European Food Safety Authority

The EFSA Journal (2009) 1145, 1-9

Statement of the Animal Health and Welfare Panel (AHAW)

Knowledge gaps and research needs for the welfare of farmed fish[1]

(Question No EFSA-Q-2009-00627)

Issued on June 5th 2009

SUMMARY

Since 2003, the Animal Health and Animal Welfare Panel (AHAW) of EFSA adopted fifteen generic Scientific Opinions related to the welfare of farmed fish. These Scientific Opinions addressed aspects of husbandry systems, transport and slaughter practices and covered seven species of fish. The AHAW Scientific Opinions showed that very limited information is available in the peer reviewed literature regarding fish welfare, making welfare assessment difficult. The biology of fish, their production systems, the development of welfare indicators, and learning and cognitive ability in different species of fish are major topics for research. Welfare oriented research should address specific issues within the following twelve research areas: welfare indicators, vaccines and other veterinary medicines, epidemiology of endemic diseases, neuro-biology, physiology of stress, stocking density, water quality, genetics, transport, pre-slaughter handling, stunning and killing, and domestication of farmed species. The order of importance for these areas significantly differs depending on the fish species, developmental stages and production systems. Therefore the list is not a strict research priority ranking.

Key words: fish, welfare, research, husbandry, transport, stunning, killing, salmon, trout, eel, seabream, seabass, turbot, carp, tuna.

[1] For citation purposes: Statement of EFSA prepared by the AHAW Panel on: knowledge gaps and research needs for the welfare of farmed fish. *The EFSA Journal* (2009) 1145, 1-7

TABLE OF CONTENTS

BACKGROUND

Since 2003, the Animal Health and Animal Welfare Panel (AHAW) of EFSA adopted fifteen Scientific Opinions related to the welfare of farmed fish, including transport and slaughter. The mandate requesting a Scientific Opinion on animal welfare aspects of husbandry systems for five groups of farmed fish was received in 2006. At the AHAW plenary meeting of June 2008, after adoption of the Atlantic salmon welfare opinion a new request for a Scientific Opinion on the stunning and killing methods for seven species of fish was received. The European Commission also suggested that the Panel's Scientific Opinions include recommendations for future research and these recommendations be prioritised.

ACKNOWLEDGEMENTS

This statement was prepared by the Unit on Animal Health and Welfare (AHAW). The European Food Safety Authority wishes to thank the members of the Panel on Animal Health and Welfare for their contribution to the preparation of this statement.

AHAW Panel members: Bo Algers, Harry J. Blokhuis, Anette Bøtner, Donald M. Broom, Patrizia Costa, Mariano Domingo, Mathias Greiner, Jörg Hartung, Per Have, Frank Koenen, Christine Müller-Graf, David B. Morton, Albert Osterhaus, Dirk U. Pfeiffer, Mohan Raj, Ronald Roberts, Moez Sanaa, Mo Salman, J. Michael Sharp, Philippe Vannier and Martin Wierup.

EVALUATION

1. Introduction

During the past five years, the Animal Health and Animal Welfare Panel of EFSA has prepared and adopted several Scientific Opinions related to the welfare of farmed fish in response to requests from the European Commission. These opinions applied to Atlantic salmon (*Salmo salar*), trout (*Oncorhynchus mykiss* and *Salmo trutta*), European eel (*Anguilla anguilla*), gilthead seabream (*Sparus auratus*), seabass (*Dicentrarchus labrax*), turbot (*Psetta maxima*), common carp (*Cyprinus carpio*), and farmed bluefin tuna (*Thunnus thynnus*).

AHAW Scientific Opinions showed that very limited information is available in the peer reviewed literature regarding fish welfare, making the recognition of poor and good welfare and its assessment along with operational welfare indicators difficult.

The objective of this document is to summarise the recommendations for research on welfare of fish, as expressed in previous opinions of the AHAW panel, and to prioritize them.

2. Main areas for further research

The biology of fish, their production systems, the development of welfare indicators, and learning and cognitive ability in different species of fish are major topics for research.

Species specific criteria for the assessment and monitoring of fish welfare including stress indicators, and how these should apply and specific requirements for developmental stages are considered in the following paragraphs.

This document identifies twelve priority research areas some of which are interrelated. The order of importance differs depending on the fish species, developmental stages and production systems. Therefore the list below is not a strict research priority ranking.

2.1. Welfare indicators

Welfare is multidimensional and it is impossible to find one single measurement or welfare indicator that will cover all these dimensions and applicable in all possible husbandry and management systems, farmed species and environments and all stages of development. Indicators fit for purpose should be developed and any proposed welfare indicator should be validated. Welfare indicators should be developed and must be valid, measurable, standardised, repeatable and feasible, so that they can be applied in the field.

2.2. Vaccines and other veterinary medicines

There is a serious lack of available veterinary medicines licensed for use in farmed fish. The lack of availability of useful veterinary medical products is considered within the industry as a major welfare constraint.

Oil-adjuvanted vaccines are known for their adverse effects in fish, causing for example pain and abdominal adhesions. Quantitative studies on the adverse effects of certain types of vaccines are needed for the development and licensing documentation of fish vaccines for the future.

Research programmes on vaccines should be particularly focussed on technologies which can alleviate the negative welfare effects that currently accompany many otherwise effective fish vaccines.

The use of DNA vaccines has a potential for improving welfare through disease prevention, but there is a limited understanding of the fate of DNA vaccines after injection into the fish. There is a need for more research focussing on unintended outcomes that may lead to poor welfare in the recipient fish.

2.3. Epidemiology of endemic diseases

The impact of disease and its control measures on fish welfare is an important topic. Much of the research on fish diseases in Europe currently concentrates on pathogens and pathogenesis of notifiable diseases, while there is little emphasis on effective practical disease prevention and control strategies for endemic diseases that are not notifiable.

One major topic for further research is to improve our knowledge and understanding of the epidemiology of endemic diseases in an effort to better characterise, quantify and control their impact on the welfare of fish. This implies that the lack of uniformity in the definition of diseases and their causative agents, and the imprecision arising from the wide variation in pathogenicity of their many strains be addressed. In addition, better data collection at the EU level concerning the volumes and origins of traded aquatic commodities and epidemiological studies on the pathways of infectious agents are needed to assess the risk of introduction, establishment and spread via susceptible, vector and carrier species.

2.4. Neuro-biology

Future research is needed in the fields of neuro-physiology and neuro-anatomy of fish in order to better understand the question of sentience, consciousness and pain and stress physiology in fish. Research and development, for example in the area of cognition and brain imaging techniques, should be carried out in fish to further our knowledge and understanding of pain perception and how it applies to all stages of development.

2.5. Physiology of stress

Fish farming systems inevitably introduce a number of stressors to the fish. These include inappropriate water temperature and chemistry (NH_3, NO_2, NO_3, pH, dissolved oxygen, CO_2), handling, physical damage, disease treatments and nutritionally induced conditions. It is impossible to avoid many of the procedures known to induce stress responses in fish. There is a need for a better understanding of stress responses mediated via the hypothalamic-pituitary-inter-renal (HPI) axis, and the brain-sympathetic-chromaffin-cell (BSC) axis and for the actions of Heat Shock Proteins in limiting these stressors in fish. Modulation of the stress response in fish of different genotypes, stage of development and at different season must be linked to secondary responses as humoral mediated factors and metabolites, immune capacity and behaviour, measurable in the live fish. To be able and quantify severity of stress is a prerequisite in order to perform a meaningful risk assessment and thereby minimising the risk for compromised welfare in fish. Knowledge to preventive actions of acute stress by pharmacological means and long term stress by design of the holding facilities at the farm should also be focused.

2.6. Stocking density

Although the effects of stocking density on welfare vary according to species and temperature, too low or too high a stocking density remains a major problem in several farmed fish species. The effects of stocking density on welfare should be studied in each farmed species and different stages of development in order to determine the ideal stocking densities and water quality that prevent poor welfare or that promote good welfare.

2.7. Water quality

Further studies are needed for determining the lowest observed effects of the concentration, or levels, of abiotic factors in interaction with other water quality factors. Research on the various species of fish should be directed towards establishing the impact of exposure to sub-lethal concentrations of abiotic factors that affect significantly the welfare of farmed fish during the various life-stages.

The environmental conditions that apply to fish, referred to as water quality, should be defined for a range of interrelated factors and while each specific variable is described separately, there are very few occasions where only a single factor is involved in any welfare issue relating to environmental conditions. For this reason, the various factors always should be considered in the context of the other variables involved. Research should be directed toward elucidating the interrelations and the complexity of interactions in water quality associated with poor welfare of fish.

2.8. Genetics

There are few publications quantifying the positive or negative effects of genetic selection on fish welfare; this subject needs to be addressed. Genetic selection can improve fish welfare, for example if it facilitates adaptation to the farming situation reducing fear and stress, or if it increases disease resistance. Selection can cause poorer welfare in a wide range of ways, for example via effects on: functional systems in fish (respiratory, cardiac, locomotion, reproduction), disease prevalence, muscle structure and flesh quality, or genotype/environment interactions. There may be impacts of genetic selection on aspects of the life history and these should be considered.

Where any genetic change is brought about, particularly if the change is substantial or cloning or genetic manipulation for future breeding stock is envisaged, a full range of welfare indicators should be investigated, developed, and used to determine effects on welfare before it is implemented commercially.

2.9. Transport

Transport and transfer of fish may occur at different stages of the production process. This covers a broad spectrum of situations ranging from transport of juveniles from hatchery to rearing facility to transport of commercial size fish during pre-slaughter handling. There should be research on welfare of the various species of farmed fish during transport at all life stages.

2.10. Pre-slaughter handling

There should be research on welfare of the various species of farmed fish in particular associated with feed withdrawal, crowding, transfer (netting, pumping), grading, exposure to air, and holding conditions. The effect of repeated exposure to some of these stressors also needs to be investigated in various species of farmed fish.

2.11. Stunning and killing

Research is needed on how stunning methods induce brain changes associated with unconsciousness and insensibility in each farmed species and how death, unconsciousness and consciousness can be practically recognised in order to monitor killing and stunning systems. The possibility to improve welfare by pre stunning techniques by pharmacological or electric means should be investigated, especially in situations where either high end quality is required or in situations where fish is not intended for human consumption and will be killed by pharmacological means, macerated or die by asphyxia.

2.12. Domestication of farmed species

Wild fish captured for aquaculture purpose may not be adapted to farming conditions. Where farming systems from brood fish to egg and from egg to commercial size fish are not completely developed (e.g. eel, tuna), research efforts should focus on controlling the entire life cycle of these species to achieve breeding in captivity and avoid fish supplies from capture fisheries and threats to wildlife populations.

REFERENCES

Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on the species-specific welfare aspects of the main systems of stunning and killing of farmed tuna. *The EFSA Journal* (2009) 1072, 1-9.

Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on welfare aspect of the main systems of stunning and killing of farmed turbot. *The EFSA Journal* (2009) 1073, 1-34.

Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on welfare aspect of the main systems of stunning and killing of farmed Atlantic salmon. *The EFSA Journal* (2009) 1012, 1-77.

Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on Species-specific welfare aspects of the main systems of stunning and killing of farmed rainbow trout. *The EFSA Journal* (2009) 1013, 1-55.

Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on welfare aspect of the main systems of stunning and killing of farmed eel (*Anguilla anguilla*). *The EFSA Journal* (2009) 1014, 1-42.

Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on welfare aspect of the main systems of stunning and killing of farmed seabass and seabream. *The EFSA Journal* (2009) 1010, 1-52.

Scientific Opinion of the Panel on Animal Health and Animal Welfare on a request from the European Commission on the Animal welfare aspects of husbandry systems for farmed fish: trout species. *The EFSA Journal* (2008) 796, 1-22.

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.

Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on animal welfare aspects of husbandry systems for farmed fish: European eel. *The EFSA Journal* (2008) 809, 1-18.

Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on animal welfare aspects of husbandry systems for farmed fish: Atlantic salmon. *The EFSA Journal* (2008)736, 1-31.

Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on animal welfare aspects of husbandry systems for farmed fish: common carp. *The EFSA Journal* (2008) 843, 1-28.

Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on animal welfare aspects of husbandry systems for farmed fish: European seabass and Gilthead seabream. *The EFSA Journal* (2008) 844, 1-21.

Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on aquatic animal species susceptible to diseases listed in the Council Directive 2006/88/EC. *The EFSA Journal* (2008) 808, 1-9.

Scientific Opinion of the Panel on Animal Health and Welfare on a request from the European Commission on possible vector species and live stages of susceptible species not transmitting disease as regards certain fish diseases. *The EFSA Journal* (2007), 584: 1-163.

Opinion of the Scientific Panel on Animal Health and Welfare on a request from the Commission related to welfare aspects of the main systems of stunning and killing the main commercial species of animals, *The EFSA Journal* (2004), 45, 1-29.