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# Recommendations on animal welfare in aquaculture

## Preliminary remarks

The present recommendations are intended to contribute to the fundamental protection of aquaculture animals. The Aquaculture Welfare Standards Initiative (ITA) intends to formulate minimum requirements that are both comprehensible and implementable for producers of a wide variety of aquaculture animal species and in a wide variety of countries.

The ITA's recommendations cannot ensure optimal conditions. However, they do draw a line between what seems acceptable and shortcomings that need to be addressed. This line may be far from the ideal.

The term "animal welfare" is used in these recommendations. However, the term may be misleading in that it can give the false impression that it is simply a matter of making conditions in animal husbandry more "pleasant". This contradicts the everyday experience of keeping animals for economic purposes. The ITA's recommendations are about protection from avoidable pain, suffering and harm, as defined in and required by the German Animal Welfare Act (*Tierschutzgesetz*).

The ITA has agreed to make its recommendations in five key areas considered to be particularly relevant to animal welfare issues:

1. Water quality
2. Animal handling
3. Feeding
4. Transport
5. Species-specific stunning and slaughter

The ITA uses the term "stress" in the sense of a natural physical reaction of a living creature to cope with challenging influences. The occurrence of stress is inevitable in any animal breeding facility. However, the intensity and duration of a stress stimulus determine whether the animal can withstand it without harm or whether it leads to suffering and harm. Animal welfare in aquaculture requires the effective minimisation of harmful stress ("distress").

The living conditions and welfare of farmed animals are the lifetime responsibility of the livestock owner. This responsibility must be taken into account socially through ethical action. Animal welfare in aquaculture should be more aligned with animal welfare efforts for terrestrial farmed animals and should challenge certain practices used by fisheries. In this sense, the ITA considers aquaculture to be clearly distinct from industrial capture fisheries. What is described below for fish also applies in a similar way to other animals bred in aquaculture, e.g. shrimps and mussels.

As a foundation, the ITA recommends the use of basic management strategies, which, together with the implementation of the five core areas in line with animal welfare requirements, are known as "best practice" in aquaculture.

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## Animal welfare through best practice in aquaculture

Best practice helps to prevent stress, suffering and harm to farmed species in advance.

In Germany, best practice is already partly enshrined in law and also forms part of the training content for students of professions related to aquaculture.

There are often less stringent legal rules governing compliance with good practice and related training standards in aquaculture businesses in other countries, particularly outside the EU.

### Adherence to a hygiene plan

Risks of introducing pathogens and diseases to livestock can be effectively reduced by complying with hygiene rules and guidelines or by implementing biosecurity measures.

In accordance with the Regulation (EU) 2016/429 on transmissible animal diseases, referred to as Animal Health Law, aquaculture establishments are required to implement biosecurity measures.

The Institute of Fisheries of the Bavarian State Research Center for Agriculture (LfL) has published "Recommendations for the application of the EU Hygiene Package in the production, processing and marketing of fishery products in Bavaria".

These recommendations provide valuable technical information for fish producers to successfully implement hygiene and biosecurity strategies in aquaculture establishments.

With kind permission of the LfL, the ITA has translated these recommendations into English and can now make them available to a broad public.

[https://www.aquaculture-welfare-standards.net/downloads/LfL\\_brochure-EU\\_hygiene\\_package](https://www.aquaculture-welfare-standards.net/downloads/LfL_brochure-EU_hygiene_package)

### Risk analysis and risk assessment

Harm to animals and the occurrence of harmful stressors can also be prevented in advance by mitigating potential risks.

It is advisable to follow the general guidelines of a risk assessment for this purpose. Risks must be identified and recorded through critical control points.

Target values and instructions for action to achieve these values must be defined.

In general, it is recommended that facilities with a high production intensity are equipped with strategies for handling critical changes in process parameters. In highly technical, intensively operated facilities, experience has shown that emergencies result in fatal damage to animals much more quickly than in extensively managed systems.

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## On-farm self-monitoring

In any type of aquaculture business, critical changes can be detected early by a trained observer before they lead to harmful effects on the livestock.

Risk factors must be weighted differently depending on the type of production, the degree of mechanisation and the intensity of production. An extensively operated carp pond, for example, requires less elaborate water quality control than an intensively operated recirculation system, but must take into account greater risks from predators and weather influences.

Since 2014, Section 11 (8) of the German Animal Welfare Act has required every commercial livestock farmer to perform self-monitoring. Livestock farmers have to prove by means of animal-related indicators that they keep their animals in accordance with the animal welfare provisions of Section 2 of the German Animal Welfare Act. Fish kept for the purpose of stocking or food production, but not crustaceans or molluscs, are also considered farmed animals as defined by the German Animal Welfare Act. Therefore, crustacean and mollusc farms are not subject to any legal self-monitoring obligation. The ITA recommends that these livestock should also routinely undergo proper self-monitoring.

The "Animal Welfare Indicators" Working Group of the Verband Deutscher Fischereiverwaltungsbeamter und Fischereiwissenschaftler e.V. (Registered Association of German Fisheries Administrators and Fisheries Scientists, VDFF) has issued its "Animal Welfare Indicators" Guidelines with recommendations for the implementation of self-monitoring in accordance with Sec. 11 (8) of the German Animal Welfare Act in aquaculture establishments.

With kind permission of VDFF, the ITA has translated these guidelines into English and can now make them available to a broader public.

[https://www.aquaculture-welfare-standards.net/downloads/VDFF\\_guidelines-fish\\_welfare\\_self\\_monitoring](https://www.aquaculture-welfare-standards.net/downloads/VDFF_guidelines-fish_welfare_self_monitoring)

The ITA recommends that aquaculture livestock farmers based outside Germany that are not obliged by national law to perform such self-monitoring should base their operational practice on the above-mentioned guidelines.

## Establishment of monitoring procedures

As soon as critical control points have been defined within the framework of regular self-monitoring and target and threshold values for process parameters have been set in line with animal welfare requirements, it is further recommended that measures for checking and correcting these values in operational practice be laid down for all employees.

For intensively operated facilities, software-supported expert systems are available on the market for this purpose. In addition to routine recording and documentation of parameters, alarm strategies can be integrated into these systems in order to quickly identify possible problems.

In less mechanised facilities, regular documentation should at least record all essential data necessary to identify and prevent risks to animal welfare.

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This includes records of feed use, feed quantity, growth and loss rate.

Critical increases can be detected in good time from documentation of losses over the entire cultivation period and countermeasures can be initiated.

The occurrence of diseases in the stock, treatment measures and drug administration should also be routinely documented in every aquaculture facility, if not already required by law.

Such documentation measures are already common practice in businesses that are audited regularly as part of a certification process by certification bodies that award labels such as "ASC", "EU-Bio", "GGN" or "Naturland".

The ITA recommends that businesses that have not yet undergone certification themselves set up their own audit-like monitoring procedures to ensure process quality.

### Expert care of the fish stock

In order to effectively ensure and sustainably improve animal welfare in aquaculture, the ITA recommends that every aquaculture livestock farmer should be able to identify any issues concerning the welfare of the stock at an early stage and to remedy these immediately.

The behaviour of the animals, their appearance, state of health and mortality are suitable indicators for identifying and mitigating possible weak points in production.

Whether aquaculture animals are in good condition or not can be determined by daily inspections.

Poor quality of the holding water, diseases or excessive stress may become evident through reduced appetite, unusual swimming behaviour (e.g. lethargy, darting around, loss of balance) or increased respiratory rates.

With sufficient expertise, indications of problems in husbandry management are easily recognisable in the animals' external appearance and can therefore be identified and remedied.

The animals' external appearance can be observed directly in the tank with a clear view of the fish stock or alternatively by looking at the individual fish, e.g. during control catches or vaccination, weighing, sorting or slaughter.

The use of pictures ("evaluation") is particularly useful for comparing the actual state with the target state.

Staff responsible for the care of animals during such inspections must be adequately trained. According to Section 2 of the German Animal Welfare Act, any person keeping or caring for aquaculture animals must have the knowledge and skills necessary to provide the animal with food, care and accommodation appropriate to its species.

In Germany, gaining specialist knowledge necessary for animal welfare-oriented inspection is part of the three-year training course for fish farmers specialising in aquaculture (*Fischwirt - Fachrichtung Aquakultur*) and inland fisheries. It is not,

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however, a requirement under animal welfare legislation to have completed appropriate specialist training in order to operate an aquaculture business.

Specialist training is not yet available in other international locations.

Nevertheless, the ITA recommends that the fish stock in every aquaculture establishment should be looked after by an individual with equivalent specialist training.

Some international training institutes and certification bodies already offer online training in animal welfare issues in aquaculture, which would be helpful for this purpose.

The Fish Site (2019) Salmon Welfare Course.

<https://thefishsite.com/learn/atlanticsalmon>

NAFC (2019) Fish Welfare course.

<https://www.nafc.uhi.ac.uk/courses/fish-welfare/#d.en.244275>

In addition to expert animal care by facility personnel trained in animal welfare, the ITA strongly recommends that, regardless of legal requirements, the stock is regularly checked by a veterinarian specialising in fish or a professional service provider.

## 1. Water quality

The needs of each aquatic organism in terms of the quality of its surrounding water are species-specific. Meeting these needs is the highest animal welfare priority of any aquaculture business.

The water represents the complete habitat of a fish. It provides contact with the environment and animals of the same species through sensory stimuli such as sound and pressure waves, through electromagnetic fields and optical impressions as well as through hormones, smells and tastes. Oxygen dissolved in the water enters the blood through the gills and carbon dioxide leaves the body in the same way. The water removes metabolic waste products from the animal and also influences the body temperature of all cold-blooded aquatic animals.

Water quality can be determined in a scientifically reproducible manner by means of clearly defined parameters. The temperature, the content of dissolved respiratory gases such as oxygen and carbon dioxide and the concentration of decomposition products such as ammonia and nitrite must always be kept within species-specific limits in order to avoid harmful stress or even poisoning.

Upper and lower limits within which the values are considered optimal for the fish can be scientifically determined for each parameter.

The extent to which deviations from this defined "comfort zone" can be withstood without any harm through stress coping mechanisms and at what point they are to be regarded as critical or harmful depends on, among other things, the fish species in question. For example, a salmon adapted to life in the cold North

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Atlantic can tolerate much lower ambient temperatures than a warm-water fish such as the African catfish. By contrast, evolutionary adaptations to adverse habitats, such as floodwaters in Africa that dry out to form muddy puddles, allow the African catfish to survive critical environmental conditions under which many other fish species would perish. This does not, however, mean that a catfish finds such conditions advantageous. It is able to endure them for a limited time by using special physiological adaptation processes. Like other fish, its ideal is to live in the water, not to survive in the mud.

As a matter of principle, the ITA recommends avoiding deviations in water quality parameters from the optimum as far as possible.

In addition, possible interactions between different water parameters, such as a reduction in dissolved oxygen with an increase in water temperature, should be sufficiently familiar to all individuals involved in stock management in an aquaculture establishment managed in accordance with animal welfare requirements and should be fully taken into account at all times in the management of the establishment.

Fluctuations in water quality affecting animal welfare may occur depending on the husbandry system applied, the origin of the water used and its availability. Use of surface water may introduce parasites and pathogens into the fish stock. In salmon production, for example, the control of "salmon lice" is an extremely serious challenge for any salmon aquaculture business that cares about animal welfare.

If groundwater or spring water is used to supply a fish farm, precipitation of dissolved salts (iron, calcium, carbonate) in a treatment plant may be necessary, depending on the geological location, before the water enters the fish culture.

Aquaculture establishments that experience significant environmental and climatic fluctuations in water quality at their production site should have all the necessary equipment to measure water parameters as well as skilled personnel to detect potentially critical changes at an early stage.

Aquaculture establishments linked to flowing water can suffer when water levels drop during particularly dry periods in mid-summer unless fresh water can be supplied from other sources.

As a matter of principle, the ITA recommends that all aquaculture establishment should at all times be able to keep the water parameters at least within tolerable limits as appropriate to their location by controlling the supply of fresh water, aeration measures, oxygen supply, feeding, fish stocking as well as the removal or filtering of process water.

In particular, the oxygen content must be kept sufficiently high and the level of metabolic waste products and the concentration of pathogens sufficiently low throughout the holding period.

Changes in water quality can occur quickly in an aquaculture facility, especially with high stocking densities. The more animals there are per cubic metre of water, the more frequently water parameters must be measured and fluctuations affecting animal welfare must be offset.

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If no density-dependent suffering or harm is observed in the stock in the routine operation of a fish farm, the ITA considers this to be the result of the successful implementation of animal welfare measures. Stocking densities may be either too high or, in some circumstances, too low, depending on the species and age range of the stock.

When density-dependent stress can no longer be managed by countermeasures, stocking density must be adjusted to a stress-reducing level.

## 2. Fish handling

In its natural habitat, a fish is only caught and held by something or lifted out of the water into the air in life-threatening situations, for example, when a predator has seized it. According to evolution, therefore, any handling and any time spent out of water are always linked to massive defensive reactions and consequently stress for all fish species.

Handling of farmed fish is unavoidable in aquaculture. Fish are brought together and removed from the water with nets or pumps for the purposes of weighing, sorting, treatment and vaccination, transfer, stunning and slaughter.

Care must always be taken to ensure that such handling is carried out as quickly and as gently as possible. The protective mucus layer of fish, their skin and scales, eyes, gills and fins are all susceptible to damage during handling. These are entry points for pathogens and can cause suffering. Effective measures must be taken to avoid this and prevent resulting damage to livestock.

Fish experience stress if they are removed from the water with a fishing net. Improper handling or overfilled nets can cause crushing and damage due to concentration and fish lying on top of each other. These risks must be reduced as far as possible.

On larger farms where large numbers of fish need to be moved regularly, it is recommended that fish pumps are used in which the fish are moved within the water body and not exposed to the air.

Equipment that comes into direct contact with the animals, such as fishing nets or holding containers for fish, must be designed in such a way as to minimise the risk of injury to the animals. This can be ensured by selecting suitable materials and implementing special processing features.

Cleaning, disinfection and maintenance of this equipment are all relevant to animal welfare. It is advisable to check operational procedures for possible improvements in the handling of fish and to record appropriate measures in a quality assurance system.

In order to ensure that fish in an aquaculture establishment is exposed to stress as little as possible, it is also recommended that any necessary or unavoidable removal of animals from the water, for example, for vaccination or weighing, should always be followed by an inspection.

In particular, damage to the body of the animal, its skin, fins and eyes should be expertly assessed, as conclusions about the health of the fish can be drawn from

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such observations, which, depending on the type of establishment, are difficult to perform under water without mechanised aids.

If damage is detected during this inspection, it is the responsibility of every responsible livestock farmer to determine the cause of this damage and find an immediate remedy.

### 3. Feeding

Every fish species uses a range of food options appropriate to its species and natural habitat. Juvenile fish have different dietary requirements to adults. Feed must therefore always be tailored to the particular stage of development.

Food intake is also different according to the fish species in question. Some fish forage at the bottom, others at the surface, some fish hunt, others feed mainly on plants. The form and presentation of the feed should correspond with the innate behaviour of the particular fish species.

For all fish species, feed can only be considered of high quality and appropriate for the species if it includes all the necessary nutrients required for growth, the development of a good immune system and stable health.

Some fish species, such as salmon and trout, rely on dietary components that can currently be obtained from feeds of marine origin, such as fish meal, fish oil or algae. The ITA welcomes all efforts to further reduce the proportion of fish in the feed composition. However, this must not be detrimental to the welfare of the farmed fish and must continue to allow the use of by-products from fish processing. All fish feed must contain the ingredients required for the physiology of the species.

Feeding that is not tailored to the particular fish species can also affect animal welfare through the occurrence of harmful permanent stress. In the long term, fish species that can be successfully farmed on a predominantly plant-based diet offer a possible resolution to the social conflict of feeding fish with fish.

Fish kept in a fish stock compete for the food offered. The amount and frequency of the food supply should prevent the occurrence of competition for food in the stock, wherever possible. This makes it easier to limit aggressive behaviour among the fish and to prevent the stock from growing too far apart in body size.

In order to prevent competition between the fish and injuries caused by the fish getting too close to one another, it is appropriate in terms of animal welfare to feed over a larger area rather than at an insufficient number of points in the stock. It is also usually advisable to feed several times a day.

In the interests of animal welfare, the fact that digestion of the feed requires more oxygen and that feed residues and faeces have a negative effect on water quality must be taken into account when feeding. Oxygen depletion due to bacterial conversion of organic residues and the formation of, in particular, ammonium or ammonia and nitrite during the decomposition of nitrogen compounds must not cause the fish excessive stress. The amount of feed and feeding frequency can be adjusted accordingly.



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A good nutritional condition with uniform growth is a suitable indicator for the evaluation of feeding in the stock in line with animal welfare requirements.

Feeding behaviour and feed intake should be observed during feeding. Reluctance to feed can be a sign of problems in the stock and requires investigation and adjustment of feed quantity. Inspections of damage caused by bites, for example, can provide information about possible aggression.

It is not only economically relevant for an aquaculture establishment to keep a constant eye on the relationship between the growth of the fish and the feed used. The calculation of growth parameters such as the feeding quotient and the condition factor provide valuable information as to whether a fish stock is developing healthily or whether any problems need to be rectified in terms of animal welfare.

## 4. Transport

In principle, any transport causes stress to aquaculture animals. It is not uncommon for transport to lead to stress-related feed refusal and outbreaks of disease in the fish stock. Transport should therefore be limited to what is absolutely necessary and, if possible, avoided altogether.

Council Regulation (EC) No 1/2005 on the protection of animals during transport and related operations contains regulations on the transport of animals including fish. Among other things, it stipulates that transport documentation must be carried and that, depending on the transport distance and the planned journey times, transporters must have an authorisation or an extended authorisation. Transporters of fish must be appropriately trained. The German Decree on the protection of animals during transport (*Tierschutztransportverordnung*, TierSchTrV) also contains further requirements for the transport of fish and aquatic invertebrates, which are intended to ensure the welfare of the animals during transport.

LfL has published recommendations for transport in line with animal welfare requirements that have been translated into English by the ITA with the kind permission of LfL and made available to a broad public.

[https://www.aquaculture-welfare-standards.net/downloads/LfL\\_brochure-transporting\\_live\\_fish](https://www.aquaculture-welfare-standards.net/downloads/LfL_brochure-transporting_live_fish)

The transport process also includes fasting and handling before and after transport. Transport out of water is linked to massive and harmful stress for most aquatic life.

### Fasting

Before transport, stunning and slaughter, it is usually necessary to stop feeding the fish for a few days to allow them to completely empty their intestines. Excrement decomposes bacterially in the water and can lead to a deterioration of the water quality in the transport tank, which does not comply with animal welfare requirements. The fasting phase must be adjusted to varying degrees for the particular species of fish, the size of the animals and the ambient temperature.

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There are both ethical and economic reasons for keeping the fasting period as long as necessary but as short as possible. Many fish species can go several days without food in their natural habitat. However, food withdrawal, known as fasting, can lead to hunger in the fish and to restlessness, aggressive behaviour and stress through intensified foraging behaviour.

Water temperature also influences whether or to what extent hunger, altered behaviour and stress occur during transport. Fish are poikilothermic (cold-blooded) animals whose metabolic activity decreases with decreasing water temperature.

### Prevention of transport stress and damage

The animals must be in good, transportable condition before being transported.

Transport containers must be suitable for the particular species, easy to clean, disinfectable and designed in such a way that no injuries can occur during transport.

During and after transport, the welfare and health of the fish must be closely monitored.

The duration of transports should also be kept as short as possible and the density of transported animals as low as professionally justifiable in order to minimise water quality deterioration and stress.

Transport stress means excitement for the fish. Their respiratory rate increases and so does their requirement for oxygen. Deterioration of water quality during transport increases stress and oxygen depletion. The stocking density in the transport container must therefore be as low as possible to ensure that water quality is maintained at an adequate level throughout the transport period.

An adequate oxygen supply must also be maintained and controlled appropriately at all times. In addition, the excretion of metabolic products by the fish into the transport water must be taken into account and the influence of the outside temperature must be offset.

Animal losses during transport should be recorded by the establishment and regularly evaluated in a quality assurance system in order to improve animal transport.

Moving from one body of water to another can cause stress. Changes in water temperature and quality when moving the animals from the holding water to the water of the transport container and then to new holding water must therefore be avoided as far as possible.

If this is not possible for operational reasons, the fish must be acclimatised to the new water conditions at least as slowly as required to avoid harmful stress.

It is essential that the transporters are adequately trained to carry out the transport and are encouraged to perform regular checks during the transport to ensure the water quality is adequate and to avoid harmful stress as far as possible.

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## 5. Species-specific stunning and slaughter

In the opinion of the ITA, aquaculture animals should, in principle, only be slaughtered after effective stunning. This follows legal regulations in Germany and, with regard to fish, the European Convention for the protection of animals kept for farming purposes.

The ITA advocates the introduction of equivalent regulations for aquaculture establishments worldwide.

Effective stunning before slaughter reduces the pain and suffering of the animals to be slaughtered. The ITA members now consider it to be sufficiently scientifically proven that fish, crustaceans and cephalopods (octopuses) can also experience suffering and must therefore be given a similar level of protection as, for example, chickens or cattle. However, in addition to ethical reasons, aspects of food quality are also a justification for limiting as far as possible the occurrence of stress before the slaughter process.

Any stunning must be carried out in a manner which is legally acceptable, scientifically proven to be effective for the species concerned and carried out in a professional manner.

Stunning methods considered acceptable by the ITA include, for example, electrical stunning and a blow to the head for trout and carp.

Stunning may only be carried out by individuals with the necessary knowledge and skills ("expertise"). According to the German Animal Welfare Act, at least the supervisor must have evidence of this specialist knowledge, which must be presented to the relevant authority.

Good water quality should always be ensured in containers used for holding before stunning or slaughter.

The effectiveness of the stunning must be ensured by inspecting the individual animal following stunning. Checking eye reflex and respiratory movement are usually suitable for this purpose.

In the event of inadequate stunning, the animal must be stunned again immediately.

Slaughter must take place immediately after stunning.

The period between stunning and slaughter must be short enough to ensure that the animals do not regain consciousness before slaughter.

## Concluding remarks

A plethora of indicators and parameters are being cited in the current social debate on better animal welfare in aquaculture. In its work, the ITA concentrates on those aspects that can lead to a scientifically sound improvement in animal welfare for fish and other animals in aquaculture without calling into question the principles of animal production or making its economic implementation practically impossible.

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It is also important to find a reasonable order to priority for suggested improvements.

For example, the use of structures in holding facilities to create retreats and hiding places is being discussed. Such measures may be beneficial for the expression of innate behavioural traits in fish ('enrichment').

However, they must not be allowed to have a negative impact on other aspects of animal welfare, be it through a deterioration of water quality or an impediment to daily inspection.

Scientific approaches are currently being proposed to make aquaculture more behaviourally appropriate by means of shading or new strategies for self-feeding. However, these are not yet developed enough for universal recommendation.

Another conflict that is extremely difficult to resolve is the demand often raised in animal welfare debates for complete control of measures implemented at aquaculture establishments. Even the best audit systems cannot provide this level of monitoring, nor is this the goal of an audit system.

Best practice is always a result of will, skill and action.

In its recommendations, the ITA formulates an ideal scenario for how aquaculture establishments should act in accordance with animal welfare requirements.

The necessary expertise is increasingly being transferred from science and research for practical application.

It is up to the individual establishments to accept and implement this expertise.

It is the task of retail and the consumer to pay a fair price for these efforts.

Measures in line with animal welfare requirements, such as automated monitoring technology, intensive water treatment, fish pumps, appropriate stocking densities as well as the use of mechanised stunning methods require financial resources that will ultimately need to be paid for.

It is vital that an animal can grow up healthy, unharmed and free from harmful stress, damage, suffering and pain and can be slaughtered without avoidable suffering.

Images of neglected and damaged animals are just as undesirable to consumers as inferior fish meat quality.

The present recommendations are intended to contribute to the current social discourse in order to create a common basis for a minimum standard of responsible aquaculture animal handling in line with animal welfare requirements.