Open letter from the CARE Salmon Group

The CARE Salmon collective is composed of French economic stakeholders who have voluntarily come together to engage in a joint technical reflection on ways to improve the welfare of farmed salmon. This work may lead to the development of recommendations concerning farming practices.
The implementation of these technical recommendations is left to the discretion of each member. For those members who wish to promote them, the methods of implementation remain the sole and independent responsibility of each, individually.
Throughout this project, the members of the collective have adhered to the principles of fair competition, refraining from any action prohibited by Article L 420-1 of the French Commercial Code and Articles 101 and 102 of the TFEU. Discussions have been strictly limited to technical and scientific information.

In recent years, consumer concerns regarding salmon have evolved to include issues such as the protection of seabeds, reducing the carbon footprint of production, and taking animal welfare into account (see recent European survey). The latter is based on robust scientific knowledge about salmon's capacity to experience different emotions (both positive and negative) in their environment (see popular science article). For example, the Norwegian sovereign wealth fund already requires animal welfare standards to be respected by companies in which it invests.
Beyond meeting societal expectations and new certification requirements, better consideration of salmon welfare can bring direct benefits such as improved production (with reduced mortality or losses at slaughter), anticipation of future regulations, and a better image of the sector among consumers and the general public.
Many tools to monitor transparency regarding salmon welfare are now being deployed, such as the BBFAW or the Salmon Welfare Scorecard from CIWF.

The members of the CARE Salmon collective agree on the need to implement the following practices—some of which are already recognized as good practices and widely adopted by producers, while others require adjustments or additions to current practices:

Water quality

It is essential that water quality in aquaculture farms be subject to strict and daily monitoring. Key parameters such as dissolved oxygen concentration, temperature, and salinity must be measured daily at each sea site and at various depths corresponding to the fish's living zones. It is also recommended to measure turbidity and to monitor key parameters at the individual cage level.
As soon as a deterioration in water quality is detected—based on a multifactorial analysis—appropriate corrective actions must be implemented without delay, in order to safeguard the health and welfare of the farmed animals.

Health indicators

Monitoring fish welfare cannot be limited to environmental parameters alone; it must also include physical and behavioural indicators. For example, during sampling carried out for sea lice monitoring, at least 4 of the 7 main physical indicators (listed in the annex) must be measured and recorded. Additionally, behavioural analysis based on surveillance cameras must include the observation of at least two behavioural indicators, according to a defined protocol (example provided in the annex). These measurements are essential for the early detection of any welfare impairment and for adjusting husbandry practices accordingly.

Mortality

Mortality reporting must be carried out on a regular basis, ideally once a month, and at a minimum at the end of the production cycle for each salmon cage. This calculation must cover the entire production cycle, in both freshwater and seawater, over a rolling two-year period (see technical annexes for an example of reporting). Mortality monitoring, for its part, must be continuous. Furthermore, the causes of mortality, when they can be identified, whether related to a specific treatment, water quality degradation, or disease, must be rigorously recorded and regularly monitored, in order to improve understanding of risk factors and to guide preventive measures.

Stocking density

It is recommended to define a maximum stocking density that must not be exceeded, and to monitor and report the maximum density reached for each batch/cage at the company level (see detailed calculation methods in the annex).

If average production density is reported, it is recommended to separate reporting for the freshwater and seawater phases, and to further distinguish reporting based on fish size, in order to allow for more precise monitoring tailored to the different developmental stages (see detailed reporting methods in the annex).

Additionally, it may be relevant to initiate scientific studies aimed at better understanding the actual density based on the dynamic spatial distribution of salmon within sea cages, providing a more refined approach to density monitoring.

Sea Lice Management

The use of cleaner fish (whether wild-caught or farmed) as a method to control sea lice raises serious ethical concerns and should be prohibited. Failing that, a clearly defined improvement plan should be established, including a timeline for their gradual phase-out.

Regarding sea lice infestation monitoring, it is recommended to adopt a sampling plan that is more rigorous and statistically representative than what is required by national regulations. Priority should be given to automated monitoring systems to enhance precision and reduce handling.

Furthermore, research and innovation efforts must be actively encouraged to develop preventive strategies or individualised treatments against sea lice.

Handling

Fish handling must be kept to an absolute minimum and always be justified. At every stage of the production cycle, fish must be kept in water as much as possible. Health assessments should therefore be carried out in specially designed and optimised tanks (see illustration in the annex). When removal from the water is unavoidable, it must not exceed 15 seconds, and fish must be handled horizontally with both hands to minimise stress and injury. For any procedure requiring prolonged exposure out of water, such as vaccination, anaesthesia is mandatory.

In cases where handling equipment is modified or replaced, it is recommended to incorporate a passive sorting system to ensure compliance with best practices (illustration provided in the annex).

Crowding

The duration and frequency of crowding (overstocking), when it concerns the entire salmon population in a cage, must be limited to a maximum of two hours per cage, twice a week, and three times per month. Suppliers are responsible for accurately monitoring these parameters and must report, upon client request, the crowding practices implemented for each batch.

Regarding water quality, pre-oxygenation must be ensured before each crowding event, and dissolved oxygen levels must be continuously monitored throughout the operation. Finally, a protocol for monitoring key animal welfare indicators must be systematically implemented prior to any handling of salmon during crowding. This protocol assesses the intensity of crowding and the risk of salmon experiencing excessive stress. If excessive stress levels are detected, the procedure should be stopped immediately.

Transfer and transport

The transfer of fish must be conducted under conditions that ensure their safety and welfare. Only pumping is permitted as an active transfer method due to its better control and reduced impact on the animals. Passive transfer by gravity is also allowed. For each batch transported, rigorous monitoring must be conducted, including the following parameters: dissolved oxygen level, stocking density, transport duration, holding time, and mortality rate during transport. Furthermore, a sufficient resting period must be strictly observed after transport and prior to slaughter to minimize stress and its consequences on the fish.

Stunning and slaughter

Certain fish slaughter methods must be strictly prohibited, including carbon dioxide (CO_2) asphyxiation, asphyxiation out of water, bleeding without prior stunning, as well as the use of ice/water mixtures, whether alone or as a stunning method.

Stunning is a mandatory step in the slaughter process and must always be followed by bleeding to ensure death. The recommended methods primarily include automatic percussion followed by bleeding (due to its higher effectiveness) and electrical stunning followed by automatic percussion and bleeding. Also permitted are electrical stunning coupled directly with bleeding, or the combination of percussion followed by bleeding.

An emergency stunning device must be available upstream of the bleeding tank on the slaughter line to allow immediate intervention in case of process failure. Furthermore, monitoring reliable indicators of fish unconsciousness is essential (see examples in the annex). This monitoring must be accompanied by rigorous control of the percentage of effective stuns on the first attempt, as well as the immediate implementation of corrective actions if any malfunction is detected.

Emergency euthanasia (outside the slaughterhouse)

A clear and formalized procedure must be in place for managing fish unfit for transport or slaughter. These animals must be attended to as quickly as possible and euthanized humanely, avoiding any unnecessary suffering. Fish removed from the production line must under no circumstances remain out of the water for more than fifteen seconds before emergency euthanasia.

In aquaculture, several methods are recommended to ensure a rapid and humane euthanasia: **manual percussion**, **semi-automatic percussion** for isolated individuals, and **overdose of anesthetic** in the case of small groups.

Depending on the situation, euthanasia may also be performed by harvesting on the boat, followed by electrical or percussion stunning prior to bleeding.

Initial and continuing training

Training of professionals is a key lever for ensuring the respect of salmon welfare throughout their lives. Initial training should include specific modules on animal welfare for all personnel who have direct contact with live fish, including fish farm workers, transporters, slaughterhouse staff, farm managers, and supervisors. Monitoring water quality, a critical parameter, should be entrusted to personnel who are specifically trained for this task.

Continuing education should be scheduled every two to three years to maintain and update skills, particularly in light of evolving techniques and regulations. Training sessions should cover a range of essential topics: recognizing signs of stress and pain in salmon, best practices for handling and transport, slaughter techniques that minimize suffering, and the impact of farming conditions on fish health and behavior. A regulatory component, covering both national and European frameworks, should also be included to ensure compliance with professional standards (see proposals in the appendix).

KPIs and transparency

Each producer is responsible for ensuring transparency regarding their animal welfare practices. To this end, they must provide their clients with access at least once a year to a summary of key data concerning their entire production or the specific slaughter batches involved in the supply. This summary must include:

- The mortality rate during the transfer of smolts to seawater,
- The mortality rate in sea cages along with the main identified causes,
- The total mortality over the entire production cycle,
- The percentage of slaughter sites equipped with a stunning system prior to bleeding,
- The percentage of salmon effectively stunned before bleeding,
- The percentage of salmon for which unconsciousness verification is carried out before bleeding,
- The percentage of personnel in contact with live salmon who have received animal welfare training,
- The average stocking density in production (with clarification on the calculation method, for example using the one defined by Norwegian regulations),
- And the maximum density reached in cages, measured at the production unit level (according to methodology specified in the annex).

It is strongly recommended that this information be made publicly accessible. Furthermore, voluntary sharing of continuous improvements or good practices benefiting animal welfare should be encouraged, fostering a culture of transparency, accountability, and collective progress.

<u>Fasting, Feeding Practices, and Environmental Enrichment</u>

Fasting salmon before transport or slaughter, although commonly practiced, raises growing ethical concerns. In light of the most recent scientific data and existing certification requirements, it is strongly recommended to establish a constructive dialogue among all stakeholders (scientists, producers, certification bodies, NGOs) to reach a common and widely acceptable position on fasting. Furthermore, research aimed at adapting feeding practices to the natural behaviours of salmon should be encouraged.

Finally, studies on environmental enrichment for salmon, whether sensory, physical, occupational, or social, are also highly recommended. These efforts aim to more precisely meet the behavioural needs of the animals. References on enrichments already tested with rainbow trout are available in the annex and can serve as a foundation for developing initiatives tailored to Atlantic salmon.

<u>Conclusion</u>

Ensuring a high level of welfare for farmed salmon throughout their life requires a collective effort, supported by scientific advances and driven by a concrete commitment from producers. The commitments and recommendations presented here aim to establish a common foundation of responsible, transparent practices that align with growing societal expectations.

In this context, it is essential to promote dialogue and the sharing of experiences among all stakeholders in the sector: producers, veterinarians, researchers, NGOs, certification bodies, and distributors. Voluntary sharing of challenges encountered, improvement avenues explored, and good practices implemented is a key driver of progress. This approach helps to develop relevant solutions adapted to field realities while collectively raising the standard of requirements.

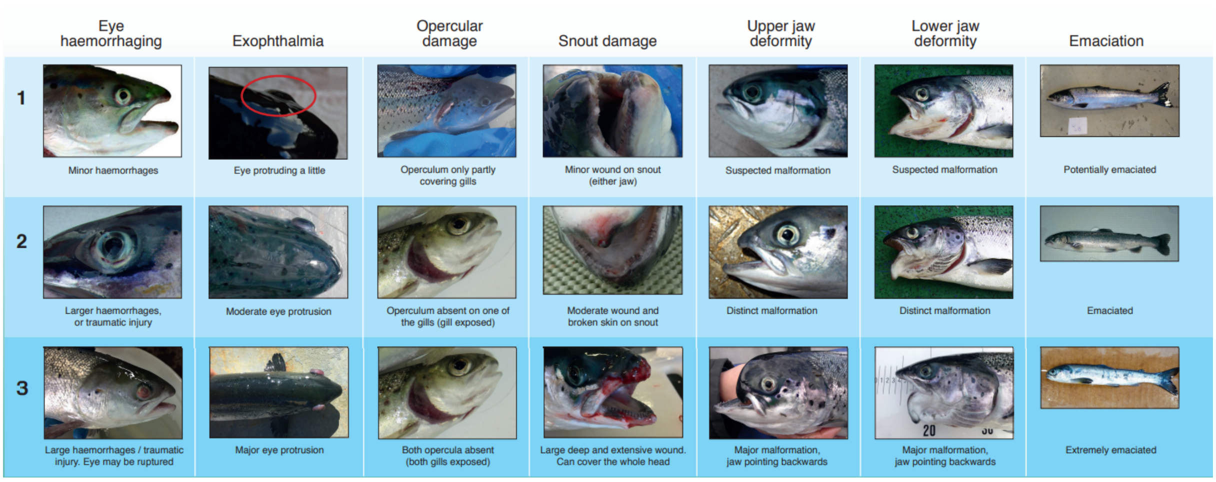
Technical annexes

1) Health and Behavioral Indicators

List of the 7 main physical indicators to monitor in fish, particularly within the framework of health and welfare monitoring. Four of these must be systematically measured and recorded during sea lice counting samplings:

- **Skin condition**
  Observation of the presence of lesions, ulcerations, abrasions, or abnormal discolorations. This indicator is essential to detect skin damage related to parasites, handling, or the environment.
- **Eye damage and condition**
  Assessment of the clarity, symmetry, and integrity of the eyes. Anomalies may reflect environmental, infectious, or traumatic problems.
- **Deformed or damaged operculum**
  Inspection of the shape and condition of the opercula. Deformations or lesions may indicate developmental disorders or mechanical injuries.
- **Fin damage and condition**
  Analysis of wear, tears, or necrosis of the fins. These signs are often associated with chronic stress, social conflicts, or poor water quality.
- **Mouth condition**
  Verification of symmetry, mouth opening, and integrity of external structures. Alterations may indicate malformations or trauma.
- **Vertebral malformation**
  Observation of the body line and positioning of the spinal column. Abnormal curvatures or shortening may have genetic, nutritional, or environmental origins.
- **Condition factor (K)**
  Index calculated from the weight and length of the fish (K = [weight (g) / length^3 (cm)] × 100). It helps evaluate the general health status and growth of individuals.

Note: The underlined indicators must be systematically measured and recorded during sea lice counting operations, as they provide key data on the potential impact of infestation on fish health.



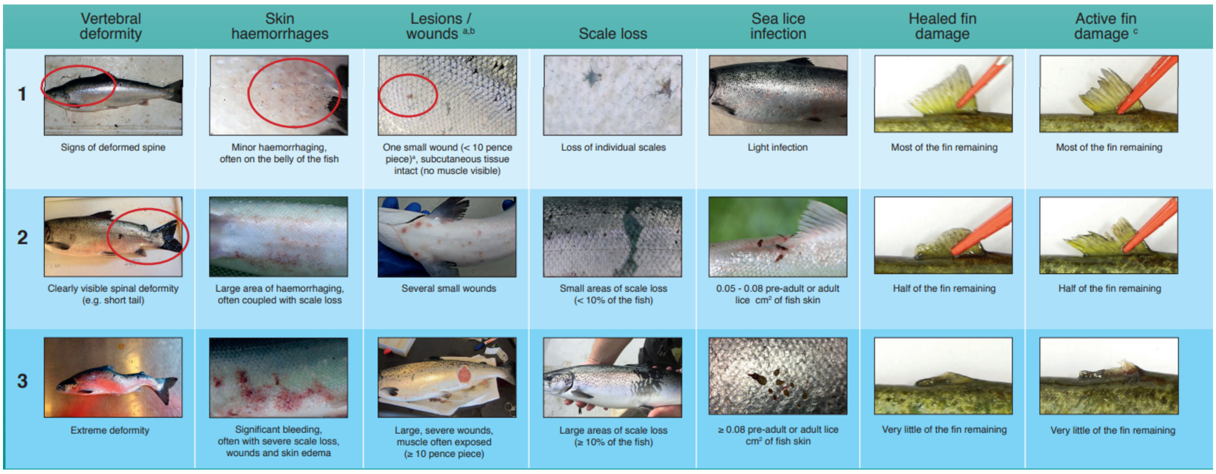


Figure 1 : Health Indicators to Monitor

- https://nofima.no/wp-content/uploads/2021/05/FISHWELL-Welfare-indicators-for-farmed-Atlantic-salmon-November-2018.pdf
- https://nofima.no/wp-content/uploads/2021/05/FISHWELL-OWI-poster-v1.1.pdf

List of the main observable behavioral indicators in fish, notably via video surveillance systems. At least two of these indicators must be measured and recorded using surveillance cameras:

- **Aggressiveness**
  Attack or chasing behaviors between individuals, biting, visible dominance. Aggressiveness can reflect social stress, competition for food, or an imbalance in density or resource distribution.
- **Exploration of the environment**
  Active searching in the environment, for example substrate digging, inspection of structures or walls.
- **Anticipatory behavior**
  Reactions observed before a predictable event, such as feeding (gathering under the feeder, increased activity).
- **Food-seeking behavior**
  Active hunting or capturing of food (insects, pellets, prey).
- **Feeding (appetite)**
  Direct observation of food intake, reaction time after feeding, competition for food.
- **Group swimming / schooling**
  Alignment and coordination of swimming in groups.
- **Individual swimming behavior**
  Observation of isolated fish, frequent changes in speed or direction, or slowed swimming.
- **Abnormal or stereotypic behaviors**
  Repetitive or unusual behaviors such as rubbing against substrate, bumping the mouth against walls, swimming on one side, frequent jumping, swimming in circles. These signs are often linked to discomfort, irritation, or chronic stress.
- **Space use**
  Swimming at the surface, bottom, edges, or abnormal gathering in certain zones.

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https://aac-europe.org/wp-content/uploads/2023/10/14.-AAC-Recommendation-Fish-Ethology_2023_14.pdf

Example of a behavioral indicator monitoring protocol designed to ensure regular and standardized tracking of farmed fish behaviors, enabling early detection of any behavioral anomalies that may indicate welfare issues, health problems, or unsuitable farming conditions.

- https://link.springer.com/content/pdf/10.1007/s10695-011-9518-8.pdf
- https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1753-5131.2012.01083.x
- https://nofima.no/wp-content/uploads/2021/05/FISHWELL-Welfare-indicators-for-farmed-Atlantic-salmon-November-2018.pdf

2) Handling of salmon

- Example of a tank optimized for in-water observation:

The Tellekar is an observation and counting tank designed for direct immersion in water, optimized for rapid and safe examination of live fish. It allows visual assessment of the physical condition and behavior of fish in natural or semi-natural conditions while minimizing stress related to handling.

Figure 2 : Photo of an observation and counting tank: the Tellekar

https://nettbutikk.marinhelse.no/products/tellekar

- Example of passive grading:

The Flexi Panel is a patented passive grading device used for size-based selection of fish, without direct handling or stress, directly within cages or crowding nets.

https://www.gradingsystems.com/about-flexi-panel

- Crowding severity scoring scale (fish concentration)

1. **Optimal:** Fish located at the edges of the group swim slowly, displaying normal swimming behavior (though not all in the same direction). No dorsal fins visible above the surface, and no white sides (bellies) visible at the surface.
2. **Acceptable:** Normal swimming behavior at the suction point, low stress level, a few dorsal fins visible above the surface, no white sides visible at the surface.
3. **Undesirable:** Overactive or disorganized swimming (in different directions), more than 20 dorsal fins visible at the surface, some white sides consistently visible at the surface.
4. **Unacceptable:** Overcrowding, disorganized and agitated swimming (in different directions), some fish show reduced activity, pumping flow is unstable or impossible to maintain, many fish are pressed against the crowding net, numerous dorsal fins and white sides visible at the surface, some fish appear lethargic.
5. **Unacceptable:** Extreme overcrowding, mass of fish in a "boiling" state, high risk of mass mortality without rapid release, generalized panic within the population, exhausted fish, many individuals floating on their sides.

https://www.sciencedirect.com/science/article/pii/S2352513424002990

3) Recommended initial and continuing training in aquaculture

Continuous training is essential for maintaining and updating skills in the aquaculture sector, particularly in relation to animal welfare, biosecurity, health management, and farming technologies. Below are two key platforms offering online training courses in English, recognized by industry professionals:

https://blueplanetacademy.com/en/courses

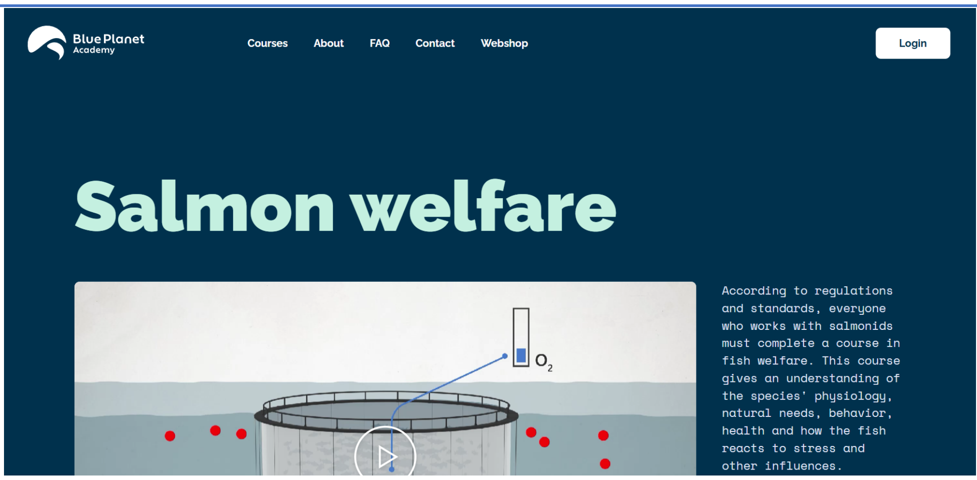

Figure 3 : Homepage of the training provided by BluePlanet Academy

https://aquaculturecourses.com/

Figure 4 : Homepage of the training provided by Aquaculture Courses

4) Slaughtering of fish

Examples of Indicators of Unconsciousness in Fish.
Indicators of unconsciousness are used to verify the effectiveness of stunning before slaughter. They must be simple to observe, reliable, and based on behavioral and physiological responses of the fish.
Indicators of effective stunning (absence of consciousness):

- **Loss of equilibrium**
  The fish remains lying on its side or swims erratically, without postural correction.
- **Absence of vestibulo-ocular reflex (VOR)**
  No compensatory eye movement when the head is rotated.
- **Absence of respiration**
  No opercular movement (no regular respiratory movements).
- **Absence of coordinated swimming movements**
  No organized fin or body movement; no directional swimming.
- **Absence of escape behavior**
  No reaction to a threat or attempt to capture, even in response to a sudden movement nearby.
- **Absence of reaction to painful stimulus**
  No reflex observed when the fin is pinched or when gently pricked with a needle (nociceptive reflex absent).

Note: It is recommended to combine several of these indicators to confirm unconsciousness, especially in situations where observation conditions are difficult (lighting, water turbulence, density).

5) Density

<u>Reporting of the Maximum Density Reached:</u>

To improve the accuracy and comparability of density data in aquaculture, several elements should be integrated into the reporting procedures:

- Include batches or cages harvested during the 24 months preceding the reporting date. This rolling period allows for the inclusion of recent complete cycles, thereby enhancing data representativeness.

- Monitor the density evolution within each cage and select the maximum density to which the salmon have been exposed. This maximum density is generally reached just before the first harvesting event (when the harvest is not complete), but it may occur earlier in some cases. The highest observed value should always be recorded.

- Report this maximum density at the company level by indicating the highest measured value and/or calculating the average of the maximum densities observed for each cage or batch monitored. When reporting an average, it is essential to include dispersion indicators such as the standard deviation or standard error to facilitate interpretation.

		Measure points						
Farm	Cage	a	b	…	x	SD at 1st Harvest	MAX SD recorded	Date of end of batch
F1	C1	4	5		15	14	15	Jan-25
	C2	3	10		8	13	13	Feb-24
	C3	3	5		22	18	22	May-23
	C4	5	7		8	21	21	May-25
F2	C1	4	7		13	10	13	Apr-25
	C2	4	7		12	15	15	Oct-24
	C3	6	4		8	17	17	Sep-24
	C4	4	5		19	17	19	Jul-24
F3	C1	2	10		10	25	25	Jun-23
	C2	4	9		11	14	14	not harvested yet
	C3	3	4		7	11	11	Nov-23
	C4	3	9		19	23	23	not harvested yet

Example:
Reporting date is April 2025
Cages between April 23 - March 25: F1C1, F1C2, F1C3, F2C2, F2C3, F2C4, F3C1, F3C3
Reporting date is July 2025
Cages between July 23 - June 25 F1C1, F1C2, F1C4, F2C1, F2C2, F2C3, F2C4, F3C3

Measure points : can be daily, weekly, monthly... this is up to the producer to decide on the frequency of SD measurement in each cage.
Batch : defined as a population of salmons that have been together since hatching

Figure 5 : Example of Density Calculation

<u>Example :</u>

Report date: April 2025:
The cages with the end of the batch between March 23 and April 25 are considered: F1C1, F1C2, F1C3, F2C2, F2C3, F2C4, F3C1, F3C3 (in orange).

Report date: July 2025:
The cages with the end of the batch between June 23 and July 25 are considered: F1C1, F1C2, F1C4, F2C1, F2C2, F2C3, F2C4, F3C3 (in blue).

<u>Notes</u>: Within the framework of continuous monitoring of fish welfare and performance, we would like to provide some clarifications regarding the methodology used for reporting periods and the associated definitions.

- **Cumulative cages over multiple reporting periods**
  Some cages may be included in two consecutive reporting periods. This is due to our system relying on a rolling 24-month period, ensuring consistent and comparable monitoring over time.
- **Frequency of measurement points**
  Measurement points can be daily, weekly, monthly, or follow any other suitable frequency. It is the responsibility of the producer to define the frequency of stock density (SD) measurements for each cage, based on their farming practices and monitoring capabilities.
- **Definition of a batch**
  A batch is defined as a population of salmon raised together from hatching. This definition ensures consistent and reliable traceability over time.

All stakeholders are encouraged to maintain rigor in data collection and sharing to ensure continuous improvement of practices and animal welfare.

<u>Reporting of production density or average density by fish weight:</u>

- Do not use fish weights that differ significantly to calculate an overall average density within the reporting framework.

- Report density by homogeneous fish weight ranges.

- Use only cages for which the average fish weight is reliably estimated to calculate the corresponding density.

- Include statistical dispersion indicators, such as standard deviation or standard error, to better reflect data variability.

Table translated form a producer's policy reporting current stocking densities		
Weight	Average density (kg/m3)	StDev
<1.5 kg	2.4	1.5
1.5 - 3.0 kg	4	1.6
>3.0 kg	9.9	3.3

Figure 6 : Example of density reporting:

Example of calculating density by sizes					
	Average estimated weight	SD			
Cage 1	0.9	1			
Cage 2	1	1.5			
Cage 3	4.5	5.2	Overall		
Cage 4	6	12	SD	St dv	
Cage 5	3.2	7.8	5.29	3.42	
Cage 6	3	4			
Cage 7	1.2	2.6			
Cage 8	2	3.7			
Cage 9	2.1	3.9	By size		
Cage 10	6	10	Weight	SD	St dv
Cage 11	4	8.3	<1.5	1.475	0.697764
Cage 12	2.6	4.2	1.5 - 3	3.95	0.180278
Cage 13	0.8	0.8	>3	8.716667	2.077191
Cage 14	5.2	9			

Figure 7 : Example of density calculation by size:

6) Mortality

Reporting mortality data is required, over a rolling period of two years, or 24 months, to smooth out short-term fluctuations and obtain a more representative and stable view of observed trends. For each reporting period, whether monthly or yearly, the calculation should be based on the cumulative mortality for each cage or batch whose cycle is completed. In other words, only the final mortalities, known with certainty once harvesting is completed, should be taken into account. Furthermore, it would be relevant to include measures of dispersion, such as standard deviation or standard error, alongside these averages to facilitate interpretation and better reflect the actual variability between batches or sites.

7) Environmental Enrichment

Environmental enrichment involves introducing structural or sensory elements into rearing tanks to improve the well-being of fish. It promotes the expression of natural behaviors, reduces stress, and can enhance health and growth.

- https://assets-eu.researchsquare.com/files/rs-1536435/v1/90debb26-8683-49b3-ab09-ed4b25893355.pdf
- https://www.sciencedirect.com/science/article/pii/S0044848621014885
- https://ccmar.ualg.pt/sites/ccmar.ualg.pt/files/arechavala-lopezetal_2021_reviewee.pdf