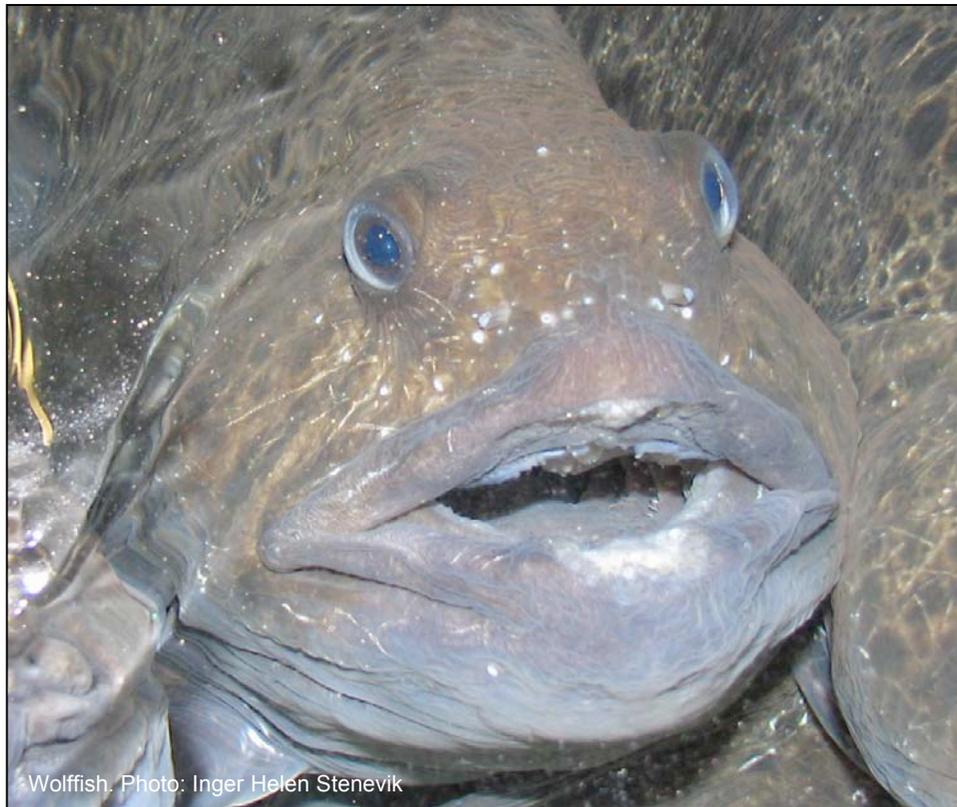


# Challenges in fish research: The protectionist's view



**Anton Krag**, scientific adviser for NAPA

Harmonisation of the Care and Use of Fish  
in Research, Oslo

22 - 24 September 2009

**Dyrevern**  
alliansen 

**Norwegian Animal Protection Alliance (NAPA)**

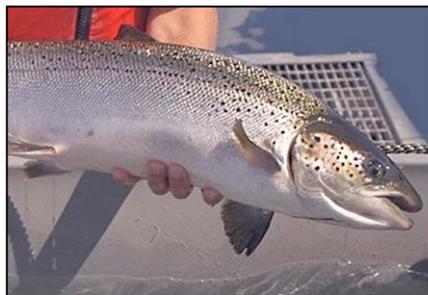
Adr.: Dyrevernalliansen, Brenneriveien 7, 0182 Oslo

Tlf: +47 22 20 16 50 Fax: +47 22 20 60 39

[www.dyrevern.no/english](http://www.dyrevern.no/english)

[anton@dyrevern.no](mailto:anton@dyrevern.no)

# About NAPA



## Norwegian Animal Protection Alliance (NAPA)

- Established in 2001
- Represents 8 local animal protection organizations.

Vision: A world where human activities do not involve intentionally causing suffering to other **sentient beings**.

In practice: Adopt democratic methods to reduce the harm caused by humans - particularly in **farming** and **research**.

For example:

- Dialog with **authorities**, **academia** and **industry**.
  - Norwegian Animal Research Authority
  - Norwegian Council for Animal Ethics
  - Norecopa - consensus platform for alternatives
- Information to the **public**.
  - Ethical consumer network (etiskforbruk.no)
- Fund animal welfare **research**.
  - Norwegian Animal Protection Fund (dyrevernfondet.no)

# Overview



Aim of this presentation is to:

- Present **ethical views** relating to fish research.
- Outline animal **welfare concerns**.
- Offer **suggestions** to all stakeholders.

Point of reference will often be **fish farming related research** as this is the major field of fish experimentation in Norway.

However, the views presented should also be relevant for other areas of fish research:

- basic research (e.g. experimental biology)
- biomedical research (e.g. GM zebra fish)
- wildlife research (e.g. tagging)
- regulative toxicology (e.g. OSPAR)

# Animal protection

“The question is not, Can they reason?, nor Can they talk?  
but, Can they suffer?”<sup>1</sup>



Photo: www.istockphoto.com

Two main branches of animal protection:

- **Animal rights** - animals are sentient beings and “subject-of-a-life”, they have vital interests that humans must not override.<sup>2,3</sup> Calls for an end to exploitation.
- **Animal welfare** - animals can suffer, their interests must be taken into account in relation to human interests.<sup>4</sup> Work to end unnecessary suffering.

The distinction between these branches varies from country to country. Usually, the **practical application** and **resulting outcome** of these two views overlaps to a large degree. E.g.

- Peta work with retailers to end unnecessary suffering.
- RSPCA campaign to end exploitation of whales.

1) Jeremy Bentham, 1748-1832. 2) Regan, Tom, The Case for Animal Rights, University of California Press, 1983. 3) Singer, Peter, Animal Liberation, Random House, 1975. 4) Bekoff M., Aquatic animals, cognitive ethology, and ethics: questions about sentience and other troubling issues that lurk in turbid water, Diseases of Aquatic Organisms, 75(2): 87-96, 2007.

# Animal ethics and science

”A consideration of ethical questions [...] involves applying to science itself the scientific spirit of scepticism, rationality, and a demand for evidence.”<sup>1</sup>



Photo: [www.istockphoto.com](http://www.istockphoto.com)

Having ethical concerns about animal research is **not anti-science**. All areas of modern science are now required by society to adhere to ethical norms.

Science is seldom **value-free**. The questions asked, the methods chosen, and the conclusions reached, are influenced by ethics, religion, culture, politics, funding etc.

For example:

The scientific use of fish in research is based on the moral belief that fish are cognitively inferior to humans and thus exploitable. One could argue that this makes the non-animal (alternatives) road to scientific progress harder to envisage, and less motivating to follow.

1) Bekoff, M. and Jamieson D., Ethics and the study of carnivores, *In Carnivore Behavior, Ecology, and Evolution*. Cornell University Press, Ithaca, New York, 1996.

# Animal ethics and fish research

"We suggest that the concept of animal welfare can be applied legitimately to fish."<sup>1</sup>



Photo: [www.istockphoto.com](http://www.istockphoto.com)

Fish **research** has undoubtedly contributed greatly to the understanding of fish behaviour, cognition and sentience.

Better **insight** into fish biology has in turn led to greater public and regulatory **concern** for fish welfare.

This insight-ethical feedback loop means that researchers need to constantly **revise** the welfare aspects of their research.

Unfortunately fish ethics seems to have been **overshadowed** and **outpaced** by rapid growth in the commercial exploitation of an increasing number of fish species.

1) Chandroo K.P. et al., Can fish suffer?: perspectives on sentience, pain, fear and stress, Applied Animal Behaviour Science 86:225–250, 2004.

# Repeating others mistakes...

“These findings [in salmon] are very comparable with what we know about mammals and broilers that grow very fast”<sup>1</sup>

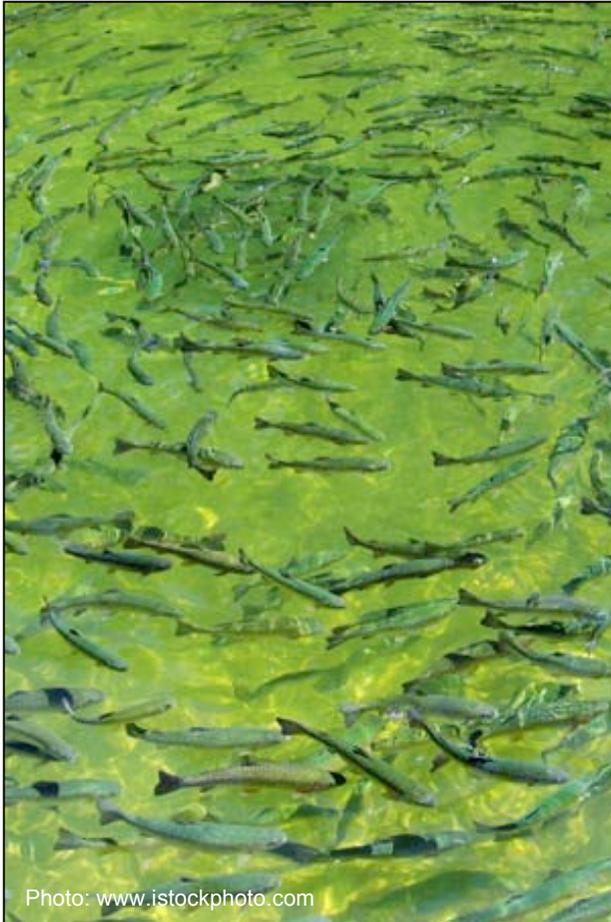


Photo: [www.istockphoto.com](http://www.istockphoto.com)

Development of factory farming on land was largely shaped by **practical** and **economic** factors. Natural behaviour and welfare were given little consideration.

Today's trend is a move away from **behaviourally restrictive** and **welfare detrimental** practices.

Fish farming seems largely to be ignoring history and **following in the footsteps** of land based factory farming.

This trend has also influenced fish research: **Lagging behind** on key principles such as 3Rs, humane endpoints, enrichment etc.

The result of repeating others mistakes is **wasted resources** and **unnecessary animal suffering**.

1) Per Gunnar Fjellidal (Norwegian Institute of Marine Research) to NTB (Norwegian News Agency) on the subject of skeletal deformities due to breeding for rapid growth in salmon, 15th March 2005.

# Rethinking our attitude to fish

“A heightened appreciation of fish by those who work with or exploit them might go a long way towards redressing some current shortcomings in fish welfare.”<sup>1</sup>



To be **sincere** about fish welfare requires a change in the way we **perceive** fish.

The attitude today seems to be that convenient and profitable practices can be undertaken as long as there is no **conclusive proof** that they are detrimental to animal welfare.

It is still common that experiments on fish involve procedures that would not be acceptable on mammals either for ethical reasons or because alternatives have long been implemented.

As **Informed stakeholders**, we have a greater moral obligation to apply the **precautionary principle** in view of potentially painful procedures.

1) Fisheries Society of the British Isles (FSBI), Fish welfare, Briefing paper 2, 2002.

# Example of attitudes: Terminology

“A point that should be considered within the fish farming industry is the extent to which attitudes to fish welfare are affected by the terminology used.”<sup>1</sup>



Photo: www.istockphoto.com

Language can be misused to **distort** or **soften** certain **harsh realities**.<sup>2</sup> E.g.:

## **Fish farming**

Crop or stock = cage full of salmon

Harvesting = slaughter

Farmed fish are often referred to in tonnes not number of individuals.

## **Animal research**

Sacrificed or euthanized = killed

Noxious = harmful, damaging

Discomfort = pain, stress, suffering

Uniformly lethal = kills all fish

The first step to **tackling** a challenge is honestly **acknowledging** and **disclosing** the issues.

1) Broom D.M. & Fraser A.F., Domestic animal behaviour and welfare (4th edition), CABI International, 2007. 2) Dunayer J., In the Name of Science: The Language of Vivisection, Organization Environment, 13:432-452, 2000.

# Fish, pain and cognition

"The erroneous view that both behavioural and neural sophistication is associated with a linear progression from fish through reptiles and birds to mammals, is largely attributable to a heady mix of outdated and unscientific thinking."<sup>1</sup>



Fish slaughter. Photo: I.H. Stenevik

The popular misconception that fish are **unfeeling** creatures largely driven by **instincts** is rapidly changing.

From an academic point of view there will always be room for doubt, despite **growing evidence** that fish **perceive pain**.

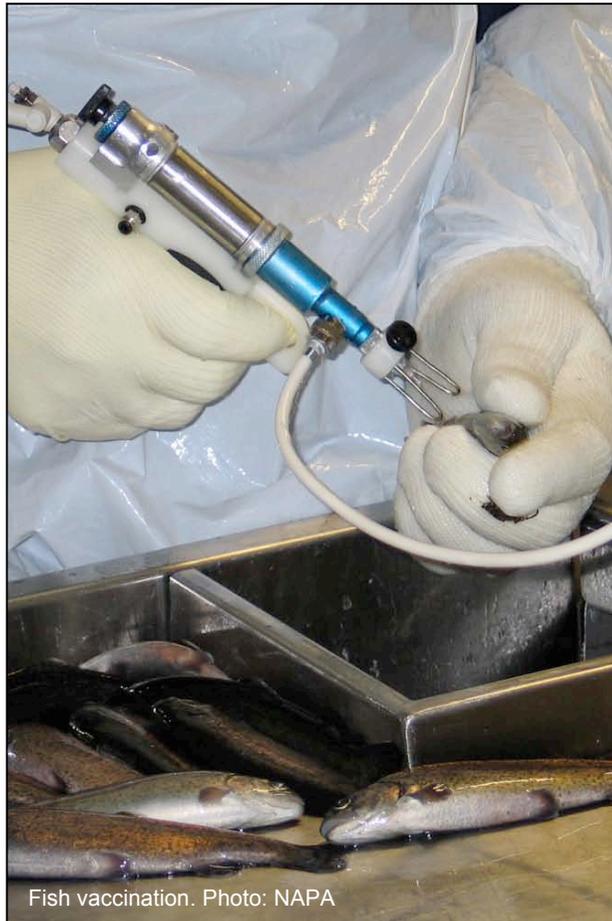
Advanced cognitive abilities in fish makes Darwinian and biological sense. Their brains are both **homologous** (derived from common ancestor) and **analogous** (functioning in a like manner) to the mammalian and avian brain.

Importantly, the absence of full evidence should not deny fish being awarded the **benefit of the doubt**.

1) Brown C. et al., Fish cognition and behaviour, Blackwell publishing, 2006.

# Pain and severity

"The appropriate question appears not to be do fish feel pain? but rather, what types of pain do fish experience?"<sup>1</sup>



Fish vaccination. Photo: NAPA

Fish husbandry practices involve a lot of **distress** which in turn leads to a lot of "severe" research.

Norway: Painful procedures considered "normal husbandry" (e.g. vaccination side-effects) are generally not defined as "**severe**" (significant or lasting pain).

Still, this was the official situation in Norway in 2008:<sup>2</sup>

|                   | Total number of permits given | Number of "severe" permits | Number of "severe" individuals |
|-------------------|-------------------------------|----------------------------|--------------------------------|
| Mammals and birds | 510                           | 12 (≈2%)                   | 2.712                          |
| Fish              | 201                           | 16 (≈8%)                   | 24.863                         |

1) Gregory N., Do fish feel pain? New Zealand Council for the Care of Animals in Research and Teaching , ANZCCART News Vol. 12 No. 4, 1-3, December 1999. 2) Norwegian Animal Research Authority, yearly report and audits, 2008.

# Anaesthesia and analgesia

"Our knowledge of fish physiology and the efficacy of different analgesics does not match the severity of the procedures to which fish are exposed."<sup>1</sup>



Coded wire tag Photo: [www.dmr.state.ms.us](http://www.dmr.state.ms.us)



Implanted tag. Photo: USFWS

Anaesthesia in fish is **challenging** as it involves many species, lifecycles, water conditions etc.

Few of the currently used agents and administration methods have been **validated** on animal welfare grounds.

Some **agents** and **protocols** have been shown to be **aversive** but are still widely used e.g.: MS-222<sup>2</sup>

Welfare aspects of some **sedation** and **immobilization** methods are questionable at best - e.g.: CO<sub>2</sub>, rapid chilling and electrofishing.<sup>2,3</sup>

Practical **analgesia** is not readily available for fish.

# Alternatives

"The greatest scientific experiments have always been the most humane and the most aesthetically attractive, conveying that sense of beauty and elegance which is the essence of science at its most successful."<sup>1</sup>



Photo: Lucas Roth

Thankfully there is **strong consensus** that the 3Rs should be applied to all animal research.

Yet **Replace**, **Reduce** and **Refine** appear to be less frequently applied to fish research:

- Far fewer **papers** on the subject compared to mammal and bird research.
- No specialized **databases** for alternatives in fish research.

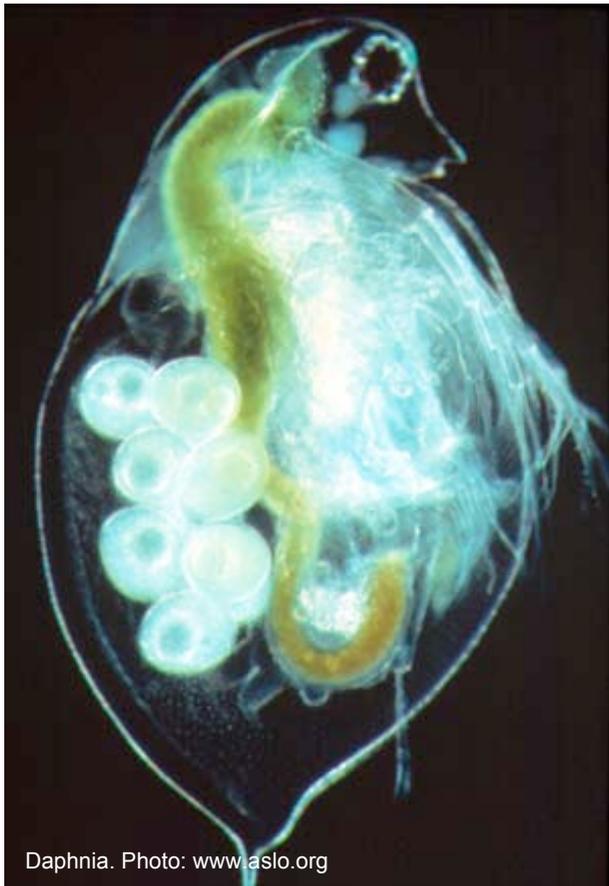
A number of **extra Rs** have been proposed to include a broader approach to alternatives:

- **Redirection**
- **Rejection**

1) W.M.S. Russell and R.L. Burch, The Principles of Humane Experimental Technique, Methuen, London, 1959.  
[http://altweb.jhsph.edu/publications/humane\\_exp/het-toc.htm](http://altweb.jhsph.edu/publications/humane_exp/het-toc.htm)

# Replacement

"Replacement means the substitution for conscious living higher animals of insentient material."<sup>1</sup>



Daphnia. Photo: [www.aslo.org](http://www.aslo.org)

Fish have long been considered a replacement to using **"higher" phyla** animals. This should no longer be seen as ethically acceptable.

The potential for replacement alternatives in fish research appears to be **great**, as it continues to be for research on mammals and birds.

Examples:<sup>2,3</sup>

- Replacing adult fish with fish embryos
- Fish cell and tissue cultures
- Non sentient organisms - e.g. daphnia and algae
- Non-invasive sampling - e.g. from water not blood
- Models and interactive media for teaching and training

1) Russell W.M.S. and Burch R.L. , The Principles of Humane Experimental Technique, Methuen, London, 1959. 2) de Wolf W. et al., Animal Use Replacement, Reduction, and Refinement: Development of an Integrated Testing Strategy for Bioconcentration of Chemicals in Fish, Integrated Environmental Assessment and Management 3(1): 3–17, 2007. 3) Scott P.A. & Ellis T., Measurement of fish steroids in water - a review, General and Comparative endocrinology, 153(1-3): 392-400, 2007.

# Reduction

"Reduction means reduction in the numbers of animals used to obtain information of a given amount and precision."<sup>1</sup>



Unlike mammal research involving **standardized animals**, fish research often involve relatively large numbers of fish under less controlled conditions.

There appears therefore to be **huge** potential for the reduction of fish in research.

Examples of reduction in fish research:

- Genetically standardized fish - less variability<sup>3</sup>
- Improved regulations - more harmonization
- Improved methodology - e.g. threshold approach in acute fish bioassays it could reduce number of fish by 60-70%<sup>2</sup>

1) W.M.S. Russell and R.L. Burch, The Principles of Humane Experimental Technique, Methuen, London, 1959. [http://altweb.jhsph.edu/publications/humane\\_exp/het-toc.htm](http://altweb.jhsph.edu/publications/humane_exp/het-toc.htm) 2) Castano A., Applying the Tree Rs in Acute Ecotoxicity, ALTEX 23, Special Issue, 2006. 3) Grimholt U. et al., A review of the need and possible uses for genetically standardized Atlantic salmon (*Salmo salar*) in research, Lab Anim 43:121-126, 2009.

# Example of Reduction - data sharing

"[...] we are clear that, in principle, duplication of harmful research is unacceptable."<sup>1</sup>



Scientific research demands a certain amount of **replication** to verify findings. However many animal lives are wasted due to unnecessary **duplication**:<sup>2</sup>

- Legal barriers (e.g. lack of harmonization).
- Commercial barriers (e.g. “unprofitable” results).
- Publication bias (e.g. negative results unpublished).

**Mandatory data sharing** is an option to overcome duplication (e.g. implemented in REACH - EC regulation of chemicals).

Some scientific journals require **pre-registration of a trial** so that unfavourable results are not withheld from publication.

1) W.M.S. Russell and R.L. Burch, *The Principles of Humane Experimental Technique*, Methuen, London, 1959. [http://altweb.jhsph.edu/publications/humane\\_exp/het-toc.htm](http://altweb.jhsph.edu/publications/humane_exp/het-toc.htm) 2) Nuffield Council on Bioethics, *The Ethics of Research Involving Animals*, 2005.

# Refinement

"Refinement means any decrease in the incidence or severity of inhumane procedures applied to those animals which still have to be used."<sup>1</sup>



Photo: [www.istockphoto.com](http://www.istockphoto.com)

Refinement involves developing technology and techniques to ensure that animals are harmed as **little as possible** for as **short a time as possible**.

There appears to be **considerable** potential for refinement in fish research.

Examples:

- improved handling
- refined marking techniques
- improved training/expertise
- best practice for routine procedures

1) W.M.S. Russell and R.L. Burch, The Principles of Humane Experimental Technique, Methuen, London, 1959.

# Example of Refinement - humane endpoints

”Undoubtedly, the rapidly expanding development and use of humane endpoints epitomizes their [Russell and Burch] concept of refinement as a means to achieve more humane use of animals.”<sup>1</sup>



Cod, Photo: Inger Helen Stenevik

Endpoints are the earliest indicator in an animal of pain, distress, suffering, or impending death on the basis of which an animal is killed.<sup>2</sup>

This is seldom the case in much fish research. Norwegian fish research applications regularly involve:

- **“Counting dead fish”** at end of study
- **“Removing ‘faint’ fish”** (“svimere”) daily

Challenges:

- Many protocols require death as an endpoint.
- Large experimental groups
- Suffering fish difficult to catch
- Lack of scoresheets
- Lack of welfare indicators

1) Stokes W., Reducing Unrelieved Pain and Distress in Laboratory Animals Using Humane Endpoints, ILAR Journal 41(2), 2000. 2) OECD definition from [www.humane-endpoints.info](http://www.humane-endpoints.info)

# Example of Refinement - environmental enrichment

"Enriching the environment is therefore considered beneficial both to the welfare of the captive animal and for research validity."<sup>1</sup>



Photo: www.istockphoto.com

Environmental enrichment has been **widely applied** to mammal and birds in research, but little work has been done on improving the housing of fish.

Possibilities for enrichment:

- Shelter - pipes, vegetation, shading
- Activity objects - objects for biting
- Exercise - water currents
- Varied diet - varying size and location
- Substrate - for benthic fish
- Group housing - for shoaling species
- Fish-human interaction - familiarization and training

1) Brydges N.M & Braithwaite V.A., Does environmental enrichment affect the behaviour of fish commonly used in laboratory work?, Applied Animal Behaviour Science, 118:137–143, 2009.

# Redirection

"[...] the three Rs principle, in its narrowest interpretation, does not encourage critical scrutiny of the motives for animal use."<sup>1</sup>



Photo: [www.istockphoto.com](http://www.istockphoto.com)

At a public level, focus on the 3Rs tends to **evade** more **fundamental discussions** on the relevance and acceptability of animal experiments.

Redirection is Replacement in a **wider perspective**. Redirection seeks to solve problems outside the realm of animal research - by political, social or other means.

Examples:

Legislation - more extensive fish farming

Education - shaping consumer behaviour

1) Vorstenbosch J.M.G., The ethics of the Three Rs principle: a reconsideration, Animal Welfare 13: 339-345, 2005.

# Rejection

"We must accept that ethics might dictate the demise of certain projects."<sup>1</sup>



Photo: www.istockphoto.com

Because something is **doable**, does not not necessarily mean it should be done.

From an animal protection point of view there are instances where invasive procedures on animals should simply be rejected on **ethical grounds**. Or because suitable **humane technology** does not yet exist.

Example from fish research:

Norwegian authorities have rejected an application to infect fish with disease (Vibrio-bacteria) causing "significant or prolonged" pain for student education purposes.<sup>2</sup> Repeating painful procedures for educational purposes is not justified.

1) Bekoff, M., The importance of ethics in conservation biology: Let's be ethicists not ostriches, Endangered species update, vol. 19 no. 2, 2002. 2) Norwegian Food Safety Authority, Klage på vedtak - dyreforsøk i undervisning, letter to NAPA (ref.: 2008/43899), 17th. June 2009.

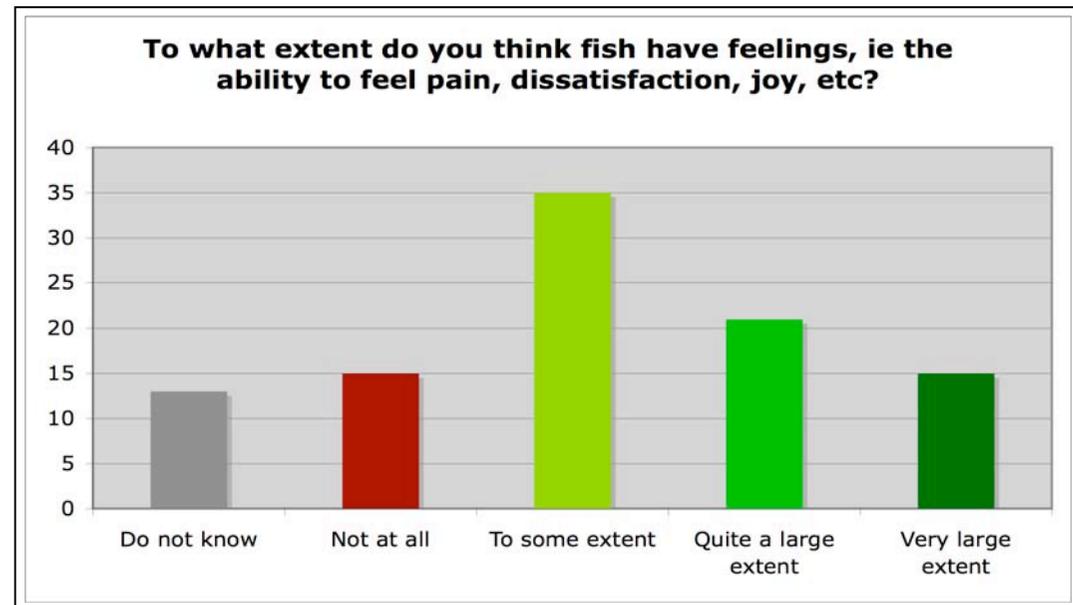
# Suggestions to stakeholders

"We will come to a consensus about ethics of specific practices only if we expose our differences to the light of day, and frankly discuss the issues that are involved."<sup>1</sup>



Photo: www.istockphoto.com

There is **growing public concerns** for the welfare of fish.<sup>2</sup>



These concerns need to be **met** by all stakeholders.

1) Murray D.L. & Fuller M.R., A Critical Review of the Effects of Marking on the Biology of Vertebrates, *In Research Techniques in Animal Ecology*, Columbia University Press, 2000. 2) Dalen, E., Telephone survey on attitudes to animal welfare, MMI for Norwegian Ministry of Agriculture, 2002.

# Suggestions to academia

"Fish as a taxon have found solutions to almost all the problems that supposedly led to the evolution of a large neocortex and cognitive skills in primates."<sup>1</sup>



Photo: Karsten Dahl

Animal welfare **considerations** and **consequences** should be more widely **acknowledged** and **published**.

Fish research societies should provide more **specific**, **binding** and **progressive** guidance on ethical issues of fish research.

Scientific journals should promote **high standards** of fish welfare.

More **negative results** need to be shared to avoid duplication. *Journal of Negative Results in Biomedicine* would be a good example to follow.<sup>2</sup>

1) Bshary R. et al., Fish cognition: a primate's eye view, *Animal Cognition*, vol 5 (pp 1-13), 2002. 2) [www.jnrnm.com](http://www.jnrnm.com)

# Suggestions to authorities

”Even though there might exist a small doubt whether fish feel pain in a similar way to mammals, we should treat them as if they do.”<sup>1</sup>

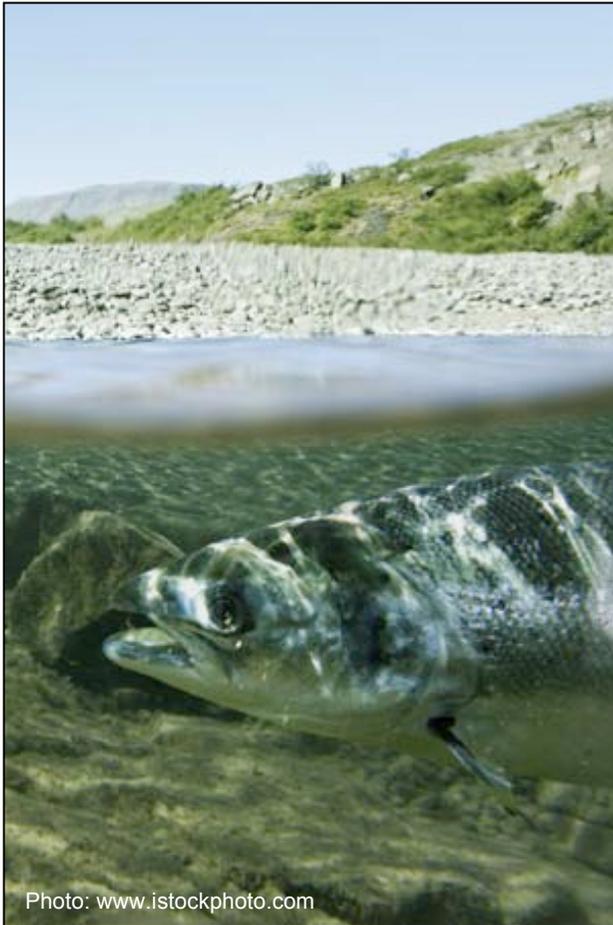


Photo: www.istockphoto.com

Licensing bodies should apply the **same ethical standards** of animal welfare to fish research as they do to mammal and bird research.

Funding bodies should do more to support **fish welfare research**. Lives are wasted if poor animal welfare leads to bad science.

Legislative authorities should do more to **prevent** suffering, rather than to ban or modify methods that are already established.

All authorities should encourage **transparency** in all areas of fish research in order to stimulate **informed debate**.

1) Norwegian Ministry of Agriculture and Food, Norwegian Action Plan on Animal Welfare, Proposition to the Storting No 12 (2002-2003) Animal Welfare and Animal Husbandry. <http://tinyurl.com/n97wy3>

# Suggestions to aquaculture/fisheries industry

"There is growing societal and scientific interest in the welfare status of fish used for commercial enterprise."<sup>1</sup>



Photo: [www.istockphoto.com](http://www.istockphoto.com)

The industries' current ethical approach is largely **reactive** - efforts on fish welfare are kept at a minimum required to maximize production/profit.

Aquaculture and fisheries industry need to take a far more **proactive** approach to animal welfare: Possible welfare problems should be assessed, monitored and addressed from an early stage.

In terrestrial animal species work is being done to **promote positive welfare**. On the other hand, fish enterprises are still focused on **suppressing negative welfare**.

1) Chandroo K.P. et al., "An evaluation of current perspectives on consciousness and pain in fishes", *Fish and Fisheries*, 5 (pp 281-295), 2004.

# Suggestions to animal protection groups

"In the face of such evidence [that fish feel pain], any argument to the contrary based on the claim that fish 'do not have the right sort of brain' can no longer be called scientific. It is just obstinate."<sup>1</sup>



Photo: www.istockphoto.com

Animal protection organisations have **traditionally** focused on experiments with mammals and birds.

Yet, in Norway at least, the **vast majority** (>90%) of animal research is done on fish.

Fish often undergo treatments that would be **unthinkable** to do on mammals or birds. Animal protection organizations should focus more on fish protection, including fish experimentation.

Animal protection organizations should no longer waste energy by being **sidetracked** into debates on whether fish feel pain.

1) Webster J., Animal Welfare: Limping Towards Eden. Blackwell Science, 2005.

# In summary...

**Animal ethics** should be seen as a natural part of fish research.

**Animal welfare** effects of fish experimentation should receive more attention.

The **5-R principles** should be more widely implemented in fish research.

**All stakeholders** should **actively** seek to **rapidly** improve the present situation. The **pace** being taken today is **not ethically sustainable**.

# Suggested reading

Armstrong S.J. & Botzler R.G. (editors), **The animal ethics reader**, Routledge, 2003.

Branson E.J. (editor), **Fish welfare**, Blackwell Publishing Ltd, 2008.

Brown C. et al. (editors), **Fish cognition and behaviour**, Blackwell publishing Ltd, 2006.

Chandroo K.P. et al., **Can fish suffer?: Perspectives on sentience, pain, fear and stress**, Applied Animal Behaviour Science 86:225–250, 2004.

Johansen R. et al., **Guidelines for health and welfare monitoring of fish used in research**, Laboratory Animals 40: 323-340, 2006.

Ross G.R. & Ross B., **Anaesthetic and sedative techniques for aquatic animals**, Blackwell publishing Ltd, 2008.

Thorsteinsson V., **Tagging methods for stock assessment and research in fisheries**, Report of Concerted Action (CATAG), Marine Research Institute Technical Report 79, 2002. <http://www.hafro.is/catag/>

Williams T.D. et al., **Key issues concerning environmental enrichment for laboratory-held fish species**, Laboratory Animals 43: 107-120, 2009.

Diseases of Aquatic Animals, Special Issue: **Welfare of Aquatic Organisms**, available (open access) at <http://www.int-res.com/abstracts/dao/v75/n2>