review of the fish pain debate, Wolfgang Klausewitz, an ichthyologist at the University of Frankfurt, predicted in 1989 that it would be only a matter of time before the use of live fish-bait and sport angling would be banned in West Germany.

Anglers at the dock

In the 1980s the German Animal Defense League (*deutscher Tierschutzbund,* DTSB) escalated its campaign to protect fish. The group began taking anglers to court for using "keepnets," in which fish are kept alive after being caught, even as they slowly suffocate. Citing the 1972 Animal Welfare Act, the DTSB pressed charges against an angler participating in a 1986 fishing competition on the Lippe River, where fish were kept languishing for hours in a keepnet before being thrown back into the river. In 1990 a judge ruled in DTSB's favor, and fined the angler. After the victory, a leader of the DTSB, Wolfgang Apel, declared, "We will stick close (*auf den Pelz rücken*) to these stubborn (*unbelehrbar*) organisers of these fraudulently mislabelled (*Etikettenschwindel*) events, until the last assembly-line angler understands that these shindigs come at the cost of a suffering creature and are a finable offense."

A second legal turning point came in 2001, when the DTSB won an animal cruelty case against sport anglers in the town of Bad Oeynhausen, near Hanover. Unlike the case a decade earlier, which centered on the suffering of fish in a keepnet, the defendant in this case took a carp out of the water for five minutes to weigh and photograph before releasing it back into the Weser River. Using the angler's own photographs as evidence, the DTSB successfully argued that Germany's Animal Welfare Act forbade inflicting pain on animals without good reason, and good reason, according to the law, did not mean catch-and-release. Although Germany still has no official nationwide prohibition on angling, the 2001 ruling triggered a de facto ban on catch-and-release fishing. Indeed, catch-and-release competitions were seen by many Germans as a relatively recent Anglo-American import that departed from the German tradition of eating one's catch. The legal victory, a culmination of years of activism against angling, was followed by similar cases in other countries, including one in Switzerland, which in 2008 imposed restrictions on catch-and-release, live bait, and barbed hooks.

Meanwhile, on the other side of the pond

Yet countervailing forces of science and politics came into play when it seemed that European anti-angling activism might spill into the United States. The trigger was likely PETA's decision in 1995 to hire Davey Shepherd from the UK organization Pisces (formerly the Campaign for the Abolition of Angling) to run its US anti-angling campaign. Following the German precedent, that campaign focused on catch-and-release competitions rather than fishing for sustenance. Columnists in fishing magazines revived arguments about fish pain originally made by Smith, and warned that the United States was following Germany's path. In 1998, the American Fisheries Society (AFS), a professional association that represents commercial, recreational, and indigenous fisheries, set up a Task Force on Human Use of Fish and Other Living Aquatic Resources. Soon after the 2001 Bad Oeynhausen case, AFS asked the neurobiologist James Rose to write a report on fish pain, to be used in updating the society's guidelines for field research. In the preface to its previous (1988) guidelines, the society's then-chair, John Nickum, had asserted that one could not "credit fishes with human emotions." Nickum, who was again chair of the committee updating the guidelines, read drafts of Rose's paper, and relied on it heavily in the revised document, released in 2004. Nickum and the committee once again stressed that because fish, unlike mammals, did not have a neocortex, "Assumptions and perceptions based on experiences with mammals, especially primates, must not be

extrapolated to fishes."

Until his work for AFS, Rose had conducted most of his research on newt hormones. However, in 1999 he had published an article in a popular angling magazine, *The Fisherman,* titled "Do Fish Feel Pain?" and he was lead author on a 2000 article about whirling disease in trout. Rose taught at the University of Wyoming, an important hub in the AFS network. In terms of Rose's influence on the fish pain debate, however, perhaps the most important factor was his training as a neuroscientist. Rose's report to AFS served as the basis for his influential 2002 article, "The Neurobehavioral Nature of Fishes and the Question of Awareness and Pain," published in the society's periodical *Reviews in Fisheries Science*. Rose remains commonly cited in articles skeptical of fish pain.

Rose, advancing the position that Smith had laid out decades earlier, stressed that fish lacked a neocortex and therefore consciousness, and "without consciousness, there is no awareness of pain." Like Smith, he argued for an evolutionary break in consciousness, casting fish as evolutionary relics, and stressing the uniqueness of mammals,

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especially humans, with the latter being the most sensitive to pain because they possess the "greatest degree of cerebral hemisphere development." If fish struggled against anglers, Rose reasoned, it was because "interference with their free movement is a major factor creating flight responses rather than noxious stimulation from a hook." Caught fish did not even feel fear because "fear is also a conscious psychological phenomenon that, similar to pain, requires an adequate neocortical system to be felt." The undergirding assumption of his framework was that "anthropomorphic thinking undermines our understanding of other species." Rose's 2002 article attracted significant attention in media outlets catering to anglers, such as the magazines *Field & Stream* and *Game & Fish,* and the website anglingmatters.com.

A case of nerves

The science seemed to be keeping up with the politics, and expanding to other countries too. In the early 2000s, Michael Gentle and Victoria Braithwaite, animal behavior researchers at the University of Edinburgh, began a research program to study fish pain, and soon thereafter hired Lynne Sneddon as a postdoctoral assistant. Gentle, the oldest of the three, had been publishing articles on animal pain, especially the suffering of poultry, since the 1980s. In the 1990s, Braithwaite studied the spatial intelligence of animals, first in pigeons and later in fish, which likely led to her conviction that fish were capable of felt experiences. After joining the program, Sneddon published a series of papers on A delta and C fibers—nerves that transmit pain-related information to the brain—reporting that she found them indistinguishable from the nerve endings found in mammals, and concluding that they functioned in a similar fashion.

In 2003, Sneddon, Gentle, and Braithwaite focused on the question of whether hooks caused pain in fish, using the technique of injecting the lips of rainbow trout with acetic acid, bee venom, and a saline solution. They interpreted the fishes' resulting behavior, including rubbing lips on gravel, rocking motion, and lack of appetite, as consistent with the experience of pain. Further research demonstrated that such sensations distracted rainbow trout enough to diminish their fear of novelty, another likely indication of pain. Their results, published in two articles in 2003, influenced the fish pain debate and seemed to create a coherent basis for consensus for English-speaking scientists, a feat not dissimilar from what Schulz accomplished in West Germany in the 1970s.

Rose, in turn, wrote a critique of Sneddon and colleagues' 2003 papers on rainbow trout pain, arguing that they had "misinterpreted" their results. Fish resumed eating "less than three hours" after being injected in the lip with noxious liquids, he said, "hardly supporting the claim that they were in pain." Perhaps Rose had never bit his lip. He also argued that fish "feed avidly on potentially injurious prey like crayfish, crabs and fish that have sharp spines in their fins—which further indicates that [they] are not highly reactive to noxious oral stimuli." A year later Braithwaite and a colleague, F. A. Huntingford, published a paper in the journal *Animal Welfare* arguing that Rose's conclusion that only mammals could feel pain was "an extreme stance that finds little support among others working on animal pain." Further work by Braithwaite explained how the brains of fish could bestow consciousness without a neocortex.

Rose's 2002 article for AFS had meanwhile invigorated those skeptical of fish pain, and scientists in the United States and Germany began to work together. In Germany, the recreational fishing community, which includes businesses, government bureaus, and university scientists, invested significant resources into research that challenged earlier work demonstrating that fish feel pain. Much of the German-led effort has been carried out by Robert Arlinghaus, who was a vocal critic of the 2001 Bad Oeynhausen decision when he was a postgraduate student. Arlinghaus is now the head of the Department of Biology and Ecology of Fishes at Humboldt University of Berlin. He often publishes with international collaborators, and was portrayed in the German magazine *Der Spiegel* as one of Germany's leading fisheries scientists. His research has often been supported by businesses related to angling (as he has openly acknowledged), and in a 2012 paper in the journal *Fisheries* he and his coauthors encouraged researchers to publish angling-friendly research because "without sufficient support, radical claims portraying

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anglers as cruel sadists who play with fish for no good reason can be rhetorically effective. Powerful intervention is needed to counterbalance such tendencies" In 2018 the US-based American Fisheries Society gave him an "award of excellence."

Scientists skeptical of fish pain often present anglers as environmental stewards. Arlinghaus and others have formulated an angling code of conduct, which allows for the practice of catch-and-release, especially when participating in sport fishing competitions. In this vision, "model anglers" fish often, devote themselves to fishing trips and tournaments, follow regulations, speak out on behalf of angling, and can be mobilized to defend the sport against the animal-rights movement and other threats, such as pollution. In a 2007 article critical of anthropomorphizing of fish, Rose characterized anglers as nature's last defense: "If [animal-rights activists] were successful in eliminating angling, fishes would become even more of an abstraction to our largely urbanized population and there would be no alternative force coming to their aid with such commitment and financial resources."

Although most of the participants in this debate are university-based biologists (who are often anglers), some of those arguing that fish cannot feel pain are laypeople who are angling enthusiasts or angling professionals who have their own businesses. For example, Alexander Schwab, an avid Swiss angler and advertising executive, has coauthored several scientific articles with Arlinghaus. He has also written popular-audience meditations on fishing, including *Dear Jim: Reflections on the Beauty of Angling* and *Hook, Line, and Thinker: Angling and Ethics.*

Welfare states

Those arguing that fish cannot feel pain also emphasize a view of animal welfare that is "function-based." They maintain that quantitative indicators of a fish's health—for example, growth curves and fecundity—are the best indicators of its well-being. As Arlinghaus and colleagues have argued, "It might be advisable to focus on objectively measurable indicators of fish health and fitness post-release instead of relying on scientifically uncertain concepts such as suffering." Yet as David Fraser, a zoologist at the University of British Columbia, has shown, function-based welfare is only one of at least three ways that scientists and other stakeholders in these debates assess animal welfare. Some scientists look at "nature-based" welfare, which is the ability to lead a natural life in the wild. Others look at "feelings-based" welfare, which focuses on mental states rather than physical health, and emphasizes not only the avoidance of stress or fear but also the opportunity to experience positive feelings.

Any view of animal welfare is laden with assumptions. Arlinghaus himself has asserted that whether animals suffered was "not a question we can answer," even as he invokes a function-based framework to conclude that fish cannot feel pain. Dinesh Wadiwel, an animal-studies scholar at the University of Sydney, noted, in criticizing Arlinghaus, that "if we do not have the capacity to verify whether or what fish feel … how can we say confidently that noxious stimuli 'don't feel like anything to a fish'? It is doubt, rather than confidence, that would seem to prevail." Sneddon concedes that the debate has become "more philosophical," and argues that although it is "virtually impossible to get inside the animal mind … I believe we should give fish the benefit of the doubt and treat them as if they are capable of pain perception." Braithwaite and Huntingford, drawing on their research on fish spatial memory, have argued that "using Rose's own logic, if fish have the capacity for mental representation then we should consider that they may also have the capacity to experience suffering."

Despite the inescapable philosophical underpinnings, the debates continue to be carried out using the language of science. The work on rainbow trout pain by Sneddon and colleagues was criticized as unreproducible in a 2008 study by N. C. Newby and E. D. Stevens of Guelph University in Canada. Sneddon countered that the protocols used by Newby and Stevens differed from those of her group. She noted, among other deviations, that Newby and Stevens "used a completely different housing design where fish were held in barren, cylindrical tanks rather than standard, rectangular tanks with gravel. This may preclude the ability to perform behaviours such as rocking [that signify pain]." Sneddon, appealing to a nature-based welfare model, argued that she had already demonstrated that "rainbow trout do not perform anomalous behaviours or exhibit such high physiological alterations in a barren environment as they do in an enriched environment." Sneddon and others who believe their work demonstrates that fish can feel pain have in turn been accused of conducting "feelings-based," "faith-based," "emotional," and simply "bad" science. Yet Stuart Derbyshire, a pain researcher at the University of Singapore, and a skeptic of fish pain, noted in 2016 that the "entire case against fish pain rests on whether it is accepted that the fish nervous system is inadequate to generate pain."

Meanwhile, even the question of pain's origins in humans remains unsettled. In response to yet another iteration of Smith's and Rose's evolutionary argument, the noted neuroscientists Anthony and Hanna Damasio in 2016 wrote that they were "not convinced … that pain in humans depends exclusively on the cerebral cortex." In which case, the absence

of a mammalian neocortex in fish can hardly be a good basis for denying that they can feel pain.

The momentum of science

Much of the scientific research relevant to the debate over fish pain has built on foundations of bad evolutionary theory and poorly reasoned assumptions about brain function informed by the racial pseudoscience of Apartheid South Africa. For over 50 years these foundations have subtly structured the direction of research and terms of debate for both sides of the argument. Research trajectories seem to take on a momentum fueled by competing moral, legal, and scientific notions of animal welfare, and filtered through a fundamentally ethical dispute between anglers and the angling industry, and animal-rights activists. Even when the science does not appear to be driven by individuals from one side or the other of the fish pain debate, the researchers still find themselves studying questions specific to angling, with the bulk of the discussion and experimentation centering on the mouth of fish and the specific role of hooks. Very little research has considered the negative experiences that fish may encounter from other stimuli, such as low-oxygen marine environments caused by nutrient pollution and global warming, which is likely a much larger source of suffering.

The strangely narrow parameters of the fish pain debate are the result of a quirk in West German law, which has been interpreted to allow fishing for sustenance but not for recreation. From one perspective, then, our story is about science and society, and how trajectories of research and knowledge creation can be steered by legal decisions, and shackled to competing values and interests. In this story, the animal-rights movement turned to one set of scientists; those with an economic and political interest in continuing catch-and-release angling turned to another, and ideals of "evidence-based decisions" are revealed as exercises in matching different ways of defining animal welfare with different lines of evidence. Here we might say that not only has the science of fish pain been politicized, but the politics has also been scientized, as matters of philosophy, values, and competing interests are reframed as questions for researchers.

But what is all this really telling us about science and animal welfare? The number of fish caught by global fisheries each year likely would be counted in trillions. Fish farming kills at least another 80 billion fish each year (even more individuals than the 70 billion or so chickens killed annually for human consumption). In contrast to these staggering numbers, recreational angling seems likely to be a relatively minor contributor to whatever suffering fish undergo when they are caught, with estimates suggesting that the annual take from angling numbers in the hundreds of millions.

Thus, a distinctive dimension of our story is how, guided by parochial legal precedents and a narrow set of economic and cultural interests, science became captured by a quite eccentric set of questions pertaining to one limited dimension of animal welfare. Yet if the perception of pain caused by a single fish hook is a problem so tangled in a web of science and subjectivity as to be unresolvable, what does that say about our ethical obligation to animals? And if the suffering of fish is an ethical realm worth pursuing, what of industrial fishing, fish farming, river damming, and the various processes that lead to ocean pollution and oxygen depletion?

Perhaps when we decide to take seriously the full experience of fish in these other domains, what we will learn from the great fish pain debate is that allowing moral judgments to be conditioned and justified on the basis of a narrow question—a question that itself can be challenged as subjective and therefore outside the realm of science—is itself a moral error. We might want instead to begin asking on behalf of other animals the kind of questions we ask ourselves. A good life is more than freedom from pain, but somehow in the fish pain debate that came to be forgotten.

Troy Vettese *is a William Lyon Mackenzie King research fellow affiliated with the Weatherhead Center at Harvard University.* ***Becca Franks*** *is a visiting assistant professor in the Department of Environmental Studies at New York University.* ***Jennifer Jacquet*** *is an associate professor in the Department of Environmental Studies at New York University.*

Recommended reading

Robert Arlinghaus, "Voluntary catch-and-release can generate conflict within the recreational angling community: A qualitative case study of specialised carp, Cyprinus carpio, angling in Germany," *Fisheries Management and Ecology* 14, no. 2 (2007): 161–171.

Victoria Braithwaite, *Do Fish Feel Pain?* (New York, NY: Oxford University Press, 2010).

F. A. Huntingford, C. Adams, V. A. Braithwaite, S. Kadri, T. G. Pottinger, P. Sandøe, and J. F. Turnbull, "Current issues in fish welfare," *Journal of Fish Biology* 68, no. 2 (2006): 332–372.

Brian Key, "Why fish do not feel pain," *Animal Sentience* 3, no. 1 (2016): 1–34.

W. Klausewitz, "Über Schmerzempfinden und Leidensfähigkeit der Fische," *Fischökologie* 1 (1989): 65–90.

James D. Rose, "The Neurobehavioral Nature of Fishes and the Question of Awareness and Pain," *Reviews in Fisheries Science* 10 (2002): 1–38.

J. L. B. Smith, *Our Fishes* (Johannesburg, South Africa: Voortrekkerpers, 1968).

Lynn U. Sneddon, Victoria A. Braithwaite, and Michael J. Gentle, "Do fish have nociceptors? Evidence for the evolution of a vertebrate sensory system," *Proceedings of the Royal Society B* 270 (2003): 1115–1121.