TOWARDS HUMANE AND SUSTAINABLE FISHERIES

The humane treatment of animals is increasingly accepted as an important part of sustainable food production. It is widely accepted that animals killed for food should be killed humanely. Reform of the Common Fisheries Policy should include a policy to address the serious animal welfare problems, including inhumane slaughter of fish, in commercial fishing. As the Green Paper states (p 22), *"Coherence with other EU policies must be ensured within all parts of the CFP"*. The EU Treaty recognises animals as sentient beings and states that full regard should be given to their welfare needs in fisheries[1]:

> *"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."*

There is good evidence that fish are able to experience fear, pain and distress. This is the view expressed in the "General approach to fish welfare and to the concept of sentience in fish" (AHAW, 2009) adopted in January this year by the AHAW panel of scientists, following a request by EU commission for a Scientific Opinion on the animal welfare aspects of fish farming. As Professor Donald Broom of the University of Cambridge, England states (1999):

> *"at least some aspects of pain as we know it must be felt by fish."*

As discussed below, fish are likely to suffer considerably during capture and subsequent treatment, and often for long periods of time. The numbers of animals affected is also huge, making this a major animal welfare issue. The EU is beginning to address welfare problems in fish farming, for example with the Benefish project (Benefish, 2009). The importance of seeking to minimise the suffering of fish is recognised at an international level wider than the EU. In a policy statement of the international Organisation for Animal Health (OIE) it states (OIE, 2009):

> *"The use of fish carries with it an ethical responsibility to ensure the welfare of such animals to the greatest extent practicable."*

The OIE is currently developing welfare codes for transport and slaughter of farmed fish. Recommendations for improving the welfare of farmed fish have been adopted by the Council of Europe (COE, 2005).

That there is a market for better welfare is clearly demonstrated by the expansion of the free range egg market in the last 10 or 20 years. In the UK over half the shell eggs sold are now from free range hens (CIWF, 2009), despite that fact that they are a little more expensive. In Western Europe, non-cage egg production has reached 35%, according to an industry website (WattPoultry.com, 2007).

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

EU consumers are completely underserved when it comes to humanely produced wild fish. This is not available at all. As discussed below, farmed carnivorous fish, even if certified by welfare schemes, are not a better welfare alternative but multiply the numbers of fish inhumanely killed to produce each portion. Here we have another vicious circle. Although consumers can choose to buy fish certified for sustainably managed fisheries, e.g. fish carrying the MSC label, humanely caught and killed fish are not available in supermarkets. Consequently, consumers remain largely ignorant of the issue. Despite the fact that they pay twice for their fish (p8 of Green Paper) they are unable to make humane choices as they can with eggs and meat.

This communication outlines some key welfare problems in commercial fishing and proposes potential measures to reduce suffering. The EU fisheries policy should seek to promote, encourage and develop humane solutions to the huge scale of animal suffering caused in current fishing practice.

Welfare of fish in farming is beginning to be addressed and humane slaughter technology has been developed for some farmed species. A similar approach is needed for wild-caught fish which needs EU and government support. As Gandhi once said:

> *"The greatness of a nation and its moral progress can be judged by the way its animals are treated."*

1. What are the welfare problems in commercial fishing?

Considerable suffering is caused to wild-caught fish during capture, landing and subsequent processing. Fish are likely to experience fear, pain and distress as they are, for example:

- pursued to exhaustion by trawl nets
- crushed under the weight of other fish in trawl nets
- raised from deep water and suffer decompression effects e.g. burst swim bladders
- snared in gill nets
- confined in constricted seine nets
- spiked with hooks (gaffed) to bring them aboard
- caught on hooks, often for hours or days
- thrown live to tuna as bait
- impaled live on hooks as bait

In many types of fishing the duration of capture can be very long, lasting hours or even days. Fish often die, or are fatally injured, during this process.

Perhaps the worst practice of all is the use of small bait fish that are impaled alive on hooks, as bait for fish such as tuna.

In some long line and trolling fisheries, the potentially humane slaughter method of spiking is used soon on landing in order to improve the flesh quality by reducing the pre-slaughter activity (Gregory, 1998). When killing is not fast, fish will struggle to escape and this stress exercise is bad for flesh quality. Some fish may be slaughtered by a blow to the head, which is also a potentially humane method of killing fish, but these methods are the exception rather than the rule (V.d. Vis and Kestin, 1996).

Most commercially-caught wild fish that are alive when landed are not slaughtered but die either from being left to suffocate in air or by a combination of suffocation and live gutting (V.d. Vis and Kestin, 1996). Sometimes fish are put onto ice as they suffocate, or into iced water. Live chilling is stressful to fish and may also prolong their suffering (Robb and Kestin, 2002).

According to one Dutch study (V.d. Vis and Kestin, 1996), during observation of fisheries at sea, the majority of most fish species caught were still alive and conscious when landed. The time taken to lose consciousness was measured for several species of fish (herring, cod, whiting, sole, dab and plaice). Those left to asphyxiate took 55-250 minutes to become insensible. Those that were gutted first remained sensible for 25-65 minutes.

2. How could suffering be reduced in commercial fishing?

The following measures, combined with humane slaughter as soon as the fish is landed, would improve the welfare of fish in commercial fishing.

1. Avoid the use of live fish as bait, especially when impaled on hooks

The use of live fish as bait should be seen as contrary to any norms of civilised animal treatment and avoided, preferably using artificial baits or off cuts instead.

2. Reduce bycatch

As well as being wasteful and environmentally damaging, bycatch involves the inhumane treatment great numbers of fish and other animals. Modifications to fishing practice and fishing gears can reduce the numbers of bycatch animals.

3. Reduce injury and stress during capture

Less injurious and stressful methods of fish capture and handling can improve the survival chances of released bycatch (“live capture, selective harvest”) and improve eating quality. They can therefore reduce the suffering of fish caught as bycatch and could also help reduce the suffering of retained fish, if combined with humane slaughter as soon as the fish is landed. This can be achieved by the following:

(a) Reduce injury and stress during capture itself

Changes to fishing gears and fishing practice can reduce stress and injury caused during capture. For example, variations of gill net that entangle fish rather than snaring them can reduce injury and death rates caused (Vander Hagen et al, 2004).

(b) Reduce the duration of capture

This could be achieved by, for example, reducing the time period between setting and retrieving nets and lines.

(c) Develop methods of landing fish that reduce stress and injury

This would include careful handling of fish and avoiding gaffing fish. Pumping systems which minimise stress and damage have been devised for farmed fish (Ashley, 2006). These systems could potentially be adapted for use on fishing boats. “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 (Wild Salmon Direct, 2009).

3. Humane slaughter for wild-caught fish

Humane methods of killing animals are ones 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 used on farmed fish in New Zealand).

There are two traditional methods for killing fish that have the potential to be humane, namely percussive stunning and spiking (Robb and Kestin, 2002). These are the methods recommended for anglers for reasons of welfare and quality. They are described by Robb and Kestin (2002). 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. 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 done accurately, the fish can become unconscious immediately.

Percussive stunning with a club is the humane method used by artisanal fishers in the fair-fish certification scheme pilot project in Senegal (fair-fish, 2007). Spiking is used in some hook and line fisheries (Gregory, 1998). Automatic percussive stunning devices have been developed for some species in fish farming. They are used by Wild Salmon Direct on its wild-caught salmon in Alaska. This company claims to be the only wild salmon producer using humane slaughter technology (Wild Salmon direct, 2009).

Percussive stunning and spiking kill fish individually, and so may not be considered practical for larger fishing operations with large numbers of smaller fish. For these cases, humane slaughter technology used on fish farms needs to be adapted for use on fishing vessels.

Electrical stunning systems have been developed for en mass humane slaughter in fish farming (Robb and Kestin, 2002). As with some automated percussive stunning, the fish are killed without taking them out of water. A current is passed though 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. 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 (DEFRA, 2002). An important step for this will be

the development of electrical stunning systems for salt water farmed species. Electrical stunning of salt-water species is technically more challenging than for fresh water species, owing to the greater conductivity of salt water.

Other methods of the humane slaughter of farmed fish may also present the possibility of being adapted for use in some commercial fishing.

A UK fisher, interviewed on radio stated (BBC, 2008): *"the future of fishing is in quality*". Animal welfare, including humane slaughter, is a key part of good quality. As the EU-funded "Welfare Quality" project website (Welfare Quality, 2009) states:

> *"Animal welfare is of considerable importance to European consumers. Nowadays food quality is not only determined by the overall nature and safety of the end product but also by the perceived welfare status of the animals from which the food is produced."*

4. Overfishing exacerbates the welfare cost

For some citizens, the main purpose of sustainability is to manage the earth's resources, like fish, sustainably so that future generations can continue to use them. Many believe that protecting the ocean's wildlife is important in its own right. This view may be based on the idea that future generations have a right to inherit and enjoy a largely natural world with all its fascinating communities of creatures. It may also be based on the idea that non-human species have a collective right to exist in the world. Concern for animal welfare, i.e. the well being of animals as individuals, has always been an important component of public concern for the environment. EU fisheries policy should incorporate all these concerns and aspirations.

Overfishing is as bad for animal welfare as it is for conservation of fish stocks. Catches that increasingly consist of larger proportions of smaller fish mean that more fish are caught and suffer for the same amount of food. The objective of larger fish populations with catches of mature and bigger fish is therefore better for welfare as well as sustainability. So too is the objective of reducing fishing levels to reverse the "fishing down the food web" effect of overfishing. Industrial fishing in EU waters has developed partly as a result of declines in cod, mackerel and other predators of small fish, a classic example of "fishing down the food web" (Dunn, 2003).

In order to protect Europe's fish stocks it will be necessary to reduce catch limits to be at or below the MSY. Europe needs to be catching fewer fish and to do so at a rate that allows them to spawn before they are caught, in order to replenish fish numbers. The concept of the MSY is to obtain the maximum catch from a fish stock that can be maintained from year to year. If the MSY is not based on a too optimistic assessment of the stock, and if a precautionary approach is taken in setting the MSY, then the MSY protects target fish stocks from depletion while maximising food production. Maintaining fish stocks in greater abundance reduces disturbance to the food web, helping biodiversity, and fuel costs are

reduced catching them. Fish are allowed to grow larger before they are caught which means proportionately fewer fish are caught, a clear benefit to animal welfare.

There are, however, limitations to the MSY model. These arise because fisheries management has other objectives besides purely maximising food output and because MSY does not take into account the complex ecosystem effects of fishing.

Setting levels of fishing that are below the MSY would mean fish stocks in greater abundance than for levels at MSY and fish would be allowed to grow larger still before being caught. The maximum economic yield (MEY) is likely to be obtained at levels below the MSY. Fishing at the MEY, rather than the MSY, would involve lower fuel consumption and fuel costs. Fisheries management should aim to protect the whole ecosystem besides the target fish stocks, including fish habits and feeding interactions. Achieving this is likely to require fishing levels below the MSY, which is a single-species concept. Allowing fish to grow larger would clearly reduce suffering involved in fisheries capture. Fishing levels below the MSY increase the margin of error and resilience in the face of climate change.

Optimising the objectives of fisheries management is likely to be achieved at fishing levels lower than the MSY.

5. Catching fish to feed to fish – a question of proportionality

More than a quarter of the 5.2 million tonnes of recorded fish capture[2] by the EU in 2007 comprises industrial species[3], i.e. ones that are mostly used for reduction to fish meal and oil (FAO, 2009a). Because these fish tend to be fairly small, their proportion of fish numbers will be greater than a quarter. Further, possibly equal, numbers of these fish are imported as fish meal and oil.

Most fish meal and oil is used to feed to farm animals, and for other non food purposes, with a small proportion consumed by humans equating to 14% globally in 2002 (Schipp, 2003). Fish meal, and fish oil especially, are increasingly being used to feed to farmed carnivorous fish, such as salmon and trout. The EU's fish farms produced 600 thousand tonnes of fish in 2007, more than half of which comprised "salmons, trouts and smelts" (FAO, 2009b).

If we accept a duty of care towards animals used for food, there is surely a point at which the amount of food produced is too small to merit the inhumane slaughter of a sentient animal. The capture of fish to feed to carnivorous fish, such as salmon and trout, particularly raise the issue of proportionality, as the following example shows.

[2] Note that recorded capture does not include discards, illegal fishing nor unaccounted fish mortalities caused by contact with fishing gears (such as deaths of trawl escapees and fish killed by lost gill nets)

[3] Atlantic menhaden, blue whiting, Chilean jack mackerel, chub mackerel, European pilchard, European sprat, sandeels, tadpole codling

It takes 3-4 Kg of wild fish to produce 1 Kg of farmed salmon (Schipp, 2008; Tuominen and Esmark, 2003). Fish used to make fishmeal vary in weight from 10g (e.g.sandeels) to 1000g (e.g. a jack mackerel). Depending on their size, it takes roughly 14 Kg and 14-1400 wild-caught fish to feed one 4 kg farmed salmon. A portion of farmed salmon therefore involves the inhumane slaughter of tens of animals. A 20g Peruvian anchovy caught to feed to a farmed salmon suffers a death that meets no standard of humane slaughter to produce just 6g of salmon.

Fish farming systems that do not produce more fish than they consume are wasteful. Reducing levels of industrial fishing would greatly reduce the scale of animal suffering. Levels of industrial fishing (fishing for feed fish) also raise concerns about the marine wildlife that feed on industrial species, e.g. the puffins that feed on sandeels, and the impact on recovering fish stocks (Dunn, 2003).

6. Reducing numbers of fish caught

The Greenpeace call (2009) for a network of marine protected “no take” zones, in which fishing is not allowed, covering 40% of the world’s oceans would greatly improve sustainability and animal welfare. “No take” zones are restrictions on fishing effort that do not result in discards.

The best solution to the discards problem would be either to eliminate bycatch or to achieve “live capture, selective harvest” in which discards have the best chance of survival. EU fisheries should be seeking to develop and promote variations of fishing methods that can achieve this.

For the protection of the environment and animal welfare, as well as the maintenance of healthy fish stocks, management of fisheries should be based on science rather than short term political pressures. Fishing levels should be reduced to within safe biological limits based on a precautionary ecosystem approach. Fishing subsidies should only be used to effectively reduce the size of the EU fishing fleet, or to specifically promote fishing practice that is both humane and sustainable. The following measures should be implemented to reduce the numbers of fish caught for a more for a more sustainable, and also more humane, EU fishery:

- Establishment of a network of marine protected “no take” areas covering 40% oceans
- Reduce illegal fishing with effective enforcement of regulation
- Measures to effectively reduce bycatch e.g. temporal fishery closures; effective BRDs (bycatch reduction devices)
- Setting catch levels within safe biological limits within a precautionary, ecosystem approach
- Setting minimum capture sizes to allow fish to grow and spawn before they are caught
- Reducing the numbers of fish caught for, and used as, bait
- Reducing the numbers of fish caught for reduction to fish meal and fish oil

7. Alternative nutritional strategies

"A vision for European fisheries by 2020" remains fixed on the use of fish as the main source of protein and healthy fat, and fails to recognise the need to develop alternative nutritional strategies. The amount of wild fish caught (and the amount of farmed carnivorous fish produced which are themselves fed on wild fish) per person in the world will decline. Current levels of fishing are unsustainably high and the human population is growing. Health agencies in developed countries continue to encourage people to increase their fish consumption, a strategy which is increasingly questioned.

A paper published in the Canadian Medical Association Journal (Jenkins et al, 2009) argues that evidence for the health benefits of increased fish consumption is *"not as clear-cut as protagonists suggest"*. Even if the evidence were more compelling, it argues, the environmental threat posed by increased fish consumption is now obvious and advice to people to eat more fish *"does not seem wise"*. Moreover, the report says, the current levels of fish consumption in developed countries are having a harmful affect on poor coastal communities in developing ones:

> *"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".*

The report concludes that it is vital that studies which seek to clarify the benefits of omega-3 fatty acids continue, and that alternative sources of omega-3 are developed and evaluated. Alternative sources of the long chain omega-3 fatty acids obtained from eating fish include DHA produced on algae, which is added to infant formula. Eggs from hens fed on linseed offer another source.

8. Initiatives to develop humane practice

There is an urgent need to address the welfare problems in commercial fishing. The EU and other stakeholders have worked to address welfare in fish farming – a similar approach is needed for fisheries. For example, the EU could:

1. Recognise that commercial fishing is a major animal welfare issue.

2. Initiate projects to:

- conduct welfare assessments of different fishing methods,
- develop welfare codes for fishing,
- develop technology for humane slaughter and landing of wild-caught fish.

3. Encourage the development of niche market welfare certification schemes for artisanal fishers similar to fair-fish.

4. Support the development of model humane and sustainable fisheries e.g. ones using capture and killing methods similar to Wild Salmon Direct or the fair-fish scheme.

5. Regulate on welfare e.g. ban the use of live fish impaled on hooks as bait.

9. Key points

1. Common Fisheries Policy should recognise and address the serious welfare problems in commercial fishing including inhumane slaughter of fish. Failure to do so is not coherent with EU policy that full regard should be paid to the welfare needs of animals in fisheries. Nor is it coherent with the recognition of "Welfare Quality".

2. Animal welfare is an important part of quality. Where humane slaughter methods are used in commercial fishing they are used for reasons of quality (perhaps also for welfare). Both types of quality have important benefits to producers as well as consumers.

3. Consumers are completely underserved concerning fish caught to better welfare.

4. Most commercially-caught fish are not killed humanely but instead die from asphyxiation or a combination of asphyxiation and live gutting. Traditional methods of potentially humane slaughter are percussive stunning (a blow to the head with a club) and spiking. These are applied to fish individually and may be more suited to high-value fish and artisanal niche markets.

5. Technology for en mass humane slaughter needs to be adapted from fish farming. This needs to be a research objective. Low stress pumps should also be adapted to reduce suffering during landing fish from purse seine nets.

6. Less injurious and stressful variations of fishing method, including better handling of fish, can promote survival of discards and could also improve welfare. Reducing bycatch is also an important welfare issue.

7. Impaling live fish on hooks for use as bait should be banned. Use of live fish as bait should be avoided.

8. Capture durations (soak and trawl times) should be reduced as they protract suffering.

9. Fish farms that consume more fish than they produce are not acceptable from the point of view of sustainability or animal welfare. Fisheries management should be aiming for some kind of proportionality in the suffering caused vs food obtained. Fishing levels for feed fish should be reduced.

10. Use of fish as bait, and fishing for bait fish, should be reduced, preferably using artificial baits and off-cuts instead.

11. Wasteful, illegal and unsustainable levels of fishing should end.

12. A network of marine protected “no take” areas covering 40% oceans should be established.

13. Consumption of wild-caught fish (and of farmed carnivorous fish fed on wild fish) per person in the world will necessarily fall. Alternative nutritional strategies should be developed for supplying long chain omega-3 fatty acids which might include supplements grown on algae.

Alison Mood on behalf of fishcount.org.uk November 2009.

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 1st September, 2009.

Ashley, P. J., 2006. Fish welfare: current issues in aquaculture. Applied Animal Behaviour Science (2006), doi:10.1016/j.applanim.2006.09.001

BBC, 2008. BBC Radio 4's Farming Today programme, 21st July, 2008.

Benefish, 2009. Farmed fish welfare, Benefish website http://www.benefish.de/index.php?option=com_content&task=view&id=15&Itemid=31. Accessed 2nd September, 2009. Benefish Project Consortium.

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

COE,2005. Council of Europe Recommendation Concerning Farmed Fish. Accessed at http://www.coe.int/t/e/legal_affairs/legal_co-operation/biological_safety%2C_use_of_animals/Farming/Rec%20fish%20E.asp on 1st September, 2009.

CIWF, 2009. Compassion in World Farming News Release May 2009. One billion eggs now from cage-free hens as leading uk companies win 2009 good egg awards. Accessed at http://www.ciwf.org.uk/includes/documents/cm_docs/2009/n/nr4708.pdf on 11th November, 2009.

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.

DEFRA, 2002. DEFRA Science Directorate report of the workshop on farmed fish welfare held Monday 28th October 2002. Department for Environment, Food and Rural Affairs, UK.

Dunn, E., 2003. Interaction between EU industrial fishing, food stocks and the marine environment: a presentation to the EU parliament public hearing on the fishmeal and oil industry – an international perspective, Brussels 23 April 2003. Royal Society for the Protection of Birds (RSPB), UK

Fair-fish, 2007. Fair-fish instructions for artisanal fishery in Senegal (Version 2.3). 22.04.2007. Fair-fish Association, Winterthur Switzerland, http://www.fair-fish.ch. Accessed from http://www.fair-fish.ch/files/pdf/english/instructions.pdf on 2nd September, 2009.

FAO, 2009a. Capture Production 1950-2007 (Release Date: February 2009) available from Fishstat plus website http://www.fao.org/fishery/statistics/software/fishstat. Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO, 2009b. Global Aquaculture Production 1950-2007online query. Accessed at http://www.fao.org/fishery/statistics/global-aquaculture-production/query/en on 2nd September, 2009. on 2nd September, 2009.

Greenpeace International, 2009. Roadmap to recovery webpage. Accessed at http://www.greenpeace.org/international/campaigns/oceans/marine-reserves on 2nd September, 2009.

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 September, 2009.

OIE, 2009. Appendix 3.4.1. Introduction to guidelines for the welfare of farmed fish. Accessed from http://www.oie.int/Eng/normes/fcode/en_chapitre_3.4.1.htm on 2nd September, 2009.

Robb, D. H. F. and Kestin, S. C., 2002. Methods Used to Kill Fish: Field Observations and Literature Reviewed. Animal Welfare 2002, 11:269-282.

Schipp, G, 2008. Is the Use of Fishmeal and Fish Oil in Aquaculture Diets Sustainable? Technote No: 124, June 2008. Northern Territory Government, Australia.

Tuominen, T. And Esmark, M, 2003. Food for thought: the use of marine resources in fish feed. Report number: 02/03, February 2003. WWF-Norway, Oslo, Norway.

Vander Haegen, G.E., Ashbrook, C.E., Yi, K. W., Dixon, J. F., 2004. Survival of spring chinook salmon captured and released in a selective commercial fishery using gill nets and tangle nets. Fisheries Research 68 (2004) 123-133.

V.d. Vis and Kestin, 1996. Killing of fishes: literature study and practice-observations (field research) report number C 037/96 1996 RIVO DLO.

WattPoultry.com, 2007. 4% of U.S. production is cage-free Cage-Free hit Europe first, but increasingly is becoming a U.S. phenomenon. Release Date: 08 February 2007. Accessed from http://www.wattpoultry.com/eggindustryinsider/view.aspx?id=9924 on 11th November, 2009.

Welfare Quality, 2009. Welfare Quality®: Science and society improving animal welfare in the food quality chain. EU funded project FOOD-CT-2004-506508. Accessed from http://www.welfarequality.net/everyone/26536/5/0/22 on 2nd September, 2009.

Wild Salmon Direct, 2009. Wild Salmon Direct - a process for consistent quality. Wild salmon direct website: http://www.wildsalmondirect.com/page.php?4 accessed on 2nd September, 2009.