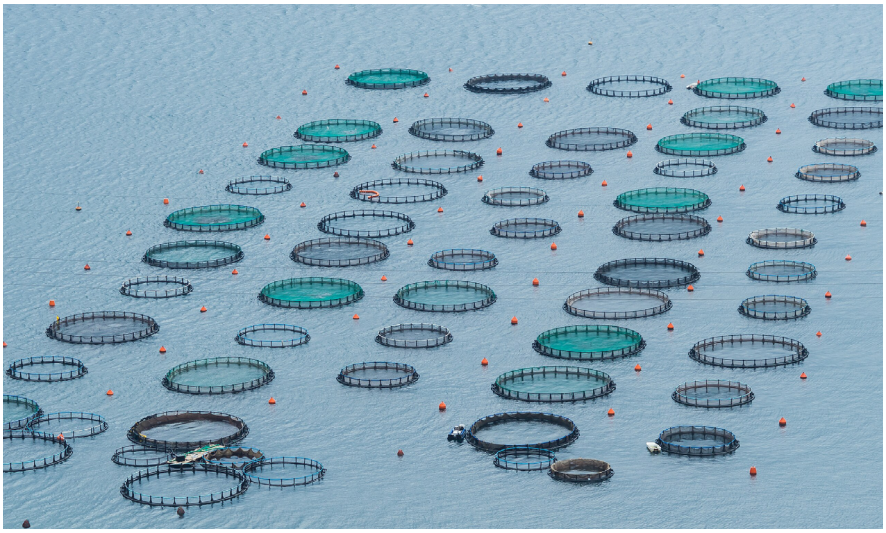
European Commission

Health and Food Safety

OVERVIEW REPORT

Farmed fish welfare



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EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR HEALTH AND FOOD SAFETY

Health and Food Audits and Analysis

Farmed fish welfare

Overview report

P23230

Executive summary

The report describes the outcome of a Commission's two-year study project looking at Member States' and Norway's provisions to ensure the welfare of farmed fish, and any recent developments or plans in this area.

Aquaculture plays a vital role in the EU's food system and blue economy. As the sector grows and consumer expectations rise, concerns have emerged over how fish are treated throughout their lifecycle — including on farms, during transport, and at slaughter. At EU level, fish are only covered by general animal welfare legislation on farm, with specific animal welfare standards and enforcement mechanisms left to Member States' level. In 2024, the Commission designated an EU Reference Centre on the welfare of aquatic animals. The 2023 Commission proposal to revise EU rules on the protection of animals during transport includes specific provisions on aquatic animals. However, mechanisms for fish welfare appear less advanced than for terrestrial livestock. This misconception that fish are not sentient could be a contributing factor.

The study found that:

- *Most countries do not have specific legislation on farmed fish welfare,*
- *Farmed fish welfare is not a priority for most countries. Authorities carry out some official controls on welfare during transport, with fewer checks at farm level (usually in the context of another inspection) and very few checks at slaughter, mainly in the context of animal health inspections. The impact of these official controls on fish welfare is negligible or not visible.*
- *Some countries have developed good practice guidelines specific for species such as salmon, rainbow trout, seabass and seabream. In addition, some private quality assurance schemes include advanced requirements such as risk assessment on farmed fish welfare. The study identified some advanced farm monitoring technologies in Norway and several EU widespread research initiatives, including some that aimed at improving welfare indicators and humane slaughter methods.*
- *The project highlighted several challenges in official controls and enforcement. These include a lack of specific legal requirements, difficulties in reaching and inspecting remote sea farms, inconsistent inspection practices, and varying levels of industry commitment to voluntary welfare measures.*

Overall, Member States have taken steps to improve fish welfare. Their approaches differ significantly in terms of national legislation, inspection systems, impact of the controls and stakeholder involvement. Good practice guides and research are growing across the EU, but their use remains inconsistent. The farmed fish sector is complex. It involves many species, production systems, technologies, and environments. Stronger official controls, better use of digital tools and data, and systematic training would strengthen enforcement and help operators improve welfare standards. Integrated quality schemes, clear welfare indicators, and defined baselines would allow progress to be measured and maintained.

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Abbreviations and definitions used in this report

Abbreviation	Explanation
Animal transport Regulation	Council Regulation (EC) No 1/2005 of 22 December 2004 on the protection of animals during transport and related operations and amending Directives 64/432/EEC and 93/119/EC and Regulation (EC) No 1255/97
EU	European Union

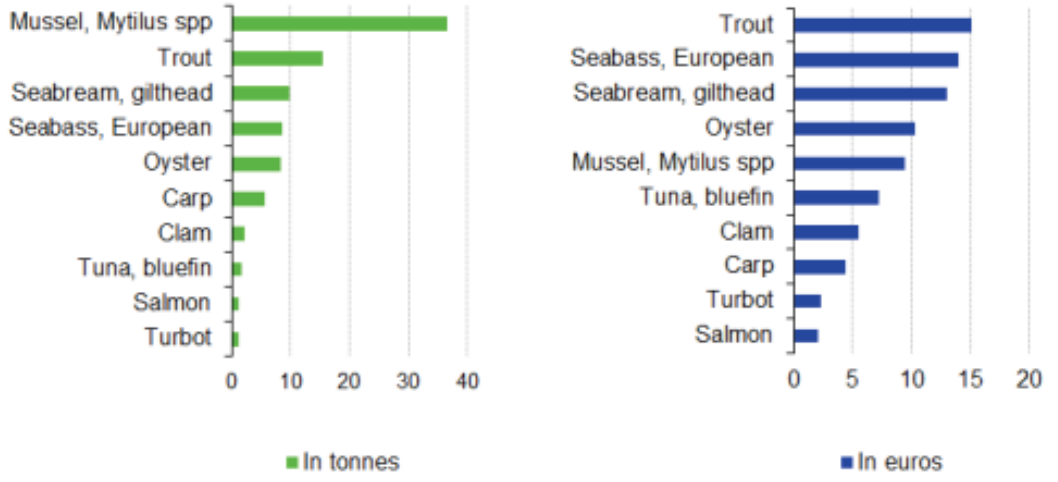
1. INTRODUCTION

Fish are among the most widely farmed animals in the EU — with an estimated over a billion farmed fish slaughtered annually; yet they are often absent from public and policy debates on animal welfare. Fish represent the most diverse and abundant group of vertebrates, with over 34,000 recognised species worldwide, inhabiting a wide range of aquatic environments. This includes all ecosystems, from the icy waters of the poles to warm tropical seas, in both freshwater and highly saline habitats, and from shallow waters to the deepest parts of the oceans. To thrive in these ever-changing environments, presenting a plethora of uncontrollable variables/factors, fish have developed morphological, physiological, and behavioural adaptations. Some species are specialised for stable conditions with minimal changes in salinity or temperature, while others can tolerate a broader range of conditions. Certain fish, such as trout and salmon, require high oxygen levels whereas species like catfish and cyprinids are adapted to survive in oxygen-deprived waters. Additionally, while some fish lead solitary lives, others form large shoals, demonstrating a variety of social behaviours.

Around 600 species of fish and other aquatic animals are farmed globally. However, most of the global production (in terms of volume and value) comes from about 20 to 30 key species, including tilapia, carp, Atlantic salmon, catfish, pangasius, rainbow trout, seabream and seabass.

According to Eurostat, in 2022, the EU's aquaculture produced around 1.1 million tonnes of aquatic organisms, valued at €4.9 billion. This production accounted for about 25% of the EU's total fisheries output. For fish, **salmon, trout, seabass, and seabream** are the main farmed species and Spain, France, Greece, and Italy, collectively contribute more than two-thirds of the total aquaculture output, while Norway remains a key exporter to the EU market.

Main species in aquaculture production
(%, EU, 2022)



Source: Eurostat (online data code: fish_aq2a)

eurostat

Aquaculture plays a vital role in the EU's food system and blue economy. However, as the sector grows and consumer expectations rise, concerns have emerged over how fish are treated throughout their lifecycle — including on:

- farms,
- during transport, and
- at slaughter.

According to the Food and Agricultural Organisation of the United Nations, aquaculture production has grown significantly, accounting for 51% of global aquatic production by volume as of 2020. Fish constitutes over 90% of animals killed for food worldwide. Animal welfare is increasingly seen as an important aspect of corporate social responsibility and part of the sustainable food systems concept. *However, mechanisms for fish welfare appear less advanced than for terrestrial livestock. This misconception that fish are not sentient could be a contributing factor.*

Scientific evidence confirms that fish are sentient and capable of experiencing pain, fear and stress. According to NGO studies, the welfare of farmed fish is an increasing ethical and moral concern to the European public.[1]

2. OBJECTIVES, SCOPE AND METHODOLOGY

This report outlines the result of a two-year project (2023-2024) conducted by the EU Commission's Directorate for Health and Food Audits and Analysis. The **main objective** of this project was to collect information on:

- Member States' provisions to ensure the welfare of farmed fish.
- Current arrangements on the welfare of farmed fish and on any recent developments or plans in this area.

This project also aimed at gathering information on the different production systems and management practices used for farmed fish species, the challenges faced by the operators and competent authorities, their impact in fish welfare, current or potential use of animal welfare indicators and good practices from industry and official services in protecting farmed fish welfare.

The **scope** of the project included:

- Farmed fish production.
- The EU Member States and Norway.
- National policies and guidelines on welfare.
- All stages of production from breeding to slaughter: breeders, larva rearing, pre-fattening, juvenile transport, fattening and harvesting.
- All aspects with potential repercussions in fish welfare, such as husbandry and transport practices, health issues and use of anti-microbials and other veterinary drugs.
- Freshwater and marine production.

[1] Eurogroup for Animals and Compassion in World Farming (CIWF) / Sapience Analytics (2024) – *Public attitudes to aquatic animal welfare*. Public attitudes to aquatic animal welfare | Eurogroup for Animals ; Eurogroup for Animals & CIWF / ComRes (fieldwork 30 Apr–8 May 2018; published 2019) – *European public perceptions of fish welfare.* European Public Perceptions of Fish Welfare | Eurogroup for Animals

- All farmed fish species, but with a focus on salmon, seabream, rainbow trout, seabass and common carp.
- All types of fish production (e.g. pen, pond, etc.).
- Industry and other stakeholders' arrangements to protect/promote animal welfare.

The scope excluded species other than fish.

The **methodology** of the project included six fact-finding missions (Norway, Germany, Greece, Denmark, Spain and Finland), data analysis from Commission's databases (e.g. Trade Control and Expert System), bibliographic research and exchange of views with experts.

3. BACKGROUND

3.1. Legislative and policy framework

Fish farming is an important part of animal production in the EU. In recent years, there has been an ongoing production of scientific studies and publications to help understand and evaluate fish welfare. To date, main challenges are the great diversity of fish species farmed under very different conditions (production systems), and that scientific data in this field is still limited and hard to compare.

At EU level, fish are covered by general provisions in the animal welfare legislation:

- Council Directive 98/58/EC[2] concerning the protection of animals kept for farming purposes includes fish under its general provision but does not lay down specific rules for farmed fish.
- Council Regulation (EC) No 1099/2009[3] on the protection of animals at the time of killing includes fish under its general provision but does not lay down detailed stunning/killing methods for fish.
- Council Regulation (EC) No 1/2005[4] on transport applies to all vertebrates, including fish. However, it offers limited practical guidance specific to fish transport. In 2023, the Commission proposed a revision of Council Regulation (EC) No 1/2005 which includes proposed specific provisions for aquatic animals. The legislative proposal is currently being examined by the European Parliament and the Council.

The EU Regulation on Organic Production[5] sets out more specific requirements on welfare of farmed fish, such as maximum stocking-density levels, restrictions on the use of artificial light and oxygen, etc.

International organisations have also contributed. In 2005, the Council of Europe adopted a recommendation concerning the welfare of farmed fish[6] and

2 Directive - 98/58 - EN - EUR-Lex
3 Regulation - 1099/2009 - EN - EUR-Lex
4 Regulation - 1/2005 - EN - EUR-Lex
5 Regulation (EU) 2018/848
6 Recommendation concerning Farmed Fish of the European Convention for the Protection of Animals kept for Farming Purposes. https://www.coe.int/t/e/legal_affairs/legal_co-

in 2008, the World Organisation for Animal Health adopted guiding principles for fish welfare[7]. In addition, many national authorities, NGOs and industry organisations have developed codes of practice, quality assurance schemes and guidelines to promote good welfare.

In 2023, DG Health and Food Safety of the European Commission initiated the two-year project culminating in this overview report, aiming to inform future EU policy and stakeholders on this area. In January 2024, the European Commission established the fourth EU Reference Centre for Animal Welfare, specifically dedicated to the welfare of aquatic animals[8]. This centre supports Member States with technical advice and helps improve official controls. It will also provide scientific and technical input, develop tools and indicators to assess and enhance welfare, and promote good practices across the EU.

3.2. Main production systems

In the EU, the main production systems used in fish farming (aquaculture) vary depending on the species, geographic location, and available resources. However, the most common methods of production include:

- **Pond system**: one of the oldest and most widespread methods of aquaculture, especially in Europe. It is mainly used for carp and other freshwater species. Widespread, especially in Central and Eastern Europe (e.g., Germany, Poland, Hungary, Czech Republic). While cost-effective, it presents low productivity compared to intensive systems and is susceptible to environmental factors like weather changes and predation from birds and otters. A recent Commission study[9] concluded that aquaculture in ponds and wetlands can bring significant environmental benefits.
- **Flow-through system**: commonly used for trout (especially rainbow trout) in regions with access to clean, flowing freshwater such as Alpine areas in France, Italy, Spain, and parts of Scandinavia. It offers good oxygenation and waste removal.
- **Recirculating aquaculture system**: increasingly used for high-value species like eel, sturgeon, salmon (smolt), and more recently for catfish and seabass/seabream. Found across the EU, especially in countries investing in sustainable technologies. Recirculating systems are closed-loop systems that filter and reuse water, offering high biosecurity and environmental control and therefore low environmental impact. It has high capital cost.
- **Sea pens (marine net pens) system:** mainly used for Atlantic salmon, seabass, and seabream in coastal areas of Ireland, Greece, Spain, and Italy, as well as in Norway (biggest salmon producer in the world). Fish are reared in large pens in coastal waters. It is an efficient system for large-scale production but presents environmental and disease management challenges.

operation/biological_safety_and_use_of_animals/Farming/Rec%20fish%20E.asp

7 WOAH SONT

8 EURCAW Aqua - Home

9 Assessment of the ecosystem services of bivalve mollusc farming and fish farming in ponds and wetlands, and challenges and opportunities in promoting the benefits - Publications Office of the EU

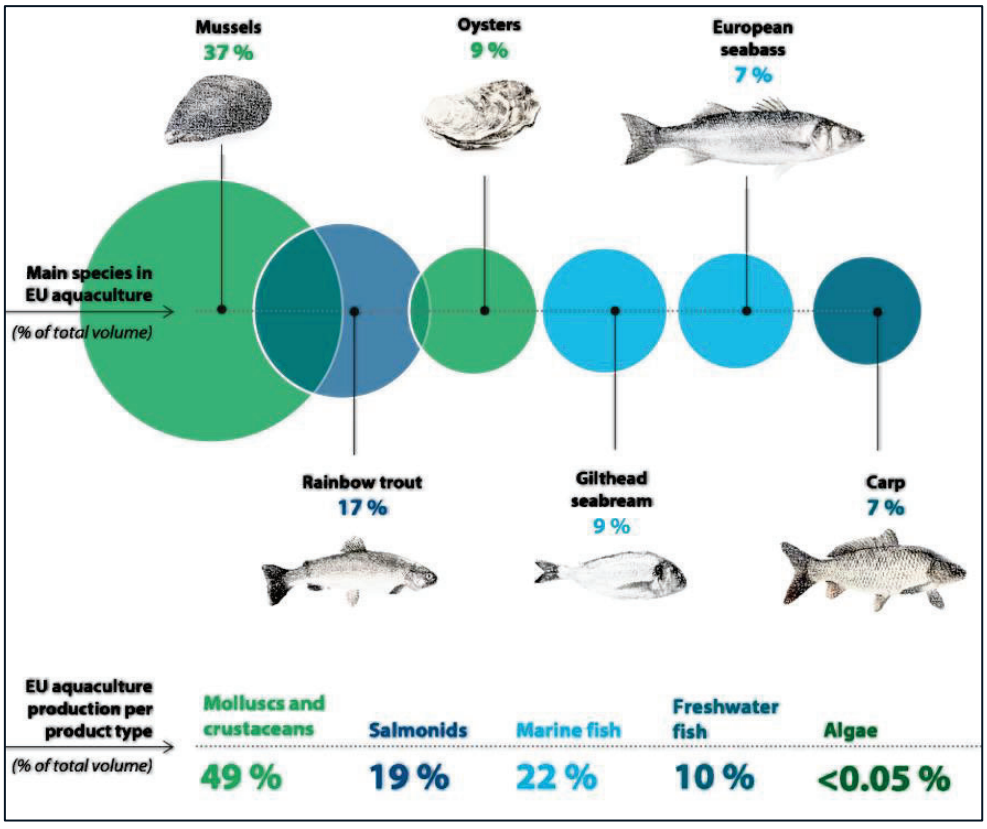
3.3. Country-specific aquaculture profiles

NORWAY

In 2022, Norway produced approximately 1.51 million tonnes of farmed Atlantic salmon, surpassing the combined aquaculture output of the entire EU. The production cycle from the hatching of an egg until the salmon is ready for harvest takes two to three years. During this production process, the salmon undergoes different life stages that require different facilities. Flow-through freshwater facilities for producing salmon during the early life stages have been used for decades, but the use of freshwater recirculating systems has now become increasingly common in the aquaculture industry.

GERMANY

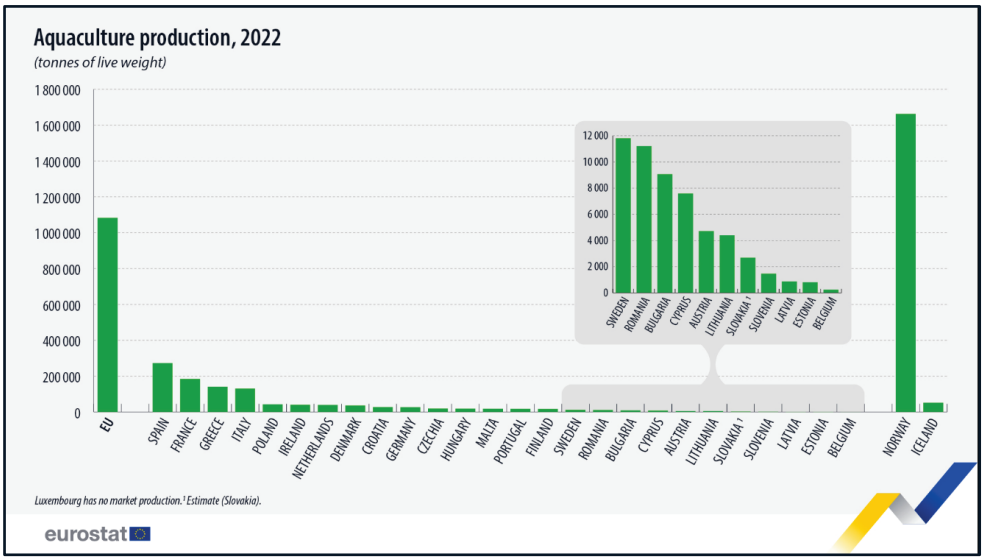
- In 2019, Germany produced around 18 500 tonnes of edible fish, including 5 086 tonnes of carp and 10 427 of trout.
- Predominantly family-owned and very small-scale operations.
- Production systems range from semi-natural, extensively managed ponds to flow-through farms and closed water cycle systems.
- Species: carp (raised in natural or artificial ponds over 23 000 hectares), trout and other salmonids (in closed cold water farms), and warm fish species such as African Wels catfish, European eel, and European Wels catfish (in recirculating systems with heated water).



Source: European Court of Auditors.
Special report 25/2023: EU aquaculture policy –
Stagnating production and unclear results despite increased EU funding

GREECE

- Mainly small to medium-scale enterprises. A few large-scale firms produce over 5 000 tonnes/year, but 80% of producers produce less than 1 000 tonnes annually. In 2021, the total production was 119 000 tonnes of seabream and seabass. In the same year there was a total production of approximately 346 million juveniles of seabream and seabass in 24 hatcheries in the country.
- Predominantly sea pen farming.
- Main species: seabream (*Sparus aurata*) and seabass (*Dicentrarchus labrax*). The country is the biggest aquaculture producer in Europe and the second biggest in the world for these species. Other species include *Argyrosomus regius* (meagre, also known as croaker), *Pagrus spp* (porgies or seabreams), *Diplodus puntazzo* (sharpsnout seabream) and *Seriola dumerili* (greater amberjack).
- More than 80% of the production is marketed outside Greece. Approximately 93% of the volume is marketed in the EU and 7% in the rest of the world.



Source: Eurostat. News articles 30 April 2024

DENMARK

- In 2021, over 190 salmonid farms produced close to 39 000 tonnes; three eel farms produced approximately 1 200 tonnes; other species include amberjack, zander, sunshine bass and sturgeon.
- Production focus: salmonids, mainly rainbow trout.

SPAIN

- Total fish production is approximately 55 000–65 000 tonnes/year.
- Production is mainly marine species in sea pens (47 sea farms for fattening). With hatcheries and pre-fattening for all species in land-based facilities.

- The main marine species (in decreasing order) are seabass (Dicentrarchus labrax, around 20 000 tonnes/year), Atlantic bluefin tuna (*Thunnus Thynnus, around 12 000 tonnes/year*), turbot (*Psetta maxima, around 8 000 tonnes/year*), gilt-head seabream (*Sparus aurata, around 7 000 tonnes/year*) and meagre (*Argyrosomus regius, around 2 000 tonnes/year*).
- Freshwater production is limited to rainbow trout (Oncorhyncus mykiss, around 7 000 tonnes/year) and takes place exclusively in land-based facilities.

FINLAND

- In 2022, total production of rainbow trout was close to 15 300 tonnes, followed by European whitefish (approximately 800 tonnes) and some smaller-scale production of brown trout, arctic char, zander and sturgeon. Fish for restocking the natural environment accounted for about 5 million individuals.
- Rainbow trout accounts for 95% of aquaculture production.
- 75% of fish farming operations are inland and 25% at sea. In terms of production, only 3 000 tonnes are produced annually inland.

Data can also be found on Country information | EU Aquaculture

4. FINDINGS AND CONCLUSIONS

4.1. Regulatory framework - National arrangements

Across the countries visited, the legal framework for fish welfare varies significantly in both scope and enforceability.

Denmark, Greece and Spain have no national rules beyond the EU requirements on fish welfare.

In Germany, the Animal Welfare Act mandates fish farmers to monitor animal welfare indicators. However, the obligations are vague and without defined indicators nor thresholds. The General Administrative Regulation for the Implementation of the Animal Welfare Act requires authorities to consider the Council of Europe's recommendation concerning farmed fish when inspecting aquaculture farms. For transport, although regulations exist, terms like "adequate" water quality remain undefined, which subsequently makes them difficult to enforce.

In Norway, a critical aspect of regulating animal welfare for farmed fish is the banning of harmful practices by law. For example, the use of carbon dioxide (CO_2) for stunning has already been banned since 2010 based on this regulation. National legislation also requires operators to perform a comprehensive risk analysis for animal welfare including for farmed fish. This applies to both their production processes and systems, as well as the development of new technologies. In addition, Norway has a broad legal framework covering many aspects of fish farming. These include staff knowledge of fish animal welfare, water quality, stocking density, alarm and back-up systems, feeding, handling and care, stunning and killing, internal

control, notifications of serious welfare incidents and reporting on high mortality. However, most of these provisions are general in nature. They lack detailed, legally enforceable requirements tailored on fish welfare.

Finland stands out for having adopted dedicated fish welfare legislation since 2010.

Example of good practice: Finland

Finland introduced specific fish welfare legislation in 2010. These national rules go beyond EU standards and include several clear, specific and legally enforceable welfare measures that fish farms must implement. Key provisions include:

- Daily welfare checks: operators must inspect fish welfare and the rearing environment at least daily, unless weather conditions or rearing methods prevent it.
- Equipment monitoring: operators must check all equipment critical to fish health daily. Such equipment must be fitted with alarms for malfunctions and have backup systems where necessary. Alarm systems must be tested regularly.
- Water quality alarms: recirculating aquaculture systems must have alarms that are triggered by low oxygen levels.
- Behaviour and health monitoring: daily inspections must assess abnormal behaviour, lesions, signs of disease, and increased mortality.
- Feeding: operators must monitor the effectiveness of feeding — especially for juveniles — and avoid sudden changes unless necessary for fish welfare.
- Handling should be minimised and, when necessary, carried out in a way that reduces stress. Fish must be supported properly, preferably kept in water, and may be sedated or anesthetised.
- Packing live fish in ice is not an allowed practice.
- Transport conditions are regulated: the water quality (oxygen, CO_2, temperature, pH) must be carefully managed during fish movements

Conclusions

National rules on fish welfare vary and most countries rely on general EU provisions or non-specific national measures. Finland is the only country visited with detailed, enforceable welfare rules covering key aspects of fish farming. Therefore, it is likely that the level of fish welfare varies across the EU, due to differences in national legislation and the general nature of some EU requirements, which may lead to different interpretations and implementation.

4.2. Official controls

The organisation of official controls on fish welfare varied across the countries visited. Most national systems did not yet include routine, dedicated checks on fish welfare at farms or at slaughter. In the cases where such checks took place, they were usually integrated into fish health inspections or conducted

on an ad hoc basis, for example following complaints or indications of welfare issues:

- In Greece, some local authorities have started using a joint checklist covering both fish health and welfare, including aspects such as stunning and killing methods, the use of welfare indicators, and references to transport requirements under Regulation (EC) No 1/2005. One region has developed a comprehensive checklist covering environmental conditions, handling, feeding, and slaughter. While not all these elements are legally enforceable, the tool offers a structured approach to fish welfare assessment at farm level.
- In Finland, routine fish health inspections include observations of fish behaviour and conditions, potentially identifying welfare issues, and plans are in place to extend these to systematic fish welfare monitoring within five years.
- In most regions of Denmark, Spain and other countries there are no specific welfare checks at fish farm level or at slaughter. In Spain, farm inspections focus on animal health and hygiene, covering some aspects of welfare. A national checklist is being developed to harmonise future controls, whereas one region already applies parts of Directive 98/58/EC to welfare checks. Similarly, in Germany, welfare is checked jointly with health, although risk assessments and procedures are not always tailored to fish welfare specifically.

Controls on transport are more widely implemented. Authorities generally apply Regulation (EC) No 1/2005 to fish and have started to include fish-specific aspects in their transport checks. Denmark, Greece, and Spain have created checklists or guidance tailored to fish transport. These tools often combine legal obligations for all live vertebrates with recommendations from the 2020 fish welfare guidelines developed under the EU Platform on Animal Welfare. However, these checklists often lack defined threshold values for key parameters like water oxygen, temperature, or stocking density, requiring inspectors to rely on behavioural indicators and the transporters' explanations on how they maintain welfare conditions during the journey:

- In Greece, the transport checklist provides detailed guidance on loading, fish fitness for transport, and vehicle assessment.
- In Denmark, these checks began in 2022 and are based on a national checklist and guidance.
- In Spain, transporters use insulated and, in some cases, refrigerated tanks, and monitor oxygen and temperature levels.
- Fry suppliers typically determine transport densities, as economic incentives encourage careful handling.

The level of technical expertise and the availability of detailed procedures for conducting fish welfare controls differs between countries and regions. In most countries, competent authorities have some knowledge of fish welfare at both central and local level. However, strengthening training for official staff and updating or developing tailored procedures would strengthen their effectiveness. Finland is planning to include systematic fish welfare

monitoring in future national controls, building on the fish health inspections already in place.

The level of technical expertise and support tools for fish welfare controls also varies across countries. In all countries visited, competent authorities had some knowledge of fish welfare at both central and local levels. However, many acknowledged the need for updated procedures and additional training for official staff:

- Some regions in Germany and Norway have developed detailed control procedures for fish welfare.
- Norway stands out for having inspectors specialised in fish health, who have taken enforcement action in cases of poor welfare.
- Finland plans to expand its official controls to include systematic fish welfare monitoring as part of future national inspections, complementing its existing fish health checks.

Example of good practice: Norway - use of data to monitor fish welfare

Norway developed two new promising data-support tools for fish welfare. Both collect and analyse data to assess welfare status and support evidence- and risk-based decision-making.

Laksvel: the project finished in 2022 and published a protocol, a standardised method for routine welfare monitoring in fish farms:

- Focuses on salmon in sea-based farms.
- Standardises and simplifies operational welfare indicators.
- Includes a broad set of measurable welfare indicators.
- Currently used by a few companies.
- Plans include modelling more variables (e.g. sea temperature, feed intake, mortality, delousing).

Institute of Marine Research's risk model:

- Applies at production area level; can be adapted to site level.
- Requires new data sources and inter-agency cooperation.

Conclusions

The lack of harmonised practices and minimum requirements across Member States limits consistent enforcement of fish welfare requirements and may weaken fish welfare outcomes, particularly on farm and at slaughter.

Where used, dedicated checklists and regular, welfare-specific, checks are likely to improve outcomes.

Gaps in technical knowledge, clear procedures and specialised tools in the official controls systems of most visited countries indicate that fish welfare controls are less developed than those for other farmed species.

4.3. Other measures to protect the welfare of farmed fish

4.3.1. Industry-led practices

Some salmon farming companies in Norway use advanced remote system to monitor fish behaviour and health across sites. These technologies also offer potential for use by competent authorities and for expanding welfare monitoring.

In one region in Norway, producers set a mortality threshold as a self-regulated welfare indicator. Regular monitoring against this limit helped them keep mortality levels within those self-regulated limits and preventing sudden changes. This is a good example of how industry-led initiatives can effectively complement legislation.

A Norwegian firm managing the feeding in several salmon farms uses advanced remote surveillance, including underwater cameras and automatic controls to remotely monitor and manage multi-site feeding. Sudden increases in mortality or abnormal behaviour are used as early warning signs. Remote management of feeding and the underwater imaging systems to monitor fish at individual as well as group level (e.g. behaviour, signs of injuries, diseases, etc.), facilitate the operators' knowledge of the health and welfare status on the farms and offer potential for use by competent authorities and for expanding welfare monitoring.

Fish producers and transport operators in several countries monitor water temperature, oxygen flow rate and dissolved oxygen concentrations. They use alarm systems to detect when the oxygen flow rate drops below a certain limit and have backup air compressors to pump oxygen into the tanks and protect fish during transport.

4.3.2. Research and innovation

In Germany, the NatiMon project is developing indicators for rainbow trout and carp farms (e.g. mortality, dissolved oxygen levels, physical condition and swimming behaviour). It will provide guidance but not specific welfare thresholds.

In Spain, a large producer began a pilot project to introduce electrical stunning for seabass and seabream, aiming for full implementation by the end of 2027. Another project is identifying welfare indicators for key farmed species in Spain.

In Greece, the competent authority works with academia to improve the welfare of farmed fish, focusing on transport and slaughter practices, and has designed and implemented training for farm workers and official inspectors. In addition, a large producer is using electrical stunning for seabass and seabream, following the requirements of the organic standard as well as requirements of some of their customers.

Finland has several projects aiming to improve fish welfare. These focus on identifying welfare issues, developing indicators, and offering guidance. A recent project included a stakeholder survey, and it highlighted concerns such

as carbon dioxide stunning, high mortality, and limited training. It stressed the need for better indicators and systematic monitoring.

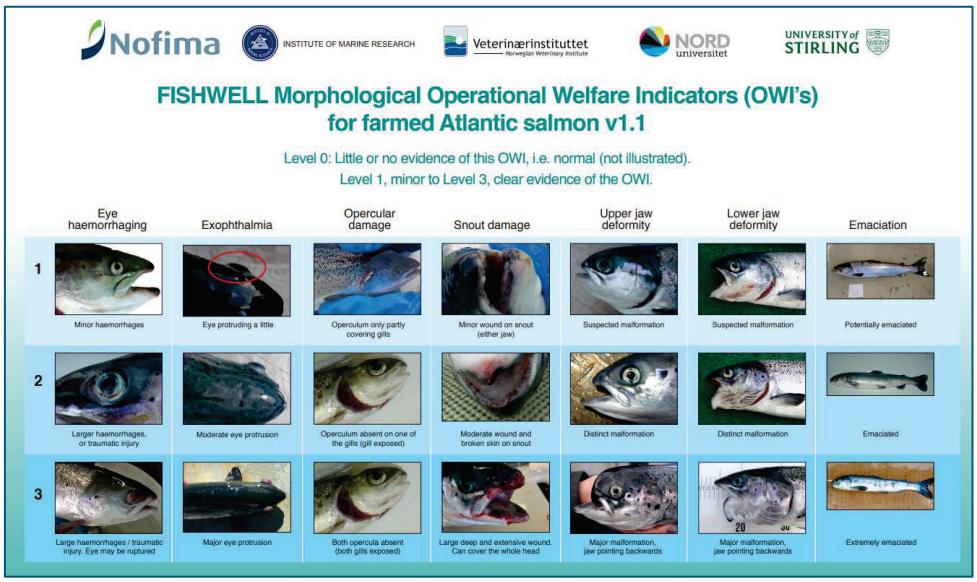
A voluntary group under the EU Platform on Animal Welfare published 'Guidelines on Water Quality and Handling for the Welfare of Farmed Vertebrate Fish'. These voluntary guidelines, based on the Council of Europe recommendation, aim to assist aquaculture operators and authorities and support potential future legislation. The group also developed species-specific annexes, but not all initiative members supported them and therefore they were not published.

Horizon Europe "EU Partnership on animal health and welfare"[10] - launched in January 2024 and co-funded by the Commission and the EU Member States - covers many R&I projects on aquatic animal welfare.

Information on research projects can also be found on Knowledge base | EU Aquaculture

4.3.3. Guidance and standards

Norway: the FISHWELL handbooks offer practical welfare indicators for farmed salmon and rainbow trout, constituting a practical, farm-friendly toolbox of operational and laboratory-based welfare indicators. They also offer guidance on how to implement and interpret these indicators across various production systems and farming practices. They cover routine farming, handling and slaughter, and are widely considered a comprehensive reference for operational and laboratory-based indicators. They present practical welfare indicators tailored to various production systems, such as sea pens and flow-through systems. They also offer welfare indicator toolboxes for specific farming operations like pumping, crowding, grading, vaccination, and slaughter.



Poster from Norwegian food research institute Nofima on operational welfare indicators (source: Nofima website- downloaded Nov 2025)

[10] EUPAHW - Home

Greece: the association of farmed fish producers published "Mediterranean fish welfare: Guide to good practices and assessment indicators". The authority adopted and distributed the guide, which focuses on the needs of European seabass and gilthead seabream in different production phases. The guide lists operational and laboratory welfare indicators, proposes corrective measures and covers several production systems, phases and husbandry practices.

More recently, a Greek University published a Welfare assessment study for European seabass. The study suggests welfare indicators and thresholds and explains what to consider when assessing risks, i.e. the acceptable level of risk and most important factors to consider. It offers a welfare assessment system that can be easily used and understood by fish farmers, regulators, and others involved in aquaculture.

In **Germany,** there is an industry produced guidance on water quality for salmonids and carp. However, uptake is very limited, and mortality remains the most used indicator, often without proper recording.

Spain: the Spanish Aquaculture Business Association published a Fish Welfare Guide in 2022[11], developed with government, industry, and research input. It recommends humane stunning methods like electrical or percussion and lists physical, behavioural and environmental welfare indicators. The association published species-specific welfare guides in 2024 and 2025 for seabass, seabream, and rainbow trout and intended to publish a guide on turbot.

4.3.4. Use of indicators

Across the countries visited, operators most commonly monitor mortality, water temperature, oxygen levels, and fish behaviour, especially during feeding or handling. These are used to assess both productivity and, to some extent, welfare. In practice, however, welfare is not yet systematically integrated into process controls.

Some companies are exploring broader indicators for fish welfare. In **Greece**, one firm uses a photographic tool to classify physical defects at harvest (e.g. haematomas, missing gill covers). While intended to improve product quality, this tool could also help detect welfare issues — though scientific benchmarks for welfare interpretation are lacking.

In **Finland**, operators use feed conversion ratios and behavioural observations as informal welfare indicators. A low feed conversion rate may signal reduced

[11] Spain (APROMAR, co-financed by the Ministry of Agriculture, Fisheries and Food of the Government of Spain and the European Maritime and Fisheries Fund of the European Union) developed 3 fish welfare guidelines:

- A guide on Fish Welfare in Spanish Aquaculture - Volume 1: Concepts and generalities | EU Aquaculture
- A guide on Fish Welfare in Spanish Aquaculture - Volume 2: Welfare on European sea bass | EU Aquaculture
- A guide on Fish Welfare in Spanish Aquaculture - Volume 3: Welfare of gilthead sea bream | EU Aquaculture

stress and good feeding conditions. In flow-through systems, farms also monitor oxygen levels and adjust water flow to counter high temperatures.

4.3.5. Public and private standards

The Spanish Association for Standardisation (UNE) published several public voluntary standards. These include:

- UNE 173300 (2016) on slaughter practices, but it controversially allows chilling in ice water as a stunning method, which the WOAH considers only a killing method.
- UNE 173201:2010 on good hygiene practices in marine aquaculture. It includes elements that support fish welfare, such as proper equipment and staff training.
- UNE 173002 on organic trout farming. It includes welfare-relevant requirements like oxygen level and stocking density limits.

Private standards relevant to fish production may be developed individually (e.g. by a supermarket chain) or collectively through alliances of companies. Non-profit organisations also set third-party certification schemes. The project examined some private standards in the countries visited.

The most notable were three accredited voluntary quality schemes that include fish welfare requirements across the production chain. These are:

- International standard: this includes general requirements on fish welfare across process steps such as feeding, grading, fasting, harvesting and slaughter. However, it does not require positive welfare measures like environmental enrichment. It identifies six core obligations: risk assessment and strategy setting for fish health and welfare, development of a veterinary health plan, monitoring fish health and welfare and protecting fish from pain, stress and injury at all times. It emphasises fish welfare risk assessment throughout production, from hatchery to slaughter, with documented mitigation measures, which is considered a potential good practice.
- Organic standard: this requires adequate oxygen supply during transport and while fish are kept in pens. It limits transport density to 1 kg of fish per 8 litres of water, mandates water changes at the latest every six hours with water of the same temperature and limits total transport time to ten hours. Stunning must be by concussion or electrocution. It sets requirements for stocking density for some species (e.g. for salmon) but not for seabass and seabream. It recommends regular review of environmental enrichments options to improve welfare further.
- Greek National standard: developed by the national association of farmed fish producers, this standard includes general welfare requirements and mandates documented procedures and record-keeping throughout the production cycle. It addresses mortality monitoring, feed control, and stress-reducing practices. It has been adopted by 21 of the 22 association members, covering approximately 80% of national production. Plans are underway to revise the standard with more specific welfare guidelines.

In some of the countries visited, competent authorities and operators acknowledged that implementing welfare standards support market access and that operational improvements are possible by introducing standardised procedures. In others, limited market interest has resulted in limited adoption of such standards.

Example of good practice: international private certification scheme

- The scheme requires a risk assessment focused on fish welfare.
- It aims to identify key welfare threats across all production stages, from hatchery to slaughter.
- It promotes the management of these risks, helping producers improve conditions for fish handling and care.
- By fostering a culture that values animal welfare, the scheme enables producers to identify critical risk areas and apply monitoring procedures, control measures, and corrective actions.
- With this strategy in place, welfare issues can be effectively controlled, reduced, or even eliminated.

Example of good practice: electric stunning of seabass and seabream by a Greek producer

Electric stunning (instead of the common EU practice of immersing these fish in an ice-water mixture) is being voluntarily trialled by some Greek producers for seabass and seabream. This practice is already used for Atlantic salmon, rainbow trout and carp. One producer is using it on a small scale, following requirements of some customers. In this context it is useful to note that:

- The method aims to anesthetise fish immediately after pumping from sea pens, before placing them in ice baths.
- Electric stunning supports EU animal welfare objectives by providing immediate loss of consciousness before killing.
- Knowledge gaps remain regarding the correct parameters for effective stunning across species and fish sizes, underlining the need for further research.
- The method requires significant investment and presents safety risks for operators.
- Stunning must take place at sea on specially equipped vessels, which can be costly—particularly for small and medium-sized producers.

Conclusions

Industry-driven efforts (e.g. in Norway) show that voluntary use of mortality limits and monitoring tools can be effective in improving fish welfare. Technological systems like remote cameras and feeding controls offer valuable insights but are not yet fully leveraged for welfare monitoring. Research projects across Europe are helping define welfare indicators, though most lack enforceable thresholds or standardised use.

Practical guidance and handbooks are available in several countries, but adoption varies, and usage is often focused on productivity rather than welfare.

Mortality and environmental conditions are the most common indicators, but many farms do not consistently record or act on these from a welfare perspective.

Private and voluntary standards provide general welfare guidance, but specificity and adoption depend on national context and market interest. Welfare is increasingly recognised as an important aspect by producers, authorities and consumers but structured, systematic approaches remain inconsistent across operators and countries. Overall, voluntary initiatives, research projects, and private standards contribute to improvements in farmed fish welfare, particularly in areas like monitoring, handling, and transport. However, uptake is uneven across countries and producers, and welfare is still not systematically integrated into daily management. While awareness is increasing, consistent implementation and measurable outcomes remain limited.

4.4. Challenges

Ensuring the welfare of farmed fish presents multifaceted challenges across the aquaculture sector:

- Defining and measuring welfare: a fundamental challenge lies in the absence of consensus on what constitutes acceptable, satisfactory or superior fish welfare. While monitoring parameters like mortality rates and growth performance are common, these metrics often prioritise productivity over welfare. In most of the cases the monitoring is just a means of ensuring productivity. The lack of standardised welfare indicators complicates efforts to assess and compare welfare conditions across different farms and regions.
- Technological complexity and data integration: the proliferation of diverse technologies and data sources in aquaculture adds complexity to welfare assessment. Integrating data from various monitoring systems to obtain a coherent picture of fish welfare remains a significant hurdle. Moreover, some technological interventions aimed at improving welfare may inadvertently introduce new stressors or challenges.
- Inspection limitation: In countries like Norway, the rapid advancement of aquaculture technologies and the offshore location of many farms diminish the effectiveness of traditional on-site inspections. Adverse weather

conditions and logistical challenges further hinder regular and thorough welfare assessments.

- Lack of scientific standards: during site visits, the project team observed instances of physical injuries such as skin lesions, fin damage, and gill issues. Operators often attribute these to minor incidents or healing processes. However, the absence of established scientific standards for interpreting such findings complicates the evaluation of fish welfare during inspections.
- Knowledge gaps and training needs: there is a notable shortage of specialised knowledge among competent authorities and farm operators regarding fish welfare. This gap extends to understanding species-specific needs and implementing appropriate welfare practices. Training programs for staff and inspectors are limited, impeding the adoption of welfare-friendly practices.
- Environmental and climate challenges: factors such as temperature fluctuations, oxygen levels, and water quality significantly impact fish welfare. The interplay of these factors with stocking densities and species-specific needs is complex and not fully understood. Climate change exacerbates these challenges by introducing more frequent extreme weather events and altering aquatic ecosystems.
- The generic nature of existing laws fails to address species-specific welfare requirements[12]. Additionally, the absence of standardised welfare indicators and thresholds hampers regulatory oversight.
- Industry concerns and market pressure: industry stakeholders express concerns about the potential economic impact of stringent welfare regulations, especially if such standards are not uniformly applied to imported products. There is apprehension about competitive disadvantages and market distortions arising from unequal regulatory requirements. Stakeholders also warn against the introduction of regulatory provisions that are not sufficiently tailored to the specific conditions of each production site, including differences in species, production systems, equipment, climate, and available technologies.
- Disease management and biosecurity: emerging diseases, such as betanodavirus infections and parasitic infestations, pose significant threats to fish welfare. Rising water temperatures due to climate change exacerbate these issues. The lack of licensed therapeutic substances and effective vaccines complicates disease management.
- Predator interactions: the increasing populations of predators, including protected species like cormorants and otters, present challenges for aquaculture operators. These predators can cause significant harm to farmed fish, leading to welfare concerns and economic losses.

[12] The EU regulation on organic aquaculture production can be considered an exception as it sets out some production parameters for aquaculture under Annex II, Part III of Regulation (EU) 2018/848, including welfare considerations relating to stocking density. Transport welfare obligations for live fish are also addressed within the main body of the same Regulation. Commission Implementing Regulation (EU) 2020/464 further details maximum stocking densities per species and certain production system conditions

- Slaughter practices: in several European countries, common slaughter methods such as asphyxiation in ice water are still prevalent, despite evidence of prolonged suffering and delayed loss of consciousness in fish. The lack of standardised, humane slaughter practices contributes to the continued use of inhumane methods.

In a few cases during visits across different fish production stages, the study team observed various injuries that can indicate fish welfare concerns (e.g. skin scars, fin and tail damage, ulcers and gill issues). Operators claimed the overall fish condition was satisfactory, attributing injuries to healing diseases or contact with equipment like nets. However, authorities acknowledged the difficulty in interpreting these findings due to a lack of established scientific standards and methods to assess fish welfare during inspections.

The study team also noted instances of inadequate stunning and killing, where some fish were not properly stunned or killed, and some regained consciousness after bleeding. In another case, an operator was supplying fish to a large supermarket chain which followed a private standard scheme with quality and food safety specifications and some generic welfare requirements. One of those was referring to respecting the five freedoms (animal welfare concept). Nevertheless, the quality team of the operator did not know about that concept.

Conclusions

The welfare of farmed fish faces a broad range of challenges that present both opportunities and threats for the aquaculture sector. Advances in technology and increased attention to welfare issues provide potential for improved assessment and management. However, scientific/knowledge gaps, non-tailored regulatory frameworks, and inconsistent enforcement contribute to ongoing welfare concerns and variability across production systems. These factors may result in reduced animal welfare standards and unequal market conditions within the sector.

5. MATTERS FOR CONSIDERATION BY MEMBER STATES

(1) **Include fish welfare in national official control strategies**: consider incorporating farmed fish welfare, including at slaughter, into Multi-Annual National Control Plans. Where necessary, establish a systematic approach to plan and conduct official controls, considering site conditions, species, and production systems.

(2) Include fish welfare in the National Strategic Plan for Aquaculture in case this has not been done yet.

(3) **Support the development of concrete, applicable, and verifiable welfare requirements:** encourage the formulation of legal provisions and standards that are specific to the species farmed, the technologies used, and the production environment together with clear thresholds and baseline levels. This would support consistent enforcement and provide clearer compliance expectations for operators.

(4) **Invest in training and build expertise in fish welfare:** provide targeted training for official inspectors and farm personnel on fish welfare science, species-specific needs, and relevant assessment techniques. This would improve the effectiveness of welfare evaluations and promote better on-farm practices.

(5) **Enhance the use of monitoring data for welfare oversight**: promote the systematic collection and analysis of welfare-related data by operators, including behavioural indicators and mortality. Use this information to identify high-risk farms and prioritise official controls accordingly.

(6) **Encourage applied research to address identified welfare challenges**: support research into the development and refinement of technologies and practices that improve fish welfare, including humane slaughter methods and welfare indicators that go beyond productivity. Use existing research outcomes to support requirements.

(7) **Facilitate the development and exchange of good practices**: promote the identification and sharing of effective welfare practices across regions and production systems, including through voluntary industry initiatives or codes of good practice developed by producer organisations. Facilitate exchanges with Member States where good practices are implemented.

(8) **Improve accessibility to remote farms:** Develop innovative methodologies to consistently monitor fish welfare in remote sea farms.

6. ACTIONS FROM THE COMMISSION

Improving the welfare of farmed animals is one of the priorities of the European Commission.

The "*Strategic guidelines for a more sustainable and competitive EU aquaculture for the period 2021 to 2030*"[13] – adopted by the Commission in May 2021 – identified animal welfare as an area for further work for the Commission, Member States and the Aquaculture Advisory Council.

In the context of the implementation of the Strategic guidelines the EU Aquaculture Assistance Mechanism (a contractor that assists the Commission in implementing the Strategic guidelines) developed two documents* that are available on the EU aquaculture website[14]:

– "Code of good practices on fish welfare and fish welfare indicators"[15] that outlines non-species-specific best practices for fish welfare and indicators used in welfare assessment in the EU, applicable across different life stages and production methods.

[13] COM(2021)236 final

[14] The Aquaculture Advisory Council is organising webinars on these documents to widely disseminate the information. In addition, the Commission's EU aquaculture website includes a Knowledge Base (Good husbandry practices | EU Aquaculture) that compiles reports, project results, guidelines, good practices etc. on sustainable aquaculture including on fish welfare

[15] Code of good practices on fish welfare and fish welfare indicators | EU Aquaculture

– "Document on Good Husbandry Practices for aquaculture"[16] that provides a non-exhaustive list of general and species-specific good husbandry practices (GHPs) on key topics related to welfare and health in the different production techniques of European aquaculture species, notably mussels, common carp, rainbow trout, Atlantic salmon, European sea bass, gilthead sea bream, meagre, Senegalese Sole and European Turbot. The selected GHPs aim to help implementing, in a practical way, key legal obligations of operators - and sometimes go beyond the key legal obligations – on animal health and welfare requirements. The GHPs have been selected from the 27 EU Member States as well as from Norway and UK.

On 17 January 2024, the Commission established the EU Reference Centre on the welfare of farmed aquatic animals. Amongst other tasks, the Centre reviews existing scientific evidence and conduct studies on the protection of aquatic animals on farm, during transport and at slaughter. The establishment of the Centre is a big step in improving and harmonising the enforcement of legislation on animal welfare. It provides technical support and coordinates assistance to EU MSs in carrying out official controls in the field of animal welfare, needs which are stressed by the competent authorities in this report. It will furthermore help in developing animal-based indicators which allow for a better monitoring of the welfare status of aquatic animals. In the Work Programme 2025-2027, the Centre will focus its activities on the most commonly farmed fish species in the EU.

Work on animal welfare indicators is also ongoing for a selection of farmed fish (rainbow trout, gilthead seabream, European seabass and common carp) in an external study. The main objective of this study is to develop and achieve consensus from key stakeholders on a cohesive set of animal welfare indicators that enables monitoring.

In addition, the European Partnership on Animal Health and Welfare was launched in 2024, supported by Horizon Europe. The European Partnership on Animal Health and Welfare is a major collaborative research initiative involving more than 90 entities throughout Europe. This partnership is pivotal in closing the knowledge gaps and advancing technologies and methods to improve the health and welfare of both terrestrial and aquatic animals. Aquatic animals are included in numerous projects, and the results will contribute to the better understanding and assessment of the welfare of farmed aquatic animals. The European Partnership on Animal Health and Welfare is set to operate until 2030.

With regards to the protection of aquatic animals during transport, the Commission adopted a legislative proposal for the revision of existing EU rules on the protection of animals during transport in December 2023. The scope of the proposal remains the protection of animals during transport in connection with an economic activity like the current regulation in place, but specific provisions are proposed for aquatic animals.

The proposed empowerments would allow for the adoption of tertiary legislation to update the technical transport rules considering technical progress, the latest scientific developments and species-specific welfare needs. The co-legislators, the European Parliament and the European Council, have started working on their position on this proposal.

[16] Good husbandry practices | EU Aquaculture

ANNEX I - LEGAL REFERENCES

Legal Reference	Official Journal	Title
Regulation (EC) No 1/2005 *Animal Transport Regulation*	OJ L 3, 5.1.2005, p. 1-44	Council Regulation (EC) No 1/2005 of 22 December 2004 on the protection of animals during transport and related operations and amending Directives 64/432/EEC and 93/119/EC and Regulation (EC) No 1255/97
Regulation (EU) No 2017/625 *Official Controls Regulation*	OJ L 95, 7.4.2017, p. 1	Regulation (EU) No 2017/625 of the European Parliament and of the Council of 15 March 2017 on official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products
Council of Europe recommendation concerning farmed fish.	Recommendation concerning farmed fish - European Committee on Legal Co-operation	Recommendation concerning farmed fish adopted by the Standing Committee of the European Convention for the Protection of Animals kept for Farming Purposes (T-AP) on 5 December 2005

Legal acts quoted in this report refer, where applicable, to the last amended version.

ANNEX II - DETAILS OF INDIVIDUAL VISITS

Member State	Dates of visit	SANTE reference
Norway	June 2023	-
Germany	15-31 May 2023	2023-7767
Denmark	11-22 September 2023	2023-7766
Greece	4-15 September 2023	2023-7909
Finland	13-17 May 2024	2024-7983
Spain	5-9 February 2024	2024-8015

Reports of visits to EU Member States are available at:

https://ec.europa.eu/food/audits-analysis/audit_reports/index.cfm

ANNEX III – REFERENCES AND BIBLIOGRAPHY

- Guidelines on water quality and handling for the welfare of farmed vertebrate fish. 2022. EU Platform on animal welfare - own initiative group on fish aw_platform_plat-conc_guide_farmed-fish_en.pdf
- EU Reference Centre for Animal Welfare Aqua.
    - Indicator Factsheet EURCAW-AQUA_European Seabass_July_2025
    - Indicator Factsheet EURCAW-AQUA_Common Carp_July_2025
- Fish-Welfare-in-European-Aquaculture-2.pdf. 2018. Eurogroup for Animals
- Welfare Indicators for farmed Atlantic salmon: tools for assessing fish welfare 2018. FAO AGRIS
- Welfare Indicators for farmed rainbow trout: tools for assessing fish welfare 2020. C. Noble et al.
- Welfare_study_for_European_sea_bass_20.09.2024_new.pdf 2024. University of Crete

Private standards

- rspca_welfare_standards_for_farmed_atlantic_salmon 2024 RSPCA
- GLOBAL GAP standard Integrated Farm Assurance for aquaculture v6 smart- key documents.
- The Aquaculture Stewardship Council (ASC) farm standard ASC-STD-001-ASC-Farm-Standard-V1.0.1-Aug-2025.pdf
- Best Aquaculture Practices. Global Seafood Alliance
- Friend of the Sea Standard ITA FOS Aqua Marine 18032013
- Aquaculture Welfare Standards Initiative. multi-stakeholder initiative (retailers, NGOs, scientists, etc.) developing common welfare recommendations and minimum requirements for fish and shrimp in aquaculture, used by German retailers as private commitments.

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