



Summary report

Worse things happen at sea: the welfare of wild-caught fish

*“One of the sayings of the Holy Prophet Muhammad(s) tells us:
‘If you must kill, kill without torture’” (Animals in Islam, 2010)*

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Summary Report

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[About this report](#)

This summary report is based on a more detailed and fully-referenced version of the report which is available from fishcount.org.uk.

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1 Introduction

It is widely accepted that animals killed for food should be slaughtered humanely. This means that they are killed in ways that cause immediate loss of consciousness which lasts until death (or if not immediate, where the method of inducing unconsciousness does not cause suffering e.g. food grade anaesthetics).

There is increasing concern for the welfare of farmed fish during rearing, transport and slaughter, and in the last few years some progress has been made here. This report argues that the welfare of commercially-caught wild fish during capture and slaughter also needs to be addressed.

Wild-caught fish are captured and killed in a manner entirely inconsistent with the concepts of humane treatment and slaughter, and the severity and duration of suffering are likely to be high. The capture of wild-caught fish may last for several hours or even days. Most are likely to die from being crushed in nets, from suffocation in air or from live dissection. They may be rapidly chilled as they suffocate, a process which may both increase and prolong their distress.

The number of wild-catch fish is also very high compared with other species killed for food. The current author has estimated that the number of wild fish caught annually is in the order of 1 trillion i.e. 1,000 billion (see chapter 17). This compares with 3 billion mammals, 57 billion birds and, at a rough estimate, 10-100 billion farmed fish slaughtered each year.

In 1980, the UK RSPCA's Medway report concluded that fish can feel pain and fear. Since then, animal welfare science has become a field in its own right, and the evidence that fish can suffer has grown. As stated by Professor Donald

Broom of the University of Cambridge (1999a):

“at least some aspects of pain as we know it must be felt by fish.”

The suffering of fish in commercial fishing is therefore a major animal welfare issue. This report proposes measures and strategies for reducing the suffering in fisheries.

2 Fish are sentient beings



Professor John Webster, of the University of Bristol, defines sentience with (2009):

"A sentient animal is one for whom feelings matter".

Sentience is about the inner life of an animal, and a sentient animal has capacity to suffer fear, pain or distress as well as a sense of well-being. There is a growing body of evidence that fish are sentient.

The learning achievements of a goldfish called "Comet", trained by his owner to fetch hoops like a dog and many other tricks, received great media interest in 2008. In 2003, the publication of a collection of articles on fish intelligence was reported on the BBC news website (BBC News, 2003) which said that, according to scientists, fish

"do not deserve their reputation as the dim-wits of the animal kingdom".

Of key importance in animal welfare is the capacity to experience pain, fear and distress. The case for fish feeling pain is summed up by Professor Donald Broom of the University of Cambridge (1999a):

Pain and fear in fish

"Anatomical, pharmacological and behavioural data suggest that affective states of pain, fear and stress are likely to be experienced by fish in similar ways as in tetrapods [amphibians, reptiles, birds and mammals]" (Chandroo et al, 2004)

Credit: National Oceanic and Atmospheric Administration/Department of Commerce. Photographer: Mr. Mohammed Al Momany, Aqaba, Jordan

"There are some differences in sensory functioning between fish and mammals because fish live in water but the pain system of fish is very similar to that of birds and mammals. Fish have pain receptor cells, nociceptive neuronal pathways, specialized transmitter substances, electrophysiological responses to cuts, bruises and electric shocks, behavioural avoidance, learned avoidance of places where they had unpleasant experiences and processing systems in the brain which parallel those in birds and mammals. Hence at least some aspects of pain as we know it must be felt by fish."

In the European Union, a scientific panel commissioned by the EU commission adopted its "General approach to fish welfare and to the concept of sentience in fish" in 2009 (AHAW, 2009). The AHAW Panel had been asked to deliver a Scientific Opinion on the animal welfare aspects of fish farming. Having examined the research that has been carried out for some species of fish (a relatively small number of species have been studied), this panel concludes:

"The balance of the evidence indicates that some fish species have the capacity to experience pain"



Fish feel pain

“at least some aspects of pain as we know it must be felt by fish” (Broom, 1999a)

and that

“Responses of fish, of some species and under certain situations, suggest that they are able to experience fear”.

Some scientists have argued that fish cannot suffer. In 2002, Rose published a paper, conducted at the behest of the American Fisheries Society, arguing that fish do not feel pain because they do not have a neocortex and that their behaviours are reflexes without feeling.

The evidence that fish do in fact have brain structures capable of feeling pain and fear is discussed below. The evidence that fish have a pain system which is

- similar to that of other vertebrates (e.g. mammals and birds), and that
- involves these animals *feeling* pain

is discussed subsequently.



Herring caught in the crush

Credit (above left): Courtesy of United Nations Food and Agriculture Organization. Photographer: Danilo Cedrone. National Oceanic and Atmospheric Administration/Department of Commerce.

Credit (above): National Oceanic and Atmospheric Administration/ Department of Commerce. Photographer: J. M. Olson.

Fish have brain structures capable of feeling fear and pain

AHAW (2009) discusses the similarities in brain structure between fish and other vertebrates and begins by saying that:

“As vertebrates, fish, birds and mammals share a similar general brain structure”.

Like that of other vertebrates, the fish brain consists of the forebrain (i.e. telencephalon and diencephalon), midbrain and hindbrain. The fish brain is not identical to the mammalian brain. It is smaller and fish do not have the extensive cerebral cortex seen in the forebrain of mammals. This is a laminated structure which covers the telencephalon. It has sometimes been argued that because fish do not possess this laminated structure (a “neocortex”), they must therefore be incapable of experiencing pain. However, there is good reason to believe that fish do experience pain and fear without this particular structure.

It is known that the same brain function can be served by different brain structures in different groups of animals, e.g. cognitive functions in birds and mammals (visual stimuli are processed by

part of the cerebral cortex in mammals but by the midbrain optic tectum in birds). Another example of this is that seen in dolphins, highly intelligent animals whose brain is organized in a fundamentally different way to that of primates. It is also a matter of some debate whether human consciousness is a function of the neocortex alone, or restricted to any single area of the brain.

As AHAW states, there is evidence that the fish forebrain contains within it several brain structures that perform similar functions to those associated with pain and fear in higher vertebrates. These are known to be active after a noxious stimulus, such as pin-prick stimuli in trout or goldfish. For example, the dorsomedial (Dm) and dorsolateral (DI) telencephalon are thought to perform the same functions as the amygdala and hippocampus respectively in mammals. The amygdala is important in arousal and emotions, particularly fear responses, while the hippocampus is involved in memory and learning of spatial relationships. Damage to the Dm area in fish has been observed to impair the fear response without affecting spatial learning, and vice versa for damage to the DI area.

Critics of fish sentience focus on the structural differences between the brain of fish and that of humans. Through convergent evolution, different species can develop the same function through anatomical structures that may be quite different. For example, there is good evidence that some invertebrates, such as decapod crustaceans (e.g. crabs and lobsters), have the capacity for pain and fear, despite the lack of a vertebrate pain system. Animal welfare scientists, such as Professor Robert Elwood and Professor Donald Broom, have argued that the welfare of these animals should also receive some legal protection. The invertebrates with the most complex brains are the cephalopods (including octopus and squid), which can solve maze puzzles and remember the solutions. Cephalopods appear to show strong emotions that are signalled by profound changes in colour. In 1993, the UK legislation governing the use of

animals in scientific research was amended to include the common octopus.

AHAW (2009) concludes its discussion on brain structure by saying:

“There is scientific evidence to support the assumption that some fish species have brain structures potentially capable of experiencing pain and fear”.

As Professor John Webster argues, since all or nearly all the evidence points in the direction of fish feeling pain (Webster, 2005):

“The claim that fish ‘do not have the right sort of brain’ to feel pain can no longer be called scientific. It is just obstinate”

and that (John Webster, personal communication, 2009)

“to say that a fish cannot feel pain because it doesn’t have a neocortex is like saying it cannot breathe because it doesn’t have lungs”.

Fish probably experience pain, fear and stress in a similar way to other vertebrates

Fish have a pain system similar to that of other vertebrates. As stated by Chandross et al (2004):

“Anatomical, pharmacological and behavioural data suggest that affective states of pain, fear and stress are likely to be experienced by fish in similar ways as in tetrapods [amphibians, reptiles, birds and mammals]”.

Fish have nociceptors (pain receptors) to detect harmful stimuli such as high temperatures or harmful chemicals. These pain receptors connect, via sensory pathways, to the brain. Activity in the brain has been measured when nociception (detection of harmful stimuli) occurs. The fact that the brain is involved during nociception *“demonstrates the potential for pain perception in*



Fish have endogenous opioids

Endogenous opioids are substances produced in the brain in order to reduce pain. *“One has to ask why they are needed in fish if these animals do not experience pain”* (FSBI, 2002).

Credit: FreePixels.com

lower vertebrates [fish]” (Dunlop and Laming, 2005).

Painkillers, such as morphine, work on fish. Fish, like other vertebrates, produce their own natural painkillers in the brain called “endogenous opioids”. The presence and action of painkillers in fish is further evidence that fish feel pain, or why would they need them?

Fish can learn to avoid noxious or threatening stimuli. For example paradise fish learned to operate an escape hatch to avoid electric shocks. Avoidance learning further suggests the behaviour is more than just a reflex. While reflexes occur quickly, the detection of noxious stimuli in fish can cause profound and prolonged changes to the animal’s behaviour, lasting several hours. Fish can also learn to avoid threatening, but not painful, stimuli suggesting they also feel fear.

Animal suffering is wider than pain and fear. AHAW (2009) report that the stress physiology in fish is *“directly comparable to that of higher vertebrates”* and manifested as primary, secondary and tertiary stress responses. The

primary response includes the release of hormones e.g. cortisol.

Most of what is known about human pain is from self-reporting and because a fish cannot report to us what it is feeling, it may be that scientific method cannot prove, in an absolute sense, that fish feel pain. Just as it cannot be totally proven that babies, or even you and I, can feel pain. The balance of evidence, together with what is understood about evolution and the biological purpose of pain, indicate that fish do feel pain and, for humane reasons, the benefit of any doubt should be given to avoiding suffering.

As this report goes to press, Dr. Victoria Braithwaite’s book *“Do fish feel pain?”* (2010) brings the science behind the debate around pain in fish into the open. She describes the many different pieces of evidence that together build up a picture of fish as animals that, she concludes, *“have the mental capacity to feel pain”*. She argues, on the basis of the evidence, that *“I see no logical reason why we should not extend to fish the same welfare considerations that we currently extend to birds and mammals”*.

The sentience of fish has huge implications for the way they are treated in fisheries and elsewhere. Dr. Braithwaite (2010) identifies the welfare of fish caught in commercial fishing as a major fish welfare concern:

“In terms of sheer numbers of fish, the real business is ocean-going trawlers scooping fish from the sea. Fish, netted by the tens of thousands, are pulled to the surface through such rapid changes in pressure that their swim bladders overinflate, causing the body to become severely distended. On reaching the surface fish are dropped onto open decks where they then flap around as they suffocate. We tend not to think too hard about the way we capture fish at sea – it isn’t very pretty. We wouldn’t accept killing chickens by throwing them into a tank of water and waiting for them to drown, so why don’t we object to fish suffocating on trawler decks?”

3 Introduction to animal welfare aspects of fish capture

Suffering is caused to fish throughout the process of capture until death, which may be considered as three parts:

- the process of capture, which may last many hours or even days for some fishing methods
- the process of removing the fish from nets and hooks and landing them
- the process of killing the fish or, more usually, leaving them to die from suffocation, live gutting or freezing.

The welfare impact of capture and landing for some major fishing methods are discussed in chapters 4-14. What happens to fish once they have been landed is discussed in chapter 15.

The environmental problems caused by each fishing method are also given briefly in chapters 4-14, since these are almost always a welfare problem too, particularly those of bycatch. Reducing bycatch is an obvious way of reducing suffering, and measures for doing this are discussed. So too are measures that promote the survival of released bycatch fish, such as shorter capture periods or hooks that cause less injury, since these could potentially reduce suffering in both target and released fish. Overfishing, and its impact on the marine environment and animal welfare, is explained separately in 18.2 of chapter 18.

4 Trawling

4.1 Animal welfare impact on captured fish

Fish caught by trawling are chased to exhaustion by a bag-shaped net towed through the water. Once exhausted, the fish become overrun and swallowed by the net, moving into the much narrower cone-shaped part of it where they become confined and start to panic. As they thrash their tails in attempts to escape, they will incur scale damage from collisions with the net and each other. Eventually they pass to the end of the net, called the cod end, which is yet narrower. As the number of fish in the cod end increases, the fish will experience compression under the crush. This may stop some of them being able to move their gills in order to breathe, resulting in suffocation. It may also stop the blood supply, resulting in death from circulatory failure.

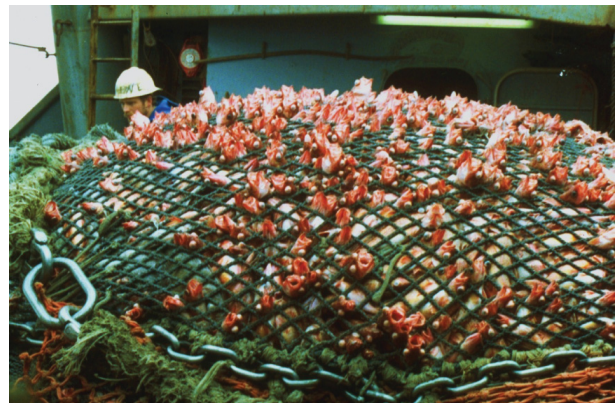
The trawl tow may last for many hours. Longer towing periods increase the proportion of fish that are dead on landing. For species that have a closed swim bladder, the sudden change in pressure caused by raising them from some depth, results in rapid decompression. Parts of the gut may be forced out of the mouth and anus, eyes may be forced from their orbits and the swim bladder may burst.

4.2 Environmental impacts

Trawl nets catch everything in their path which is not small enough to escape through the holes in the mesh, resulting in bycatch. Trawling and tropical shrimp trawling account for respectively 55% and 27% of global discarded bycatch (i.e. catch thrown overboard). Trawls towed along the sea bottom (bottom trawls) can be highly damaging to the seabed, destroying fish habitat.

4.3 Reducing fish bycatch numbers and death rates

Fish thrown back into the sea after landing because they have been identified as bycatch, often die as a result of capture. So, too, do some fish that are caught in trawl nets and subsequently escape. Escapee and discarded fish may die from



Fish caught in a trawl showing signs of decompression

Fish caught in trawls are forced towards the "cod end" at the back of the net. Here they are likely to be compressed and effectively buried under a mass of other fish. Trawls may last for several hours and a proportion of the fish die before landing as a result of crushing, suffocation or circulatory failure.

Deep-caught fish can suffer decompression as they are raised through the water table. The sudden change in pressure can cause parts of the gut to be forced out through the mouth and anus, eyes to bulge from their orbits and the swim bladder to burst.

Those which survive capture and landing will usually die of suffocation or during the course of processing.

Credit: Alaska Fisheries Science Center, Marine Observer Program. National Oceanic and Atmospheric Administration/Department of Commerce

injury, from being too exhausted or stressed to adequately evade predators, or from infection following scale damage.

Trawl gear may theoretically be made selective by modifications called bycatch reduction devices (BRDs). BRDs work by allowing unwanted species to escape through holes in the net while retaining the target species. For gear to be truly selective, the fish escaping through the BRD must be sufficiently unharmed to survive. Another method of bycatch reduction is to reduce fishing effort, e.g. by closing a fishery at a particular time and place when bycatch levels are particularly high.

For some species, survival chances of discards are likely to be increased by better handling of the fish on deck (especially reducing time spent out of water). Survival chances are also likely to be increased with shorter time spans between putting the net out and landing the fish. Other factors, such as tow speed, water temperature and depth, can also affect the survival chances for escapees and/or discards.

4.4 Possible ways to improve welfare

The following summarises measures that, combined with humane slaughter immediately the fish is landed, would improve the welfare of fish captured by trawls:

Reduce the duration of capture

- reduce the duration of the trawl tow.

Reduce the numbers of bycatch animals

- use modifications to trawl gear that reduce bycatch, without killing the escaping fish
- close fisheries as and when necessary to reduce high levels of bycatch.

Reduce stress and injury during landing

- develop methods of landing fish which reduce stress and injury and minimise time out of water
- handle fish carefully, and with minimal time out of water, prior to humane slaughter (or release as bycatch)
- avoid fishing from depths greater than 20m (for fish with swim bladders)

Reduce harm to other non-target animals

- avoid gears that are more damaging to fish habitat.

5 Purse seining



Chilean jack mackerel caught in a purse seine net

Chilean jack mackerel is caught mainly for processing into fishmeal. Studies in other species have shown that fish caught in purse seines experience high levels of stress.

Credit: National Oceanic and Atmospheric Administration/ Department of Commerce. Photographer: C. Ortiz Rojas

5.1 Animal welfare impact on captured fish

In purse seining a school of fish is gradually surrounded by a long wall of netting, possibly as long as 1km, hanging in the water and towed into a circle. Once the loop is complete, the net is drawn together like a draw-string bag, constraining the fish. The fish are then hauled aboard within the net, pumped to the deck, or scooped into smaller brail nets and lifted aboard.

The duration of the whole fishing operation is probably generally shorter than in trawling, and the duration of the phases that are the most stressful to fish, i.e. during tightening of the net and transferring the fish aboard, are shorter still. Tightening the net might take around 1 hour.

Fish are likely to experience fear as they try to out-swim the net moving towards them, and as they are finally encircled. Sometimes fish are deliberately scared by, for example, high speed chase boats used to herd the fish. Once the circle is complete, the trapped fish are confined in a

shrinking space of water and become increasingly crowded. At a certain point, the constriction of space will prevent the fish from swimming as a school, when instead they will move as individuals. This is likely to be very stressful, and fish are liable to incur injury and scale loss from collisions with other fish and with the net walls.

One study describes the panic reaction of mackerel confined in a tightened purse seine net (Misund and Beltestad, 2000):

“most of these fish swam around at burst speed and leapt frequently out of the water and up along the net wall to such an extent that the catch seemed to ‘boil’.”

Stress levels of sardine caught in purse seines have been observed to be similar to peak levels reported elsewhere for acute distress, according to one study. The same study found that stress levels continued to increase the longer the fish remained in the net.

Fish can also receive further injury as they are transferred to the fishing vessel. Pumps can

break fins and damage scales. In ramping, the seine net is hauled aboard en masse, causing fish to get crushed. In brailing, fish are transferred using a smaller brail net. Lower death rates and lower levels of “physiological disruption” have been found in salmon transferred by this method as compared with ramping.

5.2 Environmental Issues

Sometimes purse seine nets are deliberately set on dolphins, in order to catch tuna. However, the alternative of setting nets on fish aggregating devices (FADs) produces much greater numbers of bycatch animals, including turtles, sharks and juvenile tunas. Environmental groups such as Greenpeace and WWF therefore support a cleaner method of fishing, monitored by an observer programme, which sets on dolphins but allows them to escape before the net is hauled in.

5.3 Reducing fish bycatch numbers and death rates

Sometimes part of the catch (i.e. excess catch) is deliberately released from the tightened net instead of landing it, in a process called “slipping”. Despite the fact that these fish are released alive, high death rates can occur following release as a result of injury and scale damage incurred. Possible ways to reduce these wasted death rates are for fish to be released before the net is tightened, and reducing the practice altogether.

5.4 Possible ways to improve welfare

The use of pumps to transfer farmed fish between cages can cause less stress and injury than other methods of transferring them. In particular, they avoid removing the fish from water. The use and development of fish pumps for use on purse seine ships that involve minimal stress and injury to fish could, perhaps, greatly reduce the suffering during landing, especially if the fish are pumped into a tank of water (rather than air) for humane slaughter.

As discussed in chapter 19, the company Wild Salmon Direct, which claims to be the only wild salmon producer using humane slaughter technology, uses a pump specifically designed to pump live fish.

The following summarises measures that, combined with humane slaughter immediately the fish is landed, would improve the welfare of fish captured by purse seines:

Reduce the duration of capture

- reduce the duration of the whole capture process
- reduce the time spent in the net once it has been pursed and constricted ready for, and during, landing when the fish are most crowded and vulnerable.

Reduce the numbers of bycatch animals

- avoid fishing on FADs
- use encirclement methods that avoid harm to cetaceans
- use gear modifications shown to reduce bycatch, e.g. sorting grids, without killing the escaping fish
- close fisheries as and when necessary to reduce high levels of bycatch.

Reduce stress and injury to bycatch fish

- reduce the practice of slipping
- for catch to be partially “slipped”, do so before the net is tightened ready for landing
- use gears which enable quick release of fish during slipping.

Reduce stress and injury during landing

- avoid the practice of ramping to land fish
- develop and use methods of landing fish which reduce stress and injury, and minimise time out of water e.g. use and development of better pump designs may offer a potential solution
- handle fish carefully prior to humane slaughter (or release as bycatch).

6 Gill nets, tangle nets and trammel nets



Gill net catch being brought in

In some gill net fisheries, fish can remain snared in nets for many hours, or even days.

Credit: NOAA Restoration Center, Chris Doley. National Oceanic and Atmospheric Administration/Dept. of Commerce

6.1 Animal welfare impact on captured fish

A gill net is a wall of netting, hanging in the sea, which is invisible to fish. Fish of a certain size, swimming into a gill net, will pass through it only as far as their head and become ensnared as they try to reverse. As the fish struggles to free itself, it may become yet more entangled, and is likely to experience fear and panic. Constriction of the gills by the netting may also stop the fish being able to breathe properly. Struggling may result in cuts to the skin and scales. The snared fish may then also suffer attack from predators such as seals, leaving it wounded. Fish may remain like this for many hours or even days and a proportion may die before they are landed.

One study found high levels of stress in sea bream captured by trammel net under experimental conditions. A trammel net is a variation of gill net with two or three layers. Fish were caught in a trammel net for a period of between 10 minutes and 18 hours. Stress levels continued to rise the longer the fish were in the net, even after 12 hours. 28% of the fish died in the net, probably from suffocation caused by

constriction of the gills. Another 16% died following release, having incurred open wounds.

A Canadian study found that gillnet-caught coho salmon were severely exhausted when landed, but that reducing the net retrieval period from 60 minutes to 30 minutes resulted in less “physiological disruption”.

Further injury to skin and scales may be caused when the net is hauled in over roller guides and in removal from the net. Loosely attached fish may be gaffed (i.e. their bodies spiked with a hand held hook) to bring them on board. Snared fish are then pulled out by hand or removed by shaking the net.



A salmon caught in a gill net

The mesh has cut into the gills.

Credit: National Oceanic and Atmospheric Administration/ Department of Commerce

6.2 Environmental Issues

Sometimes marine turtles, birds, and mammals are tangled in gill nets and drown. Cetacean and bird bycatch can be reduced by use of acoustic devices (“pingers”) to make the nets more

“visible” to them. However, seals sometimes prey on fish caught in gill nets and these pingers can attract, rather than deter, seals like a “dinner bell”.

6.3 Reducing fish bycatch numbers and death rates

The numbers of discarded fish that die following release from gill nets will vary between species and fishery, and is likely to be very high in some. A study in the Columbia River found that survival rates of spring chinook salmon released as bycatch were nearly twice as great for those captured in a 4.5-inch mesh tangle net than those caught in a conventional 8-inch mesh gill net. The smaller-meshed tangle nets tended to catch fish round the snout rather than snaring them. This resulted in less injury and, it appeared, less exhaustion from struggling. However, the smaller-meshed tangle nets did result in larger numbers of bycatch animals.

In this study, more careful handling of the fish had probably helped to reduce the numbers of discarded fish that died. The material of the net is also likely to have a substantial effect on the injury and subsequent survival of captured fish. A study of the Kentucky Lake paddlefish gill net fishery in Tennessee found that the number of fish dying in the nets was related to the twine type and water temperature, as well as increasing with soak time (i.e. the period of time between setting and retrieving the net). Most of the fish (71%) were dead in the nets when the water temperature exceeded 17°C and fish were more likely to die in monofilament nets than in multifilament ones.

Lost gill nets may continue to catch fish (“ghost fishing”) for several months or even years. The problem can be partially addressed by constructing nets from materials that deteriorate more quickly, and by “retrieval surveys” in which vessels survey fishing grounds to retrieve lost nets. Initiatives that can help prevent gear loss include zoning fishing activities to prevent loss of nets caused by trawlers towing through gill nets, and limitations on gear use (e.g. restrictions on net size and soak time). They also include the

fitting of acoustic detection devices to nets, which can help fishers locate gears they have lost.

6.4 Possible ways to improve welfare

The following summarises measures that, combined with humane slaughter immediately the fish is landed, would improve the welfare of fish captured by gill, trammel and tangle net fishing:

Reduce the duration of capture

- reduce the time between setting and retrieving the net (the Fair-fish certification scheme (see page 42) limits capture duration to 30 minutes).

Reduce the numbers of bycatch animals

- use gear modifications shown to reduce bycatch e.g. pingers to deter cetaceans
- close fisheries as and when necessary to reduce high levels of bycatch
- use gears and practices that reduce ghost fishing e.g. nets made from biodegradable materials
- survey fishing grounds for, and retrieve, lost and discarded gill nets.

Reduce stress and injury during capture

- use gears that entangle fish rather than gilling them e.g. tangle nets rather than gill nets
- use gear type variations that reduce injury e.g. knotless multifilament nets are preferable to monofilament ones.

Reduce stress and injury during landing

- avoid gaffing fish
- handle fish carefully when landing and removing from nets, prior to humane slaughter (or release as bycatch)
- minimise time spent out of water.

Reduce death rates for released bycatch fish

- avoid fishing in warm-water weather when fish are likely to be particularly stressed.

7 Rod & line and hand line fishing

7.1 Animal welfare impact on captured fish

In hand line and “rod and line” fishing, the fish is caught individually with a hook and line. Hand line fishers don’t use a rod but hold a line in their hand. On some boats, lines are hauled in mechanically. This type of fishing carried out from a moving boat is called trolling (see chapter 8).

As with any other hook and line fishing method, fish are caught when they snap at baited hooks which then become embedded in the fish’s mouth or elsewhere. Hooking is stressful to fish and causes an alarm response in which they will struggle to become free. This can lead to severe exhaustion. Hooking fish causes injury which is sometimes severe and likely to cause additional suffering.

One study found that the response by carp to hooking was similar to that for other stimuli likely to cause pain and fear (e.g. electrical stimulation of the mouth of a free-swimming fish), indicating that hooked fish do suffer fear and pain. Even with short durations, welfare during capture will be poor. According to Broom (1999b):

“it is clear that fish welfare is poor when they are caught on hooks and when they are removed from water, even for a short period.”

Live fish are sometimes used as bait in all forms of hook and line fishing. This hugely adds to the welfare cost of this fishing method.

7.2 Environmental impacts

Conservation groups consider rod and line, or hand line, fishing to have low levels of bycatch

relative to other major fishing methods e.g. WWF Canada. Bycatch is released quickly.

7.3 Reducing fish bycatch numbers and death rates

The size and species caught by hook and line fishing is partly determined by hook size and bait type. The injury and survival chances for a released fish are affected by the type and size of the hook and bait. Barbless hooks and circle hooks have been recommended for “catch and release” fishing. In circle hooks (the name denotes the shape of hook which is more circular than the J-shaped hook) the point is turned inwards, which can increase the likelihood the fish will be hooked around the mouth rather than in the stomach, throat or vital organs.

Further wounding may be caused during removal of the hook. Removing hooks by hand, in a way that tries to take the hook out the same way it went in, causes less resulting injury than removal by automatic means that tear the hook out. In a study of Pacific halibut caught as bycatch in long line fishing, careful removal of the hook by hand more than doubled the survival chances of released fish compared to removal by automatic hook strippers.

Many factors affect the ability of a fish to cope with being hooked. These include the species and size of the fish, the temperature and depth of the water, the type and size of the hook and bait and how the hook is removed. Fishing at warm temperatures and at greater depths (causing the fish to experience sudden changes in pressure) can reduce survival chances.

7.4 Possible ways to improve welfare

This fishing method has the potential to be relatively humane because it is relatively fast. The following summarises measures that, combined with humane slaughter immediately the fish is landed, would improve the welfare of fish captured by rod and line, and hand line, fishing:

Reduce suffering of bait fish

- avoid the use of live fish as bait
- avoid the use of bait fish generally (use artificial baits or off-cuts instead).

Keep the duration of capture short

- monitor gear and land fish immediately they become hooked (the Fair-fish certification scheme (see page 42) limits capture duration to 5 minutes for fish caught by hook).

Reduce the numbers of bycatch animals

- use hooks and baits that reduce bycatch.

Reduce stress and injury during capture

- use hooks that cause less injury e.g. circle hooks, barbless circle hooks
- avoid fishing from depths greater than 20m (for fish with swim bladders).

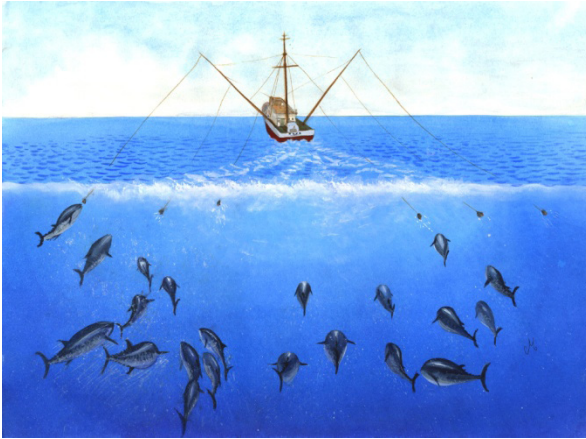
Reduce stress and injury during landing

- handle fish carefully when landing prior to humane slaughter (or release as bycatch)
- minimise time spent out of water
- remove hooks after the fish is humanely slaughtered or stunned, rather than before (as required by Fair-fish certification)
- carefully remove hooks from fish to be released
- avoid gaffing fish.

Reduce death rates for released bycatch fish

- avoid fishing in warm-water weather when fish are likely to be particularly stressed.

8 Trolling



Artist's conception of tuna trolling operation

In trolling, lines bearing baited hooks or lures are towed through the water by a slow moving vessel. Caught fish are landed quickly.

Sometimes fish are gaffed with a hook to land them. Live fish are sometimes used as bait. These practices increase the suffering caused.

Credit: National Oceanic and Atmospheric Administration/Department of Commerce

8.1 Animal welfare impact on captured fish

In trolling, lines bearing baited hooks or lures are towed through the water by a slow moving vessel. Sometimes fish are gaffed (i.e. impaled on a hook) to bring them aboard.

As discussed in 7.1, hooking is stressful to fish. Troll-caught salmon have been shown to be severely exhausted when landed. Fish can also be fatally injured by hooking, as discussed in 8.3 below.

As previously mentioned, live fish are sometimes used as bait in all forms of hook and line fishing (see chapter 13).

8.2 Environmental impacts

As with rod and line fishing, conservation groups consider trolling to have low levels of bycatch relative to other major fishing methods e.g. WWF Canada. Bycatch is released quickly.

8.3 Reducing fish bycatch numbers and death rates

As discussed for rod and line fishing, the size and species caught is partly determined by the choice of hook and bait, which can also affect the level of injury and survival chances of released fish.

A study of death rates for released trolled chinook salmon off Alaska, found that many troll-caught fish become hooked in locations other than the mouth. The study found that this increases the likelihood of fatal wounding, especially if the gills are damaged. 4% of the fish were hooked through the gills, of which 85% died within 6 days. Nearly a quarter of the fish, 23%, were hooked through the eye, of which 21% of them died within the same period.

The same study found that smaller fish may cope less well with being hooked than those of legal capture size. An earlier study of the same fishery found that the hooking location seemed to be affected by the type of lure.

8.4 Possible ways to improve welfare

The following summarises measures that, combined with humane slaughter immediately the fish is landed, would improve the welfare of fish captured by trolling:

Reduce suffering of bait fish

- avoid the use of live fish as bait
- avoid the use of bait fish generally (use artificial baits or off-cuts instead).

Keep the duration of capture short

- monitor gear and land fish immediately they become hooked (the Fair-fish certification scheme (see page 42) limits capture duration to 5 minutes for fish caught by hook).

Reduce the numbers of bycatch animals

- use hooks and baits that reduce bycatch.

Reduce stress and injury during capture

- use hooks that cause less injury e.g. circle hooks.

Reduce stress and injury during landing

- handle fish carefully when landing prior to humane slaughter (or release as bycatch)
- minimise time spent out of water
- remove hooks after fish is humanely slaughtered or stunned, rather than before (as required by Fair-fish certification)
- carefully remove hooks by hand for fish to be released
- avoid gaffing fish.

Reduce death rates for released bycatch fish

- avoid fishing in warm-water weather when fish are likely to be particularly stressed.

9 Pole & line fishing

9.1 Animal welfare impact on captured fish

“Pole and line” fishing usually means a particular type of rod and line fishing in which fish are attracted to the surface with bait fish. After locating a school of fish, the fishers create a feeding frenzy by scattering bait fish such as anchovies and sardine, usually alive, over the side of the vessel. In this feeding frenzy, the fish snap at barbless hooks attached to the fishers’ rod and lines. When a fish becomes hooked the fisher swings the rod, bringing the fish flying onto the deck behind and disengaging it from the lure.

The process of throwing bait fish overboard is called “chumming”, and it usually involves live bait fish. Occasionally minced bait, prepared from frozen sardines or similar fish in a hand mincer, is used in place of live bait for chumming. Normally bare hooks or jigs (artificial lures) are used on the lines, but hooks may be baited with live fish. The use of live bait fish in this way and in chumming, hugely adds to the welfare cost of this fishing method, as discussed in chapter 13.

From the point of view of the target fish (as opposed to the bait fish) this may be one of the most humane methods of catching fish on account of the short duration of capture.

9.2 Environmental impacts

Conservation groups consider pole and line fishing to have low levels of bycatch relative to other major fishing methods.

9.3 Reducing fish bycatch numbers and death rates

As fish are landed soon after becoming hooked, unwanted catch can be released quickly. Survival chances of released bycatch are considered to be high due to the use of barbless hooks and the quick release from them.

9.4 Possible ways to improve welfare

The following summarises measures that, combined with humane slaughter immediately the fish is landed, would improve the welfare of fish captured in pole and line fishing:

Reduce suffering of bait fish

- avoid the use of live fish as bait
- avoid the use of bait fish generally (use fish off-cuts and artificial baits instead).

Reduce stress and injury after landing

- handle landed fish carefully prior to humane slaughter (or release as bycatch)
- avoid use of gaffs
- minimise time spent out of water.

Pole and line fishing

Chumming with bait fish (1 and 2)



1 Small bait fish, usually alive, are thrown overboard to create a feeding frenzy in a school of fish.



2 Water is sprayed to prevent the tuna from noticing the activity on deck.

Notice the gaff hook used to impale the caught tuna to bring them aboard.

Landing the fish (3 and 4)



3 Bigeye tuna caught by pole and line fishing.

The fish are quickly landed.



4 Gaffing. Sometimes fish are impaled on gaff hooks to bring them aboard.

Photo credits this page.

1. National Oceanic and Atmospheric Administration /Dept. of Commerce. Photographer: Jose Cort.

2. and 4. Courtesy of United Nations Food and Agriculture Organization. Photographer: Andrey Urcelayeta. National Oceanic and Atmospheric Administration/Department of Commerce.

3. National Oceanic and Atmospheric Administration/Department of Commerce. Photographer: Bernard Frink, BCF

10 Long line fishing



A bigeye tuna caught on a long line

Unlike other hook and line methods which are fast, in long line fishing the fish may remain captured for many hours, or even days.

Credit : © Greenpeace / Jeremy Sutton-Hibbert

10.1 Animal welfare impact on captured fish

Long line fishing, or long lining, is a commercial fishing method that uses hundreds or even thousands of baited hooks hanging from a single line which may be 50-100km long. Unlike other hook and line fishing methods discussed in this report, the duration of capture for long line fishing is very long. Fish caught on long lines are landed hours, or days, later when the gear is hauled up.

Hooking is stressful to fish. It invokes an alarm response and can result in severe exhaustion and fatal injury, as discussed in chapters 7 and 8. In this method of fishing, it is common for live fish to be used as bait. A semi-automatic machine impales the live fish on hooks as the line is played out. This hugely adds to the welfare cost of this method (see chapter 13), as do long capture periods. The target fish, once hooked, may

themselves be subsequently attacked by predators.

The fate of many sharks, including those caught as bycatch on long lines, is to be “finned”. Their fins are cut off and they are thrown back into the sea, often still alive.

10.2 Environmental impacts

Long lines kill sea birds, sea turtles and sharks, as well as other non-target fish, which are attracted by the bait. Sea birds like albatross get hooked when the lines are near the surface. The birds are then dragged under water and drowned. Bird bycatch can be reduced by measures such as bird-scaring devices and weighting the lines to make them sink more quickly. US fishermen can avoid the migratory paths of sea turtles by sinking their long lines deeper.

10.3 Reducing fish bycatch numbers and death rates

Large numbers of bycatch fish are reportedly caught and thrown back dead. Long line fishing catches more sharks as bycatch than any other fishing method in international waters.

The impact of hook type, method of hook removal, water depth and temperature on survival of fish released from hooks are discussed in chapter 7. The impact of hooking location is discussed in chapter 8.

10.4 Possible ways to improve welfare

The following measures, combined with humane slaughter immediately the fish is landed, would improve the welfare of fish captured by long lines:

Reduce suffering of bait fish

- avoid the use of live fish as bait
- avoid the use of bait fish generally (use artificial baits or off-cuts instead).

Reduce the duration of capture

- reduce the time between setting and retrieving the lines (the Fair-fish scheme (see page 42) limits capture duration to 5 minutes for fish caught by hook).

Reduce the numbers of bycatch animals

- use practices shown to reduce bycatch e.g. bird-scaring devices
- use hooks and baits that reduce bycatch
- close fisheries as and when necessary to reduce high levels of bycatch.

Reduce stress and injury during capture

- use hooks that cause less injury e.g. circle hooks
- avoid fishing from depths greater than 20m (for fish with swim bladders).

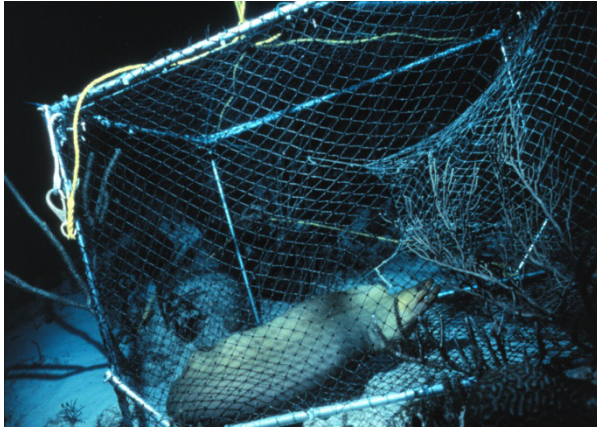
Reduce stress and injury during landing

- avoid gaffing fish
- handle fish carefully when landing prior to humane slaughter (or release as bycatch)
- minimise time spent out of water
- remove hooks after fish is humanely slaughtered or stunned, rather than before (as required by Fair-fish certification)
- carefully remove hooks by hand for fish to be released.

Reduce death rates for released bycatch fish

- avoid fishing in warm-water weather when fish are likely to be particularly stressed.

11 Trapping



Green moray eel preys on other trapped fish

Fish traps aim to catch fish live and uninjured. However, fish can be killed by trying to escape and by predators, such as this green moray eel, entering the trap. Distress, injury and death rates are likely to be reduced by shorter time intervals between setting and retrieving traps.

Credit: OAR/National Undersea Research Program (NURP); National Marine Fisheries Service - Galveston Lab. Photographer: G. Gitschlag, National Oceanic and Atmospheric Administration/Department of Commerce.

11.1 Animal welfare impact on captured fish

Trapping is a fishing method in which fish may be trapped alive and uninjured as they swim into small baited cages. Although fish caught by traps can be caught without injury, confinement may be distressing to fish, especially when potential predators approach or enter the trap. Trapped fish are sometimes attacked by such predators.

A New Zealand study investigated the stress caused to blue cod by trapping, and how this might be reduced in order to improve flesh quality. Modifications to the traps enabled them to be hauled in within a bag, the trap still surrounded by a reservoir of water. Fish caught in this way were

constantly immersed in water during capture and landing, and killed by spiking (a humane method of killing if performed correctly (see chapter 16)) within 2.5-3.5 minutes of landing. However, the fish caught by traps still suffered more fatigue (as indicated by pH, lactate and ATP levels in the white muscle¹) than a control group of captive fish killed using a low-stress method involving careful handling and anaesthesia with AQUI-S (see chapter 16).

11.2 Environmental impacts

Conservation groups consider trapping to have low levels of bycatch relative to other major fishing methods e.g. WWF Canada. Marine mammals can become entangled in the lines connecting the traps to the buoys.

11.3 Reducing fish bycatch numbers and death rates

Bycatch fish caught in traps can become injured from attempting to escape the trap, from decompression as traps are lifted to the surface to land fish, from handling during landing and from predators, such as moray eels, that enter the trap and prey on fish before the traps are hauled in.

Traps can become lost and can continue “ghost fishing”. They can be fitted with time release panels to stop them fishing after a period of time has elapsed. Bycatch can be reduced by choice of mesh size. Openings can be included in the traps to release undersized fish.

¹ When teleost fish are severely stressed and exercised to exhaustion, they make extensive use of their 'white' muscle system.

11.4 Possible ways to improve welfare

The following measures, combined with humane slaughter immediately the fish is landed, would improve the welfare of fish captured in traps:

Reduce suffering of bait fish

- avoid the use of fish as bait (use off-cuts instead).

Reduce the duration of capture

- reduce the time between setting and retrieving the trap (the Fair-fish certification scheme (see page 42) limits capture duration to 30 minutes).

Reduce the numbers of bycatch animals

- use baits and mesh sizes that reduce bycatch
- use gear modifications to allow undersized animals to escape
- use gear modifications and practices that reduce ghost fishing e.g. time release panels.

Reduce stress and injury during capture

- use gear designs that cause less stress e.g. modifications to keep the trap enclosed by water as it is retrieved
- avoid fishing from depths greater than 20m (for fish with swim bladders).

Reduce stress and injury during landing

- handle fish carefully when landing prior to humane slaughter (or release as bycatch)
- minimise time spent out of water.

12 Harpooning

12.1 Animal welfare impact on captured fish

A harpoon is a barbed spear fired at a fish and this fishing method is used to catch large species such as swordfish. When the fish has been struck and the harpoon takes hold, the fish is allowed to swim until exhausted. Once exhausted, it is secured in a sling and hoisted aboard.

12.2 Environmental impacts

As with whaling, harpooning fish raises serious welfare concerns but is considered to result in relatively low levels of bycatch since the fish are identified before the harpoon is fired.

12.3 Possible ways to improve welfare

As with all other methods of fishing, welfare could be improved by landing quickly and humane slaughter immediately the fish is landed.

13 Use of live bait fish in fish capture



Tank holding live bait on a tuna boat

Bait fish are held in a tank for days, or weeks, until they are fed live to tuna. Use of dead, rather than live, fish as bait in pole and line fishing is the exception rather than the rule.

Credit: National Oceanic and Atmospheric Administration/ Department of Commerce



Bait fish being transferred to a pole & line fishing vessel for use as live bait

Credit: National Oceanic and Atmospheric Administration/ Department of Commerce. Photographer: Jose Cort.

Some methods of fish capture use live fish as bait. This is likely to cause considerable suffering over and above that caused to the fish caught for food.

These bait fish will have suffered fear and distress caused by capture and confinement, possibly for days or weeks, before they are impaled on hooks or scattered live amongst shoals of tuna. Death rates of bait fish held in tanks for pole and line fishing can be high before baiting even starts. Fatal shock and injury can be caused by handling and crowding.

Fish are likely to be frightened further when dropped into the open sea, an unfamiliar environment to those originally caught in shallow water or reefs, in the practice of “chumming” (see chapter 9 on pole & line fishing). Gregory explains (1998):

“Typically the live bait remains motionless for several seconds upon hitting the water, and then it swims underneath the hull for protection...After the initial catch, the vessel is eased forward to flush out the live bait from under the hull and a second catch follows.”

Live fish that are impaled on hooks as bait, as is common in long line fishing, will then suffer pain and distress from tissue damage. They are likely to suffer fear from being immobilised and unable to escape predators.

The animal protection group Animal Concern has described the use of live bait fish in recreational



Baiting a hook with a live fish

This fish is alive and being impaled on a hook to use as bait in pole and line fishing, a practice considered by many to be an abuse of sentient animals.

Credit: National Oceanic and Atmospheric Administration/ Dept. of Commerce.
Photographer: Etienne Ithurria.

fishing (Robins, 2006):

“What is not natural is attaching treble hooks on wire traces to the lip and back of live roach or small trout and casting them out to lure pike. Any angler who has used this fishing method, as I did as a child, will know that the first indication of a take is when the float is dragged at great speed by the terrified bait fish as it is chased by the pike. If not taken the bait fish will eventually die and be replaced by another.”

The suffering caused during fish capture could clearly be greatly reduced by avoiding the use of live bait fish, preferably using artificial baits or fish off-cuts instead.

14 Summary of improving welfare during capture & landing

Methods that catch fish alive, with minimal injury and with capture durations in minutes rather than hours are potentially relatively more humane. To obtain any clear welfare benefit, fish must then be swiftly and humanely slaughtered. To assess the welfare of wild fish during capture, the whole process must be examined including:

- the duration and severity of suffering during both capture and landing
- the welfare impact on bait fish
- the extent and impact on bycatch
- other unintended effects such as predator attack on caught fish and ghost fishing.

The key welfare problems and assessment of the welfare potential for each method are summarised in Table 1 overleaf.

All types of fishing cause stress and injury, but these can be reduced by shorter capture duration. The longer a fish remains captured, the longer the period of suffering. Further, the severity of suffering is likely to increase with capture time, as was found to be the case for sardines caught in seine nets (chapters 5) and sea bream caught in experimental trammel nets (chapter 6).

Fast hook and line fishing methods which use artificial baits (or baits made from waste) seem to be among the potentially most humane methods. Trapping, which can catch fish without injury, may have a greater humane potential than fast hook and line methods if soak times are short. Long lining is a slow hook and line method and the long duration will multiply the suffering caused. With

long capture durations, gillnetting may cause more injury and stress than long lining. On the other hand, with short capture durations of no more than 1 hour, gill nets (or variations of them such as tangle nets) and long lines appear to have potential to be relatively humane. Gill netting with a capture duration not exceeding 30 minutes is permitted in the Fair-fish welfare scheme (see page 42).

Trawling does not seem to have the potential to be relatively humane since it inevitably involves the crushing of fish in nets. Trawling from deep water inevitably involves decompression injuries for certain species. Purse seining, on the other hand, possibly does. Fish caught in purse seines are initially trapped without injury. If the process of landing can be improved to land the fish without injury and with less stress, this could perhaps be a relatively humane method of fishing. The potential for better welfare in small-scale purse seining is exemplified by the company Wild Salmon Direct, which claims to be the only wild salmon producer using humane slaughter technology.

Table 1. Summary of the welfare impact of different fishing methods

	Key welfare problems	Duration	Bycatch problems	Measures that would reduce suffering (when combined with humane slaughter)	Overall welfare potential with these measures (when combined with humane slaughter)
Trawling	Chase to exhaustion; Fear caused by capture; Injury from collisions with net and other fish; Compression in mass of other fish; Decompression effects; Removal from water during landing.	Several hours.	High levels of bycatch.	Humane slaughter as soon as landed; Reduced trawl duration; Effective bycatch reduction devices and measures; Handle fish carefully prior to humane slaughter or release as bycatch; Avoid fishing from depths > 20m.	Suffering could be greatly reduced but injury and compression of fish will inevitably be caused. Some fish species caught from deep water will inevitably suffer decompression.
Purse seining	Fear caused by capture; Stress caused by crowding of fish in a tightened net; Injury from collisions with net and other fish during net tightening; Removal from water during landing; Compression, broken fins and scale damage during landing; Possible predator attack during capture.	Entire operation may be 2 hours or more. Duration of the most stressful period when net is tightened and fish cannot school may be less than 1.5 hours.	Setting seine nets on fish aggregating devices (FADs) results in large numbers of bycatch animals. Setting seine nets on cetaceans potentially harms dolphins and porpoises. Releasing fish from fully tightened purse seine nets, called "slipping", results in high numbers of wasted deaths.	Humane slaughter as soon as landed; Reduced time spent in net, especially in the tightened net; Develop systems, e.g. pumps, which land fish with less stress and injury; Avoid fishing on FADs; Avoid setting on cetaceans unless they are released unharmed; End, or modify, the practice of "slipping" to avoid wasteful deaths of excessive catch.	Suffering could be greatly reduced. A well designed system for transferring fish onto deck, with reduced stress and injury could make this a relatively humane method.

Table 1. Summary of the welfare impact of different fishing methods (continued)

Gill netting	<p>Fear caused by capture; Constriction of gills by netting preventing breathing; Injury from entanglement in netting; Increasing levels of stress and injury with time spent in the net; Removal from water and injury during landing; Possible predator attack during capture.</p>	<p>Several hours or days. Can be less than 1 hour in some cases (e.g. Columbia River, Canada).</p>	<p>Mammals, seabirds and turtles can be entangled in these nets and drown. Ghost fishing.</p>	<p>Humane slaughter as soon as landed; Reduced time spent in net; Handle fish carefully prior to humane slaughter or release as bycatch; Use nets that entangle rather than gill fish; Use netting materials that reduce injury; Effective measures and gears to reduce bycatch and ghost fishing e.g. pingers; Avoid fishing in warm-water weather.</p>	<p>Suffering could be greatly reduced. Short soak times not more than 30 minutes, as in Fair-fish scheme, and careful handling could make this a relatively humane method.</p>
Hook and line: Pole & line	<p>Use of live bait fish for chumming in most cases; Use of live bait fish impaled on hooks sometimes; Fear and stress during hooking and swinging the fish aboard; Possible predator attack during capture.</p>	<p>Very short.</p>	<p>Bycatch is relatively low.</p>	<p>Avoid the use of live bait fish, preferably avoiding purpose-caught bait fish; Humane slaughter as soon as landed; Handle fish carefully prior to humane slaughter (or release as bycatch).</p>	<p>Could be a relatively humane method. Only as humane as the capture and killing of any bait fish used.</p>
Hook and line: rod & line and trolling	<p>Use of live bait fish impaled on hooks sometimes; Fear and stress during hooking and landing the fish; Minor to major injuries caused by the hook, depending on where it embeds; Decompression effects; Possible predator attack during capture.</p>	<p>Fish are landed quickly.</p>	<p>Bycatch is relatively low.</p>	<p>Avoid the use of live bait fish, preferably avoiding purpose-caught bait fish; Humane slaughter as soon as landed; Keep the time for which a fish remains hooked as short as possible; Handle fish carefully prior to humane slaughter (or release as bycatch); Use hooks that reduce injury and remove them carefully from fish to be released; Avoid fishing from depths > 20m. Avoid fishing in warm-water weather.</p>	<p>Could be a relatively humane method. Only as humane as the capture and killing of any bait fish used.</p>

Table 1. Summary of the welfare impact of different fishing methods (continued)

<p>Hook and line:</p> <p>long line fishing</p>	<p>Use of live bait fish impaled on hooks common;</p> <p>Fear and stress during hooking and landing the fish;</p> <p>Minor to major injuries caused by the hook, depending on where it embeds (e.g. lip, throat, eye, gills);</p> <p>Decompression effects;</p> <p>Possible predator attack during capture.</p>	<p>Many hours or even days.</p> <p>A fishery which appears to have a minimal soak time for a fishery of this type is the Atlantic Cod long line fishery of the Northwest Atlantic. Capture duration for this fishery is 1-4 hours.</p>	<p>Bycatch includes large numbers of sharks and other fish.</p> <p>Long lines also kill sea birds and turtles.</p>	<p>Avoid the use of live bait fish, preferably avoiding purpose-caught bait fish;</p> <p>Humane slaughter as soon as landed;</p> <p>Reduce the time interval between setting and retrieving lines;</p> <p>Handle fish carefully prior to humane slaughter (or release as bycatch);</p> <p>Use hooks that reduce injury and remove them carefully from fish to be released;</p> <p>Effective bycatch reduction measures e.g. bird scarers;</p> <p>Avoid fishing from depths > 20m;</p> <p>Avoid fishing in warm-water weather.</p>	<p>Suffering could be greatly reduced.</p> <p>Could be a relatively humane method with soak times no more than 1 hour.</p> <p>Only as humane as the capture and killing of any bait fish used.</p> <p>Suffering of fish caught on long lines for hours may be less than with fish caught in gill nets for the same length of time.</p>
<p>Trapping</p>	<p>Use of bait fish;</p> <p>Fear and distress of being trapped;</p> <p>Attack by predators entering the trap;</p> <p>Fish injured trying to escape the trap;</p> <p>Decompression effects.</p>	<p>Variable?</p>	<p>Ghost fishing.</p> <p>Mammals can become entangled by ropes connecting traps to buoys.</p> <p>Fish bycatch can often be released alive and apparently uninjured.</p>	<p>Avoid the use of purpose-caught bait fish;</p> <p>Humane slaughter as soon as landed;</p> <p>Reduce the time interval between setting and retrieving traps;</p> <p>Handle fish carefully prior to humane slaughter (or release as bycatch);</p> <p>Trap designs to reduce time out of water during hauling;</p> <p>Trap designs to reduce bycatch and ghost fishing;</p> <p>Avoid fishing from depths > 20m.</p>	<p>This may be potentially the most humane method of fishing.</p> <p>Only as humane as the capture and killing of any bait fish used.</p>

14.1 Possible ways to improve welfare

The following summarises measures that, combined with humane slaughter immediately the fish is landed, would improve the welfare of fish caught in commercial fishing:

Reduce the suffering of bait fish

- avoid the use of live fish as bait
- avoid the use of bait fish generally (use artificial baits or off-cuts instead).

Reduce the duration of capture

- reduce the duration of the capture process (the Fair-fish certification scheme (see page 42) limits capture duration to 5 or 30 minutes depending on capture method).

Reduce the numbers of bycatch animals

- use modifications to fishing gear and practice that reduce bycatch, without killing the escaping fish
- close fisheries as and when necessary to reduce high levels of bycatch
- use gear modifications and practices that reduce ghost fishing
- perform retrieval survey trawls for lost fishing gears.

Reduce stress and injury during capture

- use variations of gears that reduce stress and injury to fish e.g. circle hooks
- avoid fishing from depths greater than 20m (for fish with swim bladders).

Reduce stress and injury during landing

- develop methods of landing fish which reduce stress and injury and minimise time out of water
- avoid practices that injure fish during landing, such as gaffing and (for purse seining) ramping
- handle fish carefully, and with minimal time out of water, prior to humane slaughter (or release as bycatch).

Reduce death rates for released bycatch fish

- avoid fishing in warm-water weather when fish are likely to be particularly stressed.

Reduce harm to other non-target animals

- avoid gears that are damaging to fish habitat.

15 Processing of fish alive on landing

Most commercially-caught wild fish alive when landed die either from being left to suffocate in air, or by a combination of suffocation and evisceration i.e. disembowelment or gutting. Removing fish from water is highly stressful to them and, in most cases, violent escape attempts are made. Evisceration is carried out without prior stunning and methods vary with species. Gibbing is a form used on herring in which the gills, long gut and stomach are removed from a fish by inserting a knife at the gills. The term vivisection, meaning literally dissecting a live animal, would not be inappropriate.

The time taken to die will depend on the species, treatment, and also on the temperature. In a Dutch study, the time taken for fish to become insensible was measured for fish subjected to gutting and to asphyxiation without gutting. This was done for several species of fish (herring, cod, whiting, sole, dab and plaice). It was found that a considerable time elapsed before the fish became insensible as follows:

- gutting alive (gibbing in the case of herring): 25-65 minutes;
- asphyxiation without gutting: 55-250 minutes.

Some species adapted to spending periods of time out of water, such as eels, can survive for a very long time when removed from water. There is anecdotal evidence of flatfish landed by a trawl surviving ten hours out of water (Gellatley, 2008):

“To find out about fishing I once sailed on a trawler...worst of all was what happened to a big orange-speckled flat fish – a plaice. It was tossed into a bin with other flat fish and four

hours later I literally heard it croaking. I pointed out to one of the deckhands who, without even thinking about it, clubbed the fish. It was, I thought, better than suffocating and I presumed it had been killed. Six hours later I noticed that its mouth and gill covers were still opening and closing as it struggled for oxygen. Its misery had lasted ten hours.”

Sometimes fish are put onto ice as they suffocate, or into iced water. This is likely to result in rapid chilling. It is sometimes believed that cold-blooded animals become less sentient as they cool due to slowed nervous metabolism. However, the process of chilling has been shown to be stressful to fish and may cause violent escape behaviour. Rapidly chilling live fish, therefore, is not humane and it seems likely that putting wild-caught fish onto ice, as they suffocate, will increase the severity of their distress. This practice may also cause them to suffer for longer.

16 Introducing humane slaughter for wild-catch fish

Two traditional methods for killing fish have the potential to be humane, namely percussive stunning and spiking. These methods kill fish individually, and so may not be practical for larger fishing operations with large numbers of smaller fish. For these cases, methods of en mass humane slaughter need to be developed.

Percussive stunning involves a blow to the head with a club or “priest”. This must be performed accurately and with sufficient force to be humane. Automatic percussive stunning devices have been developed for some species in fish farming. Stunning machines are more reliably accurate than manual stunning. In some cases, the fish are directed to stun machines without removing them from water or manual handling (both very stressful to fish) prior to stunning. However, percussive stunning is not suitable for all types of fish. To ensure that percussive stunning does kill humanely, it should be followed immediately by bleeding.

In spiking (also called “ike jime”) a fish is killed by inserting a spike into the brain. If this is performed accurately, the fish can become unconscious immediately. Spiking has not yet been automated for fish farming due to the difficulty in accurately locating the brain with varying fish size.

Electrical stunning systems have been developed for en mass humane slaughter in fish farming. As with some automated percussive stunning, the fish are killed without taking them out of water. A current is passed through the water containing the fish. The fish are stunned immediately, and die without regaining consciousness, if the voltage and duration of the current are sufficient. These will depend on the species and the conductivity of the water. Electrical stunning must be performed correctly or the fish may be immobilised but not

rendered insensible. The UK farmed trout industry is increasingly using this slaughter method.

Electrical stunning has not yet been developed commercially for farmed sea fish i.e. for salt water. It is believed by some animal welfare professionals that electrical stunning technology in fish farming has the potential to be adapted for use on wild-caught fish at sea. An important step for this will be the development of electrical stunning systems for salt water farmed species. This is technically more challenging than for fresh water species, due to the greater conductivity of salt water.

Other methods for the humane slaughter of farmed fish may also present the possibility of being adapted for use in some commercial fishing. One other such method is the use of food grade anaesthetics added to the water. AQUI-S is the brand name for a fish anaesthetic licensed for use on fish farms in New Zealand, though not in Europe or the USA. AQUI-S is used for “rested harvest” in which anaesthetised fish are then slaughtered by percussive stunning or spiking. Quality benefits are also obtained from this low-stress slaughter method.

For fish killed by suffocation in air, the practice of gutting them while they are still alive is likely to increase the severity of suffering, even though it may reduce the duration. The process of chilling live fish as they suffocate is also likely to increase the severity of suffering and may also prolong it. On this basis, fish should not be gutted or immersed in ice-slurry while they are still alive.

17 How many fish are caught each year?

In writing this report a key question arises: how many fish are caught each year? One expects the number to be massive – the familiar sight of trawl nets full of fish being emptied on deck suggests that many hundreds may be caught in just a single catch. The numbers of land animals slaughtered for food every year is known, since these are published by the Food and Agriculture Organisation of the United Nations (FAO). These show that 3 billion mammals and 57 billion birds were killed for this purpose in 2008.

Unfortunately, FAO statistics on wild-caught and farmed fish are given only in tonnages. Nor, unfortunately, does the FAO publish mean weights of fish, which would enable numbers to be calculated from these tonnages.

The number of fish caught each year is an important question for animal welfare assessment because, as discussed earlier, most wild-caught fish are killed (i.e. left to die) in ways that meet no standard of humane slaughter. If not the FAO, has anyone else tried to estimate the total number of fish caught?

There are some estimates for particular species and for the following cases the numbers are huge. It has been reported that the number of sandeels caught (sandeels are small fish that burrow in the sand and are caught industrially for reduction to fishmeal and fish oil) is around 100 billion in “a good year” (Johannesson et al, 2000). On an even larger scale, it has been estimated that the number of Peruvian anchovy, also largely caught to manufacture fishmeal and fish oil, was 1.3 trillion (1,306 billion) in 1971 (Froese, 2001). However, searches by the current author revealed no estimate for the total number caught.

Despite the lack of official statistics on fish capture numbers, is it possible to estimate them from FAO fisheries capture tonnages and other available data? Searches on the internet show that, to varying degrees of accuracy and representativeness, there is a significant amount of fish size data around and average weights are cited for many species e.g. on seafood marketing and angling websites. As part of the project of writing this report, the current author attempted such as task in a study to estimate the number of fish caught in global fishing each year (Mood and Brooke, 2010).

Key results of study to estimate numbers of fish caught

In this study it was estimated that 0.97-2.7 trillion wild fish are caught worldwide each year.

Recognising the limitations of the fish size data available, it is concluded that the number of fish caught annually is of the order of a trillion.

Fish capture not included in the estimate

This estimate of fish numbers includes only those represented by FAO recorded fisheries capture statistics for the period 1999-2007. It does not include the following:

- fish caught illegally
- fish caught as bycatch and discarded
- fish that die following escape from nets
- “ghost fishing” by lost and discarded gears
- fish caught for the fishers own use as bait but not recorded
- fish caught for use as feed, either whole or chopped, on fish and shrimp farms but not recorded

- all other unrecorded or unreported capture.

Illegal and discarded fish capture may comprise up to nearly a third again of reported fisheries capture. In addition, unaccounted numbers of fish are killed as a result of contact with trawl nets, from which they escape (see 4.3), and by lost or discarded gill nets that continue to fish.

17.1 Welfare implications of the numbers of fish caught

It is estimated that in the order of a trillion fish are caught in recorded capture each year.

Measuring the animal welfare impact of fishing as the product of severity * duration * numbers, it is concluded that huge numbers of fish suffer pain and distress that is likely to be severe for significant periods of time. The suffering of wild fish caught at sea therefore represents a major animal welfare issue.

Previous chapters have suggested ways of reducing the suffering of individual fish caught. The next chapter examines ways of reducing the numbers of fish caught that are compatible with the needs of people and conservation.

18 Reducing suffering by reducing numbers caught

As has been argued in previous chapters, the severity and duration of suffering caused to fish during capture and subsequent treatment is considerable and the scale of this suffering is huge, estimated to be in the order of 1 trillion individuals every year. The estimated number of fish caught per person in the world each year (assuming a human population of 6.8 billion) is in hundreds (around 100-400).

The previous sections have discussed how suffering in commercial fishing could be mitigated by measures that reduce severity and duration of distress during and after capture. While there is potential to reduce suffering here, it seems unlikely that stress of some duration could be avoided for at least the majority of caught fish. Nor can bycatch be completely eliminated.

Another approach for reducing the suffering in commercial fishing would be to reduce the number of fish caught each year. This could be achieved by some or all of the measures summarized in the box below. Each of these measures is discussed in this chapter.

Reductions in fishing levels are politically difficult to achieve. However, even a relatively small reduction in capture could prevent the inhumane treatment of millions of animals. For example, if the average annual number of fish caught, estimated to be in the order of 1 trillion, were reduced by only 0.1%, then the number of inhumane deaths would be reduced by something in the order of 1 billion each year.

The numbers of fish suffering in commercial fishing can be reduced by the following measures:

I. Reduce the numbers of fish caught wastefully or illegally

- reduce the numbers of fish caught as bycatch
- reduce the numbers of fish killed following escape or release from fishing gear
- reduce the numbers of fish caught by ghost fishing
- reduce the numbers of fish caught illegally.

II. Catch fewer fish and let fish grow larger

- reduce overall levels of fishing
- increase the size of fish caught within a species
- increase the proportion of larger species caught.

III. Reduce the numbers of fish caught not directly for food

- reduce the numbers of fish caught for bait
- reduce the numbers of fish caught to feed whole to farmed fish
- reduce levels of industrial fishing.

18.1 Reducing numbers of fish caught wastefully or illegally

Many fish are caught wastefully. Wasteful deaths include the fish caught unintentionally as bycatch (wrong species or size) and then thrown back into the sea, dead or dying. In 2005 the FAO reported an estimate that 7.3 million tonnes, or 8%, of fisheries capture was discarded each year for the years 1990-2001. In addition, an uncalculated number of fish die following escape from trawl nets. Another way in which fish are caught wastefully is in the killing of fish by lost or discarded fishing gear i.e. “ghost fishing”.

Ways of reducing the numbers of fish caught as bycatch and by ghost fishing, and increasing the survival chances of released bycatch fish and fish escaping trawl gears, are discussed in chapters 4-11 on capture methods.

The management of fisheries can only be effective if regulations are enforced. Illegal, unreported and unregulated (IUU) fishing is a global problem. Each year, illegal fisheries capture an estimated 11.06 to 25.91 million tonnes of finfish and shellfish, compared to the 92.2 million tonnes of average annual recorded capture in 1999-2007.

18.2 Catching fewer fish and letting fish grow larger

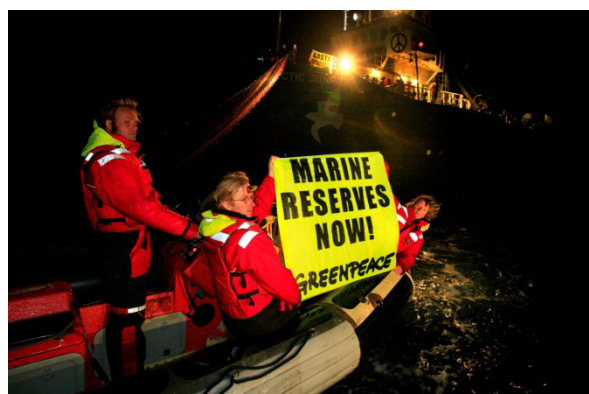
The suffering of wild-catch fish could be reduced by a strategy to catch fewer fish, and to catch them larger so that fewer fish are caught for the same amount of food. There are other good reasons for pursuing such a strategy besides those of animal welfare. Reductions in fishing effort are necessary for managing the world's fisheries sustainably. Fish are being caught too young and need to be allowed to spawn and to grow larger before being caught, in order to maintain or rebuild fish populations. The economic benefits from fisheries might be increased by setting fishing levels even lower than those required for biological sustainability,

since increasing the relative abundance of fish reduces the fuel (and hence carbon footprint) and labour costs of catching them.

Overfishing is a serious problem in world fisheries. It reduces abundance of individuals in a fish stock, by removing fish faster than they can be replaced by breeding. If continued, it can lead to a collapse of the fishery, as happened with the Newfoundland cod fishery in the 1990s.

Overfishing tends to reduce the size of captured fish over time, leading to increasingly larger numbers of smaller fish. This exacerbates the welfare cost of fishing.

Many scientists, and conservation groups such as Greenpeace, argue that fisheries management needs to adopt a more precautionary approach and to take into account the ecosystem effects of fishing when setting fishing levels, e.g. the



Greenpeace campaigners promoting marine reserves

The environmental group Greenpeace is calling for 40% of the world's oceans to be protected as marine reserves, in which fishing is not permitted, to tackle overfishing.

The current author argues that overfishing is also a major animal welfare issue. Overfishing exacerbates the suffering caused by commercial fishing, both by increasing the numbers of fish caught beyond what is biologically sustainable, and by reducing the average size of fish so that increasing numbers are caught for the same amount of food.

Credit: © Greenpeace / Jiri Rezac

impact on other species via feeding interactions and impacts of gears on habitats. Under the precautionary approach, fishing levels would be set cautiously without waiting for proof that reductions are necessary. It shifts the burden of proof, giving the benefit of the doubt which arises from the uncertainty inherent in fisheries science, to sustainability.

Fishing levels can be reduced by restrictions on fishing effort (e.g. limits on catch and the number of days at sea fishing) as well as the creation of “no take” marine protected areas (MPAs). MPAs have the advantage over setting fishing quotas as a means of restricting fishing effort, in that they do not result in excess catch being discarded because it cannot be legally landed. While the benefits of MPAs are more apparent for non migratory species, they can also protect migratory ones at vulnerable stages e.g. spawning.

Selective fishing gear is a means of capturing fish only within the optimum size range in order to reduce “recruitment overfishing” (capture of immature fish before they can spawn) and “growth overfishing” (capture of fish before they have fully realized their growth potential).

18.3 Reducing numbers of fish not directly caught for food

A substantial proportion of the huge number of fish captured annually (estimated to be in the order of 1 trillion (see chapter 17)) are caught for feed and non-food purposes.

An average of 22.2 million tonnes of fish capture was used to make fishmeal and oil each year for 2001-7, equating to between a quarter and a third of average total fish capture at 77.4 million tonnes per year for 1999-2007. However, because the fish caught for reduction to fishmeal and oil (“industrial fishing”) are mainly small ones, their proportion of fish numbers will be greater than this.

Increasingly this industrial fish catch is being used to feed farmed fish such as salmon. The feeding of purpose-caught fish to farmed salmon greatly increases the suffering involved in salmon production. Small feed fish suffer a stressful death, one that would fail any standard of humane slaughter, to produce a miniscule amount of food. It takes 3-4kg of wild fish to produce 1kg of salmon. Fish used to make fishmeal vary in weight from 10g (e.g. sandeels) to 1000g (e.g. a jack mackerel). To take just one example a Peruvian anchovy, weighing 20g, is killed inhumanely to produce approximately 6g of salmon flesh.

Environmentalists are concerned about the ecological impact of the removal of large numbers of these small fish from the ocean, e.g. how it affects the fish, seabirds and other marine wildlife that feed on them.

Fish are also caught to feed whole to farmed fish. According to an FAO report published in 2006, an estimated 5 to 6 million tonnes of fish are used in this way every year. Further uncalculated numbers of fish are used as bait in catching other fish.

19 Better welfare improves fish quality

Chapter 18 discussed how the numbers of fish caught could be reduced by fishing at lower and more sustainable levels. Fishing more sustainably has a clear long term benefit to both fishers and consumers, and is likely to increase the overall economic benefit from fisheries. In a number of fisheries the fishers have volunteered to accept catch reductions knowing it would lead to higher prices and lower costs of fishing. The use of bycatch reduction measures and devices, as well as helping fish stocks and reducing animal suffering, can benefit fishers by reducing the time spent sorting and discarding. This chapter considers how the fishing industry could also benefit from measures to reduce suffering during capture and from humane slaughter methods.

In chapters 4-14 and 16 some possible measures to reduce the suffering of fish were proposed which can be summarized as follows:

- (1) *speeding up the capture process with shorter net and line soak times and trawl times etc.*
- (2) *modifications to gear and handling to reduce injury and distress*
- (3) *methods for humane slaughter*
- (4) *avoidance of live bait fish and purpose killed bait fish*
- (5) *choosing more humane capture methods.*

Reducing injury during capture will improve carcass quality and reduce risk of spoilage. Reducing stress at slaughter is also likely to improve eating quality, as has been found for farmed fish. In some long line and trolling fisheries, the relatively humane slaughter method of spiking is used soon on landing in order to improve the flesh quality by reducing the pre-slaughter activity. “Wild Salmon Direct” is (according to its website) the only wild salmon

producer which uses humane slaughter technology, i.e. automatic percussive stunners, and is proud of its humane slaughter and of the resulting “unparalleled” quality.

All measures to improve the welfare of wild-caught fish potentially add value to the fish product by increasing the ethical value. Ethical consumers will pay extra for more humanely produced fish.

20 Key roles for improving welfare of wild-caught fish

The welfare of wild-caught fish has so far received little attention. Why is this so? Every other industry which deals with animals, at least in the UK (with the notable exception of pest control), has had to engage seriously with animal welfare issues. There is a range of possible reasons why this has not been the case with the fishing industry. People empathise less with fish than they do with birds and mammals and some even question whether fish are sentient. It all happens out at sea and generally out of mind. It is also seen as a difficult issue to deal with. It may well prove impossible to catch a wild fish in a genuinely humane manner.

This report has argued that commercial fishing causes suffering to fish on a huge scale and that this could be substantially reduced. Firstly, the numbers of fish caught could be reduced (as discussed in chapter 18) and secondly by developing more humane methods of slaughter and capture, with shorter capture durations (as discussed in chapters 4-14 and 16). To achieve any of this requires the issue of wild fish welfare to be on the radar of a range of stakeholders. The purpose of this chapter is to outline the roles of different stakeholders in rising to this challenge. It does this by looking at their contributions to the welfare of fish in other areas.

20.1 Animal welfare and fisheries scientists

The role of animal welfare scientists in providing scientific evidence that fish are sentient is clear from the discussion in chapter 2. Animal welfare scientists will have a key role in developing welfare codes of practice for commercial fishing,

and in the development of humane slaughter technology for use on fishing vessels.

Humane slaughter technology has recently been developed, by scientists at Bristol University, for wild-caught lobsters and crabs. The Crustastun humane crustacean stunner electrically stuns within a fraction of a second, and kills within a few seconds. Humane technology has been developed in recent years for some farmed fish species, such as humane electrical stunning for trout and automated percussive stunning for salmon. This technology needs to be adapted for use at sea. Other technologies for landing fish with minimal injury and stress also need to be developed.

A promising development in 2008 was the holding of a “Symposium of Fish Welfare and Fisheries” by the Fisheries Society of the British Isles, which says (FSBI, 2008):

“To date, little attention has been paid to the welfare of fish in the context of commercial fisheries, although such attention will surely come and the industry should be prepared for it. The aim of this symposium is to open up debate, exchanging thoughts and hopefully identify a way forward, drawing on the experience gained in discussion of aquaculture and recreational fisheries.”

20.2 Animal protection NGOs

The suffering of fish in commercial fishing is increasingly recognised by vegetarian-orientated animal protection groups. Several animal rights groups have written about it in the UK and USA, arguing a humane case for not eating fish. However, within animal welfare organisations, the

suffering of wild-caught fish is largely off the radar.

Several animal welfare groups have campaigned against practices that cause suffering to fish. The focus has tended to be fish farming, and to a lesser extent, angling. They have campaigned through a number of different channels including science-based reports, supermarket and government lobbying, animal welfare certification schemes, funding research, and through education of industry and the public.

The Dutch Society for the Protection of Animals has worked with the Dutch government to commission the study of fisheries slaughter methods (discussed in chapter 15) with a view to improving welfare. It continues to lobby government and supermarkets to address the suffering of wild-caught fish and hopes to set up a welfare certification scheme similar to Fair-fish, which is discussed below.

The Fair-fish Association

Fair-fish is a Swiss campaigning organisation for fish welfare that is currently developing a welfare certification scheme as a pilot project for artisanal fishers in Senegal. This is the only certification scheme ensuring humane treatment of wild-catch fish and assures standards for animal welfare, conservation and fair trade. Fair-fish certified fish must be killed humanely by percussive stunning with a priest followed by bleeding, and the whole process of capture and death must take no longer than 30 minutes (or 5 minutes for fish caught by hook). Fair-fish allows hook and line, encircling gill nets and beach seines as acceptable methods of capture. Other fishing methods may be introduced at a later time.

20.3 Environmental and conservation NGOs

Conservation and environmental groups raise awareness and concern for the impact of commercial fishing on marine ecosystems and biodiversity, and call for urgent action to address

the decline in fish stocks. They campaign for the introduction of large nature reserves in the sea that are protected from fishing, lower levels of fishing and for action to address the birds, dolphins, turtles, sharks and other fish caught as bycatch. They investigate and report illegal fishing, calling for tougher enforcement of fishing regulations.

For some people, concern for wildlife begins with a concern for animal welfare. Therefore, highlighting the fact that overfishing exacerbates the suffering of wild-caught fish could, perhaps, help widen the support for marine protection. The “Save the Whale” campaign was started as a conservation campaign by Greenpeace, but would it have gained as much public support if people did not also care about the suffering of these animals killed by exploding harpoons?

20.4 Supermarkets and retailers

Supermarkets can help raise animal welfare standards by giving shelf space to high welfare produce (such as that certified by the RSPCA Freedom Food or Soil Association Organic schemes) and by setting their own minimum welfare standards (such as not selling any eggs from caged hens).

Most UK supermarkets stock farmed fish certified by such welfare schemes. They are also recognising the environmental issue of overfishing, and most stock wild fish carrying the Marine Stewardship Council (MSC) logo, which certifies it was fished from a sustainable source (of course in this context sustainable does not mean humane). However, they have not so far recognised that commercial fish capture is usually far from humane, or provided a higher welfare alternative (e.g. fish caught to Fair-fish welfare standards).

Supermarkets and other retailers have influence over their suppliers and can encourage them to meet higher welfare and environmental standards. For example, Waitrose is encouraging measures to reduce bird bycatch in the long line

vessels that supply it. It could, for example, also encourage its supplying fishers to avoid live bait, a particularly abusive treatment of fish. There are a number of ways that supermarkets can seek to improve welfare, such as setting standards for its suppliers, clearer labelling and sponsoring research, once they recognise a welfare problem.

20.5 The fishing industry

In the longer term, the interests of fishers and the fishing industry are best met by conserving and re-building fish stocks and by a greater emphasis on quality, rather than quantity, of catch. Using faster and less stressful methods of capture and killing can improve eating quality.

Seafood companies and fishers need to recognise they have a responsibility to reduce the suffering of the huge numbers of fish that they kill. The growth of the free range egg market in, for example, the UK from almost nothing to around 50% of whole eggs sold, despite the fact that free range eggs are more expensive, demonstrates the economic benefits of animal welfare. A UK fisher, interviewed on Radio 4's Farming Today, stated (21st July, 2008): *"the future of fishing is in quality"*. Animal welfare is a key part of good quality.

20.6 Governments and inter-governmental bodies

Managing fisheries for sustainability

Scientists advocating more sustainable management of the world's fisheries argue that reductions in fishing fleets and fishery subsidies are necessary. Overfishing arises because there are too many people catching too few fish, and this is being aided by taxpayer subsidies. According to the World Bank, subsidies amount to 20-25% of the value of fish brought to port.

Governments recognise their responsibility to manage fisheries sustainably but are failing to do so effectively. The failure of the EU Common Fisheries Policy to protect fish stocks has been

recognised by the European Commission. In 2007, the Commission reported that 80% of EU fish stocks remain outside safe biological limits (EU Commission, 2007) and the reason for this problem, they say, is that:

"the total allowable catches (TACs) agreed each year in Council are much higher than those recommended by scientists".

Tougher action from governments is needed to reduce the numbers of fish caught, by effective restrictions on fishing effort, and more selective ways of fishing. There are already pressing reasons why governments should take tougher action on overfishing. The suffering of fish is another reason for doing so.

People in developed countries have been encouraged in recent years to increase their consumption of fish, e.g. the UK Government's "Food Standards Agency" (FSA) encourages people to increase their consumption of fish to two portions a week, despite the fact that current levels of fishing are unsustainable. Current levels of fish consumption in developed countries are having a harmful affect on poor coastal communities in developing ones. According to one report (Jenkins et al, 2009):

"declining catches are increasingly diverted toward affluent markets rather than local ones, with dire consequences for the food security of poorer nations, islands and coastal communities".

With a growing population, the average consumption of wild-caught fish (and of farmed carnivorous fish fed on wild fish) per person in the world will necessarily fall. Rather than advising people to eat more fish, alternative non-fish sources of omega-3 should be developed and evaluated.

Promoting humane treatment of fish

Governments and intergovernmental institutions, including the EU and the OIE, have begun to recognise the sentience of fish. The European

Union has commissioned the Scientific Opinion on fish sentience discussed in chapter 2 and the Council of Europe has published recommendations on the welfare of farmed fish. The OIE is currently developing welfare codes for farmed fish and these will give a framework for future legislation. It seems likely that these codes will state as unacceptable the inhumane slaughter practices that have been common in the industry, e.g. carbon dioxide stunning, asphyxiation in air and prolonged pre-slaughter starvation. Governments and intergovernmental institutions have also funded research into farmed fish welfare.

Despite the high numbers of fish suffering, and the severity of this suffering, caused by commercial fish capture, this issue has not been recognised by governments (none, apparently, other than the Dutch government who have sponsored research in this area) as a welfare issue. Action to address this problem is now required in the EU since the EU Treaty recognises animals as sentient beings and states that full regard should be given to their welfare needs in fisheries²:

“In formulating and implementing the Union's agriculture, fisheries, transport, internal market, research and technological development and space policies, the Union and the Member States shall, since animals are sentient beings, pay full regard to the welfare requirements of animals, while respecting the legislative or administrative provisions and customs of the Member States relating in particular to religious rites, cultural traditions and regional heritage.”

Commercial fishing is a major cause of animal suffering and governments need to address it. As Gandhi once said:

“The greatness of a nation and its moral progress can be judged by the way its animals are treated”.

² The EU Treaty as amended by the Lisbon Treaty, Title II: Article 13 (CONSILIUM, 2008)

20.7 Welfare and conservation assurance schemes for wild-caught fish

Assurance schemes are a powerful means by which consumers can exert pressure on industry to become more humane and more sustainable. The RSPCA “Freedom Foods” scheme and the “Soil Association” organic scheme are two examples of current UK welfare assurance schemes which assure welfare standards for farmed fish during slaughter and rearing. There is a need for assurance schemes that give animal welfare standards for wild-caught fish. There are currently no such schemes besides the Swiss Fair-fish scheme (see page 42), which is currently being developed in Senegal.

One possibility is that existing welfare schemes could be expanded to cover wild-caught fish. It is also possible that a marine conservation assurance scheme, such as the Marine Stewardship council (MSC), could broaden its scope to include welfare of caught fish. Another possibility is the creation of new assurance schemes for the welfare of wild-catch fish, similar to the Swiss Fair-fish scheme.

21 Strategies for improving welfare of wild-caught fish

In the order of 1 trillion fish are caught from the wild each year for human consumption, feed and oil production, bait and other purposes. Most probably suffer severe stress of a considerable duration during the course of capture. Humane slaughter following landing is the exception rather than the rule. In fact, rather than being slaughtered at all, most fish die in the process of capture, storage and processing which includes gutting, filleting, chilling and freezing. As discussed in chapter 2, fish are sentient beings

that are capable of suffering pain and fear. The suffering caused by commercial fishing is therefore a major animal welfare issue.

Whatever the merits of different ethical, religious and cultural views on fishing, fishing is likely to continue. What steps can be taken, then, to reduce the animal welfare impact of fishing whilst maintaining many of its advantages to society? A strategy to substantially reduce the welfare cost of commercial fishing is given in the box below:

Strategies for reducing the welfare cost of commercial fishing

1. **Reduce the numbers of fish caught.** This could be achieved by:
 - a) **Reducing levels of fishing to more sustainable levels, by:**
 - (i) reducing fishing effort
 - (ii) setting up temporary or permanent no-take marine protected areas (MPAs)
 - (iii) selectively fishing for larger fish
 - (iv) selectively fishing to avoid bycatch (and bycatch death rates)
 - (v) reducing ghost fishing
 - (vi) better enforcement of regulations.
 - b) **Reducing levels of industrial fishing for species intended for conversion to feed or oil.**
 - c) **Reducing the use of bait fish.** Wherever possible, fish off-cuts or synthetic lures should be used instead.
2. **Reduce fish suffering during the process of capture** by modifications to fishing gears and practice and, in particular, reducing the duration of capture.
3. **Slaughtering fish humanely as soon as possible after landing.** Artisanal fishermen could achieve this manually. Humane slaughter methods for farmed fish need to be adapted for use at sea. It needs to become unthinkable, as well as unacceptable, to gut or fillet fish that are still alive and conscious.
4. **Ban the use of live fish as bait.** This should be seen as contrary to any norms of civilised animal treatment.

Animal welfare groups can achieve much by:

1. Recognising that commercial fishing raises major welfare problems and that long-term strategies are required to address them.
2. Persuading the public that fish welfare matters. This includes educational programmes to promote animal sentience.
3. Lobbying governments and intergovernmental organisations such as the EU Commission to:
 - develop humane slaughter technology for wild-caught fish
 - carry out welfare assessment of different catching methods and develop welfare codes
 - promote greater understanding of fish sentience.
4. Lobbying the OIE and Council of Europe to develop fish welfare standards for wild-caught fish.
5. Campaigning alongside environmental groups for:
 - lower levels of fishing effort, for sustainability and welfare objectives, including the development of “no take” marine protected areas (MPAs)
 - policies that reduce levels of bycatch
 - a reduction in industrial fishing for fishmeal and oil.
6. Lobbying governments, retailers and fisheries for an end to the use of live fish as bait.
7. Lobbying the Marine Stewardship Council to develop a welfare scheme which fisheries could subscribe to.
8. Encouraging the development of fish welfare certification schemes such as Fair-fish and lobbying retailers to subscribe to such schemes.

To date, relatively few animal welfare groups have seriously addressed the welfare issues associated with commercial fishing. While there are real practical difficulties involved, the overwhelming magnitude of the welfare problem means that even modest measures may benefit very large numbers of animals. Animal welfare groups can achieve much by the measures given in the box above.

Animal welfare and fisheries scientists, environmental groups, supermarkets, retailers, the fishing industry, governments and inter-governmental bodies all have a role to play in improving the welfare of wild-caught fish.

Better things could be happening at sea.

References

AHAW, 2009. Scientific Opinion of the Panel on Animal Health and Welfare on a request from European Commission on General approach to fish welfare and to the concept of sentience in fish. *The EFSA Journal* (2009) 954, 1-26. Accessed at http://www.efsa.europa.eu/EFSA/efsa_locale-1178620753812_1211902344910.htm on 11th April, 2009.

Animals in Islam, 2010. Animals in Islam II. Islam the modern religion website: <http://www.themodernreligion.com/misc/an/an2.htm>. Accessed 16th March 2010.

BBC News, 2003. Scientists highlight fish intelligence. 31st August 2003. BBC News website http://news.bbc.co.uk/1/hi/england/west_yorkshire/3189941.stm. Accessed 7th August 2008.

Braithwaite, V., 2010. Do fish feel pain? Oxford University Press. ISBN13: 978-0-19-955120-0, ISBN10: 0-19-955120-0.

Broom, D.M. 1999a. Fish welfare and the public perception of farmed fish. Proceedings of Aquavision 1999, 1-6. Stavanger: Aquavision.

Broom, D.M., 1999b. The welfare of vertebrate pests in relation to their management. In: Advances in Vertebrate Pest Management, ed. P.D. Cowan and C.J. Feare, 309-329. Fürth: Filander Verlag.

Chandroo, K. P., Duncan, I. J. H., Moccia, R. D. 2004. Can fish suffer?: perspectives on sentience, pain, fear and stress. *Applied animal behaviour science* 86 (2004) 225–250.

CONSILIUM, 2008. Council of the European Union Consolidated versions of the Treaty on European Union and the Treaty on the functioning of the European Union. Brussels, 30 April 2008 (OR. fr) 6655/1/08 REV 1. Accessed from <http://www.consilium.europa.eu/uedocs/cmsUpload/st06655-re01.en08.pdf> on 11th November, 2009.

Dunlop, R. and Laming P. 2005. Mechanoreceptive and nociceptive responses in the central nervous system of goldfish (*carassius auratus*) and trout (*oncorhynchus mykiss*). *The journal of pain*, Volume 6, issue 9, pages 561-568.

EU Commission, 2007. Commission presents its approach to 2008 fish Quotas. IP/07/773 Brussels, 7 June 2007. Accessed from http://ec.europa.eu/fisheries/press_corner/press_releases/archives/com07/com07_43_en.htm on 3rd December, 2008.

Froese, R. 2001. Reply from Rainer Froese 17/01/2001. Fishbase.org forum correspondence webpage. Accessed at http://64.95.130.5/forum/reports/ForumsList_all.cfm on 12th April, 2010.

FSBI, 2002. Fish Welfare. Briefing Paper 2, Fisheries Society of the British Isles, Granta Information Systems, UK.

FSBI, 2008. Fisheries Society of the British Isles website <http://www.fsbi.org.uk/symposium-08.htm> Accessed 4th September 2008.

Gellatley, J., 2008. The livewire guide to going being and staying veggie. Chapter 11 - Fishy business. VIVA website <http://www.viva.org.uk/books/goingveggie/ch11.html>. Accessed 7th August 2008. Vegetarians International Voice for Animals, Bristol, UK.

Gregory, N. G. 1998. Animal welfare and meat science, chapter 11. Neville G. Gregory with a chapter by Temple Grandin. CAB International, November 1998. ISBN-13: 9780851992969.

Jenkins, D. J. A., Sievenpiper, J. L., Pauly, D., Sumaila, U. R., Polit, Dr., Kendall, C. W. C., Mowat, F. M., 2009. Are dietary recommendations for the use of fish oils sustainable? *Canadian Medical Association Journal*, 2009 Mar 17;180(6):633-7. Accessed at <http://www.cmaj.ca/cgi/content/full/180/6/633> on 6th August 2009.

Johannesson, B., Larsvik, M., Loo, L., Samuelsson, H., 2000. Aqua-scope learn more about the sea website. Available: <http://www.vattenkikaren.gu.se/fakta/arter/chordata/teleoste/ammodyti/ammo1e.html>. Accessed 2010 Apr 12.

Misund, O. A. and Beltestad, A. K., 2000. Survival of mackerel and saithe that escape through sorting grids in purse seines. *Fisheries Research* 48 (2000) 31-41.

Mood, A., Brooke, P., 2010. Estimating the number of fish caught in global fishing each year. Available from <http://fishcount.org.uk/studydatascreens/frontpage.php>.

Robins, J. F., 2006. Aquaculture & Fisheries Bill consultation December 2005. Response by John F. Robins as secretary to the pressure group Animal concern and to the charities Save our Seals Fund and Animal Concern Advice Line. February 2006. Accessed <http://www.scotland.gov.uk/Publications/2006/04/06110223/136> on 10th Dec 2008.

Webster, J., 2005. Animal welfare: Limping towards Eden. Wiley-Blackwell, February 2005. ISBN-13: 9781405118774. Pages 61-69.

Webster, J. 2009. Concepts in Animal Welfare. 1. Sentience and suffering: Why animal welfare matters. University of Bristol School of Veterinary Science, Bristol, UK. Accessed <http://bioethyics.univer.kharkov.ua/seminar/JW-WSPA-S&S.doc> on 11th April 2009.