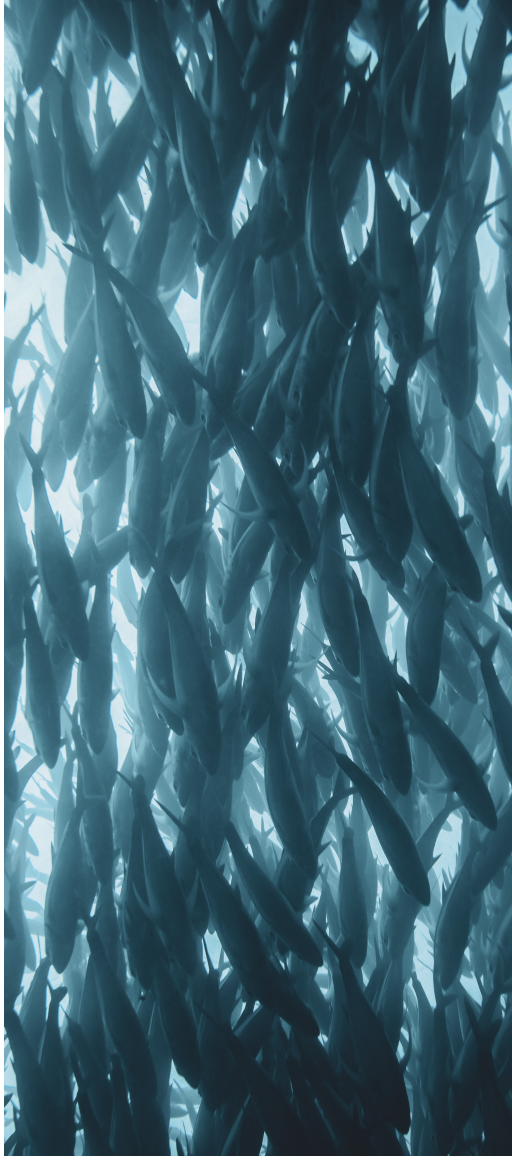
AQUATIC LIFE INSTITUTE



Aquaculture Certification Schemes Benchmark:

Aquatic Animal Welfare

The Aquatic Life Institute (ALI) launched the first edition of a welfare-based, aquaculture certification benchmark tool that analyzes current welfare requirements within the main farming standards of 6 global seafood certification schemes. The areas of assessment include environmental enrichment, stocking density, stunning and slaughter, feeding practices, and water quality. Global Animal Partnership (GAP), RSPCA Assured, Naturland, Friend of the Sea, GLOBALGAP, and Best Aquaculture Practices (BAP) were evaluated and scored based on 5 main criteria, each comprised of 2-7 sub-criteria points. This tool identifies adequate animal welfare considerations in current aquaculture certification standards, but also highlights the areas of opportunity for substantial improvements in the near future.

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Table Summary of Results:

Certification		Environmental Enrichment	Water Quality	Space Requirements & Stocking Density	Feed Composition	Stunning & Slaughter	Total Out of 10
	Global Animal Partnership Step Level 5+	**1.415**	**1.8**	**2**	**1.3**	**1.9**	**8.42**
	Global Animal Partnership Step Level 3	**1.325**	**1.8**	**2**	**1.3**	**1.9**	**8.33**
	Global Animal Partnership Step Level 1	**1.1**	**1.8**	**2**	**1.175**	**1.9**	**7.98**
	RSPCA Assured	**0.4**	**2**	**2**	**0.3**	**1.8**	**6.5**
	Naturland	**0.9375**	**0.8**	**2**	**1.3**	**1.45**	**6.34**
	Friend of the Sea	**0.3**	**1.2**	**1**	**0.3**	**1.675**	**4.48**
	GLOBALG.A.P.	**0.5**	**0.9**	**0.75**	**0.575**	**1.15**	**3.88**
	Best Aquaculture Practices (BAP)	**0**	**1.1**	**0.5**	**0.625**	**0.95**	**3.18**
	Aquaculture Stewardship Council (ASC)	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**

Introduction & Purpose:

It is estimated that there are between 51 and 167 billion farmed fish produced from global aquaculture operations[1]. However, depending on the age of the animal at slaughter, the actual number of farmed fish *living* in aquaculture facilities could be much higher than that estimate. Aquatic animals are farmed in larger numbers than any other animal worldwide and, until recently, their welfare has been neglected. Animal welfare advocates often refer to aquaculture

[1] "Numbers of Farmed Fish Slaughtered Each Year | Fishcount.org.uk." Fishcount.org.uk, fishcount.org.uk/fish-count-estimates-2/numbers-of-farmed-fish-slaughtered-each-year

facilities as underwater factory farms where aquatic animals are severely mistreated. Poor rearing conditions affect their health and wellbeing, increase their stress, and leave them more susceptible to a variety of diseases. Higher welfare not only translates to increased quality of life for billions of aquatic animals, but also improves productivity, leads to a healthier society with improved food safety standards, and ensures the preservation of ecosystems[2].

Although there is strong scientific evidence on the practices that best promote good welfare, the concept of what constitutes “humane fish” or a “high welfare seafood product” is still currently largely undefined worldwide by the public, industry, animal welfare organizations and most governments. For terrestrial farmed animals, there are many different labeling schemes and standards, such as “cage free” and “humanely raised.” Even though this is a major step in the right direction for animal welfare, it has also caused confusion for consumers. Disjointed labeling regimes have consequences for both the animals raised and slaughtered for food, and for consumers who are trying to be as responsible as possible with their purchasing power.

As institutions certifying aquatic animal products are beginning to incorporate welfare standards into their labeling programs, they must be diligent to define 'high welfare' products on the basis of the best available scientific evidence rather than what is most convenient for the industry and merely serves as humane washing. “Humanely-raised” aquaculture standards should include more than just stunning before slaughter, but also consider the welfare conditions of the animals throughout their lives. As well as accounting for other fish not directly used for human consumption, such as cleaner fish, feeder animals, and broodstock.

Currently, many consumers turn to seafood labeling schemes for guidance with an intention to avoid purchasing species that were produced against the recommended ‘sustainable’ and low welfare practices. With more than 100 certifications and ratings programs of one type or another currently in use by the seafood industry, it would appear that they are here to stay; a permanent component in the welfare landscape. This shift now means that 39% of all farmed seafood (including seaweed) is rated or certified[3], and volumes of certified farmed fish and shellfish constitute about 8% of global aquaculture production[4]. The amount of certified aquatic animal products is only expected to increase. There is no evidence that certification will be phased out anytime in the near future in view of consumers’ increasing demand for sustainable seafood, and the absence of a better alternative[5]. However, a large number of these labels lack explicit considerations for animal welfare, or fail to provide adequate protections. These schemes rely on the premium consumers place on eco-friendly and high welfare products (Hans and Yang 2011), but in reality fail to meet consumer expectations. In this report, and through the Aquatic Life Institute’s Certifier Campaign, we aim to hold seafood certifier

[2] “Why Fish Welfare? | Fish Welfare Initiative.” FWI, www.fishwelfareinitiative.org/why-fish-welfare

[3] "Sustainable Seafood: A Global Benchmark - Certification & Ratings" https://certificationandratings.org/wp-content/uploads/2019/06/Sustainable_Seafood_A_Global_Benchmark.pdf

[4]Jonell, Malin, et al. 7 Certifying Farmed Seafood a Drop in the Ocean or a “Stepping- Stone” towards Increased Sustainability?

[5]FAO. The State of World Fisheries and Aquaculture 2020. FAO, 2020.

standards accountable, and highlight the certification schemes that provide the strongest protections. Products labeled as “sustainable” or “responsible” should and must include the most robust animal welfare considerations.

Given the wide variety of aquatic animals and systems, the potential scope for a full evaluation of all certification schemes covering all of these animals and the conditions in which they live is vast. Greater species and system specificity would be ideal for a more indepth comparison of different schemes for a particular species.

For a certification scheme to effectively improve aquatic animal welfare, the scheme should enable claims made about a product to be critically examined (Helyar et al. 2014; Stokstad 2010). To enable buyers and regulatory bodies to check that claims about welfare in aquaculture are being met, it is essential for products to be traceable. Traceability requires keeping, and making available, records of all raw supplies (e.g., fish feed), production processes, dispatch, and sale; in short, documenting the origin and history of a fish product (Srinivasa Gopal and Boopendranath 2013; Doddema et al. 2020; Washington and Ababouch 2011). While regulatory bodies often encourage or mandate traceability, it is common for certification schemes to have their own traceability requirements by which producers must abide (Washington and Ababouch 2011; Islam et al. 2021).

Traceability is increasingly demanded by seafood consumers (Pulcini et al. 2020; Helyar et al. 2014; Maralit et al. 2013). Indeed, the importance that traceability has for seafood consumers has been documented in research studies (Pieniak, Vanhonacker, and Verbeke 2013; Rodriguez-Salvador and Dopico 2020), although demand does differ by context and consumer demographic (Christophorou, Colmer, and Chryssochoidis 2017; Pulcini et al. 2020). Seafood companies do express awareness that traceability helps them to retain customers (Mai et al. 2010).

In some cases, further progress towards traceability needs to be made. A significant proportion of fish products are mislabelled (Helyar et al. 2014; Maralit et al. 2013), which, in some instances, is deliberate (Barbuto et al. 2010). Progress may come from emerging digital tracing technologies (Islam et al. 2021; Washington and Ababouch 2011) and tools from biotechnology (Leal et al. 2015). Traceability is particularly important for understanding the indirect impact of fish products on the welfare of other aquatic animals, particularly when animal products are used in feed composition. Taken together, it is clear that improving traceability of fish products is a key step towards ensuring that claims about fish welfare are being met in reality.

This benchmark was created based on the most current online information that was available when research was being conducted for this report. However, as certification standards are updated, this document will be modified to reflect improvements and/or impairments. We encourage certification schemes to increase transparency and share knowledge with the public on a regular basis. We’d like to note that the Aquaculture Stewardship Council (ASC) is currently developing their Fish Welfare Project and when details of this project are complete and shared with the public, we plan to incorporate this as a new addition to the benchmark.

However, in future iterations of this benchmark, we will also analyze a commitment to evolving according to emerging welfare improvements (i.e. stagnant standards will accordingly translate to demotion).

Scoring Rationale:

Environmental Enrichment Considerations:

- ☐ Animals experience the correct amount and type of contact with conspecifics (15%)
- ☐ Physical and psychological stimulation allows for the expression of behaviors that promote psychological well-being (15%)
- ☐ Holding environment modifications to include structural complexity, shelter, and visual stimulation (15%)
- ☐ Introducing a diversity of visual, auditory, olfactory, tactile and taste stimuli (15%)
- ☐ The use of feed enhanced with appropriate nutrients, the amount and variety of food available, feeding frequency, and/or delivery system (15%)
- ☐ The scheme should have a commitment to update their standards for enrichment as new research on the motivations and needs of fish emerge (25%)

Water Quality Considerations:

- ☐ There is a range of acceptable measures provided for a wider variety of water quality parameters (40%)
- ☐ These measures consider species and life stage and are based on best available science evidence (40%)
- ☐ Water quality should be monitored at least once a day, ideally there are requirements for continuous monitoring of water quality and the formulation of effective management plans to quickly rectify issues which arise (20%)

Space Requirements & Stocking Density Considerations:

- ☐ Stocking density requirements should be based on the best available scientific evidence for the species and life stage (50%)
- ☐ Numerical limits should be provided according to species (50%)

Feed Composition Considerations:

- ☐ Limits the amount of fishmeal and fish oil (FMFO) used in aquafeed (25%)
- ☐ Prohibits the use of insect in feed (25%)
- ☐ Encourages feed compositions that contain as much plant-based content as possible, including algae and emerging new technologies (mycelium. etc) (20%)
- ☐ Requires FMFO to be sourced from offcuts and byproducts of human animal consumption (10%)
- ☐ Requires diets to contain sufficient energy and nutrients for the particular species and age group (10%)

- [ ] Considers fish's ability to access and digest food (10%)

Stunning & Slaughter Considerations:

- [ ] Effective stunning must be used and should be expressly defined to mean rendering an animal immediately and fully unconscious (i.e. within one second by a scientifically validated method) – not just immobilizing the animal – in a manner that sustains unconsciousness until death (i.e. no consciousness recovery) (50%)
- [ ] Explicitly bans the use of ice slurry, CO2, ammonia bath, salt, and other inhumane methods of slaughter (10%)
- [ ] There should be a backup slaughter method to stun and then humanely kill any fish that are alive and conscious after the initial stunning or slaughter method (10%)
- [ ] Fish should be regularly assessed for signs of consciousness after stunning (10%)
- [ ] Slaughter workers should be trained in a well-defined way and mistakes should be rare (10%)
- [ ] Culling of fish should use an effective stunning method and respect animal welfare (5%)
- [ ] Minimize time between stunning and slaughter in order to minimize risk of consciousness being recovered (5%)

Results

A score between 0 (very poor) and 2 (good) is provided for each of the evaluation criteria.

Score 0 (Very Poor) – The standards fail to address the sub-criterion or cannot be assessed owing to missing or incomplete information.

Score 1 (Fair) – The standards mention or broadly address the sub-criterion, but there are some weaknesses.

Score 2 (Good) – The standards address the sub-criterion well, few shortcomings are present.

Global Animal Partnership: Step Level 1 Total = 7.98; Step Level 3 Total = 8.33; Step Level 5+ Total = 8.42

- **Environmental Enrichment Step Level 1 (1.1), Step Level 3 (1.325), Step Level 5+ (1.415):**
    - Step Level 1:
        - 5.4.1 Enrichment must be provided by the time fry are ready for first feeding at 1 month old.

        - 5.4.2 Fry and parr must be provided with at least 1 Type A enrichment (See Appendix VII) per pen/tank.
        - 5.4.6 Adult salmon must be provided with 1 Type A enrichment (See Appendix VII) per pen/tank.
        - 5.4.8 Enrichments must be evenly distributed throughout the tank or pen.
        - Type A includes Substrate, Submerged hides (only for freshwater production), Hanging curtain and Moving Light Array
    - Step Level 3:
        - 5.4.1 Enrichment must be provided by the time fry are ready for first feeding at 1 month old.
        - 5.4.3 Fry and parr must be provided with at least 1 Type A enrichment (See Appendix VII) per pen/tank.
        - 5.4.7 Adult salmon must be provided with 2 types of enrichments (See Appendix VII) per pen/tank.
        - 5.4.8 Enrichments must be evenly distributed throughout the tank or pen.
        - Type A includes Substrate, Submerged hides (only for freshwater production), Hanging curtain and Moving Light Array
        - Type B also includes Overhanging or over tank/pen cover, Alternating water current velocity (only for freshwater production), Bubble Curtain, Simultaneous feed distributed at different depths (only for marine production.
    - Step Level 5+:
        - 5.4.1 Enrichment must be provided by the time fry are ready for first feeding at 1 month old.
        - 5.4.4 Fry and parr must be provided with at least two (2) Type A and one (1) Type B enrichments (See Appendix VII) per pen/tank.
        - 5.4.5 Smolts must be provided with environmental enrichments which alter either the direction or velocity of the current in their pen/tank (See Appendix VII).
        - 5.4.6 Adult salmon must be provided with 1 Type A enrichment (See Appendix VII) per pen/tank.
        - 5.4.8 Enrichments must be evenly distributed throughout the tank or pen.
        - Type A includes Substrate, Submerged hides (only for freshwater production), Hanging curtain and Moving Light Array
        - Type B also includes Overhanging or over tank/pen cover, Alternating water current velocity (only for freshwater production), Bubble Curtain, Simultaneous feed distributed at different depths (only for marine production.
- **Water Quality, Step Level 1, Step Level 3, and Step Level 5+ (1.8):**
    - 5.2.3 For salmon reared in tanks, water quality must adhere to the following limits:
        - Oxygen Saturation: 80-100%
        - Temperature: 8-16°C (46-60°F)

        - Maximum Free Ammonia: .025 mg/L
        - Maximum Carbon dioxide (CO2): 15 mg/L-1
        - pH: 6.2-7.8
        - Maximum Nitrate: 100 mg/L-1
        - Maximum Nitrite: .1 mg/L-1
    - 5.2.4 Ova must not be exposed to temperatures exceeding 8°C (46.4°F).
    - 5.2.5 If water quality (when controlled) is outside the levels in Standard 5.2.3, a written intervention plan, as detailed in Appendix II, designed to improve water quality must be implemented within 6 hours.
    - 5.2.6 If oxygen saturation drops below 80%, supplemental oxygen must be provided immediately until oxygen saturation returns to 80% or above.
    - 5.2.1 For salmon reared in seawater pens, any monitoring system employed must monitor and record the following water quality parameters on a daily basis:
        - a. Temperature;
        - b. Salinity;
        - c. Oxygen saturation (%).
    - 5.2.2 For salmon reared in tanks, monitoring systems employed at the operation must monitor and record the following water quality parameters on a daily basis:
        - a. Temperature;
        - b. Oxygen saturation (%);
        - c. CO2;
        - d. pH.
- **Space Requirements & Stocking Density, Step Level 1 and Step Level 3 (2), Step Level 5+ (2):**
    - 5.1.1 Salmon stocking density for freshwater production (either in tanks or in open-water pens) must not exceed 50kg/m^3 (66lbs/ft3) per pen or tank at any given time.
    - 5.1.2 Salmon stocking density in seawater must not exceed 17kg/m^3 (37lbs/ft3) per pen at any given time.
    - 5.1.3 Salmon stocking density in seawater must not exceed 10kg/m3 per pen or tank at any given time.
- **Feed Composition Step Level 1 (1.175), Step Level 3 (1.3), Step Level 5+ (1.3):**
    - Step Level 1:
        - 7.1.1 Salmon must be fed daily.
        - 7.1.2 Feed must be of an appropriate size and nutritional content for salmon at all life stages.
        - 7.3.4 Each operation must keep up-to-date feed ration ingredient lists, or tags, including mineral/vitamin mixes whether using purchased or home mixed feed. Lists and tags need to be made available to the auditor.
        - 7.1.3 Feed must be distributed over at least 75% of the surface of the tank or pen to allow all salmon to access food.
        - 7.4.1 The average annual FIFO ratio must be recorded.
        - 7.4.2 The average annual FIFO ratio must not exceed 1.5:1 per class.

        - 7.3.1 The use of insects in feed is prohibited
    - Step Level 3 & 5+:
        - 7.1.1 Salmon must be fed daily.
        - 7.1.2 Feed must be of an appropriate size and nutritional content for salmon at all life stages.
        - 7.3.4 Each operation must keep up-to-date feed ration ingredient lists, or tags, including mineral/vitamin mixes whether using purchased or home mixed feed. Lists and tags need to be made available to the auditor.
        - 7.1.3 Feed must be distributed over at least 75% of the surface of the tank or pen to allow all salmon to access food.
        - 7.4.1 The average annual FIFO ratio must be recorded.
        - 7.4.3 The average annual FIFO ratio must not exceed 1:1 per class.
        - 7.3.1 The use of insects in feed is prohibited
- **Stunning & Slaughter, Step Level 1, Step Level 3, and Step Level 5+ (1.9):**
    - Euthanasia technique(s) must cause rapid insensibility and be immediately followed by death.
    - Acceptable and unacceptable methods of euthanasia: Acceptable manual percussive blow or Automated percussive stunning followed by a second method. Unacceptable methods include Carbon Dioxide narcosis, Ice bath or ice slurry (salt or freshwater), live chilling, exsanguination without prior stunning, gill cutting without prior stunning, suffocation in air, anesthetic overdose.
    - Any salmon meeting the following criteria must be euthanized in accordance with Standard 2.5:
        - a. Emaciation score > 2 (See Appendix VI);
        - b. Extreme jaw deformities (See Appendix III for examples);
        - c. Extreme opercular deformities (See Appendix III for examples);
        - d. Extreme spinal deformities (see Appendix III for examples); and
        - e. Growth-stunted salmon (runts).
    - Slaughter Methods
        - Percussive bolt followed by exsanguination
        - Electrical stunning (electronarcosis) followed by exsanguination
        - Small baton with a weighted end (e.g. a priest) followed by exsanguination
    - A backup stunning and slaughter method must be available and implemented during the slaughter process if the automated system stops working for any reason.
    - Slaughter operations must provide training to all staff (whether full-time, part-time, seasonal or contractual) and/or managers that:
        - a. is written and/or hands-on;
        - b. is presented in all necessary languages;
        - c. describes all aspects of the individual's responsibilities;
        - d. describes emergency procedures;
        - e. is provided prior to the individual's handling of any fish on the operation;

        - f. is on-going as necessary and, at a minimum, when any changes affecting the slaughter of salmon are implemented.
    - Appendix II: Automated percussive stunning followed by exsanguination within ten seconds, electrical stunning followed by exsanguination within 10 seconds, manual percussive stunning (only as backup method) followed by exsanguination within ten seconds.

RSPCA Assured: Total = 6.5

- **Environmental Enrichment (0.4):**
    - The units in which fish are kept should be designed with full consideration of their welfare needs, and should protect them from physical or physiological discomfort, distress and injury, and allow them to perform natural behaviors. The stock-keeper is responsible for providing the life support system for farmed fish and should maintain the highest environmental quality at all times.
    - SW 1.4 Whichever net design is being used, the proportion of the cone which is included in stocking density calculations must permit a minimum of a 5m diameter swim circle.
    - Physical enrichment is only mentioned for wrasse and lumpfish.
    - CF 7.1 For wrasse over 10 grams, suitable environmental enrichment, such as artificial kelp and hides, must be provided.
    - Sea pen environment/enrichment: lumpfish CF 14.0 Pens must have suitable structures and substrates to provide the lumpfish with adequate refuges and places to rest.
    - FW 1.5 'The RSPCA are aware of trials examining the introduction of environmental enrichment to tanks to reduce fin damage. The results from such trials would be greatly appreciated by the RSPCA Farm Animals Department in order to inform future standards.'
- **Water Quality (2):**
    - FW 1.7.1 Water quality composition must be monitored at least daily.
    - EVQ 1.1 Water quality composition must be monitored sufficiently frequently, if necessary daily, depending on the system, time of year and lifecycle stage of stock (as specified in the VHWP – see H 1.1).
    - EVQ 1.2 If water quality departs from the acceptable range, steps must be taken immediately to identify the source of the problems and rectify the situation as quickly as possible.
    - EVQ 1.3 The Emergency Action Plan must contain provisions to account for potentially catastrophic events that may adversely affect water quality, such as algal or jellyfish blooms.
    - "FW 1.6 The following water quality parameters must be complied with when water quality is recycled: (Parameter Ova Alevins Fry/Fingerlings Ongrowers)
        - Oxygen (O2) mg/l 7.0 7.0 7.0 7.0.

        - Oxygen (O2) saturation % in exit water >90.0 >90.0 >70.0 >70.0
        - Free ammonia (NH3) mg/l N/A <0.025 <0.025 <0.025
        - Carbon dioxide (CO2) mg/l <10.0 <10.0 <10.0 <10.0
        - Max temp °C 10.0 10.0 12.0 16.0
        - Min temp °C 1.0 1.0 1.0 1.0
        - pH in inlet water 7.0 to 8.0 7.0 to 8.0 7.0 to 8.0 7.0 to 8.0
        - Non-spate suspended solids (turbidity) mg/l <25.0 <25.0 <25.0 <25.0
        - Nitrite mg/l <0.2 <0.2 <0.2 <0.2
        - Nitrate mg/l N/A N/A <50.0 <50.0 "
- **Space Requirements & Stocking Density (2):**
    - FW 1.5.2 For first feeding and on-growing tanks, raceways and ponds, the maximum stocking density must not exceed 60kg/m3.
    - FW 1.5 The following maximum stocking densities must not be exceeded:
        - Hatchery 15,000 per California basket/tray
        - Multi-level 20,000 eggs per tray
        - First feeding tank 10,000/m2
        - Freshwater production tank:
            - Liveweight (mean) Stocking density (kg/m3)
    - SW 1.1 Seawater enclosure 17kg/m^3
    - Seawater enclosure site maximum 15kg/m^3
    - Comprehensive scale for assessing crowdedness in appendix 2.
- **Feed Composition (0.3):**
    - Fish should have freedom from hunger and malnutrition by ready access to a high quality diet that is appropriate to their species, and allows full health to be maintained.
    - F 1.1 Feeding must be such that the quality, quantity and frequency are optimal for the fish's stage of development.
    - F 2.1 All feed must be manufactured from constituents that are free from active parasites and known fish pathogens and contamination.
    - F 2.2 All feeds used must be produced strictly to the standards laid down by all the relevant UK and EU legislation.
    - F 3.1 Food must be dispensed and distributed in such a way that fish can eat without undue competition.
    - F 3.2 Fish must be observed at least once a day during feeding.
    - F 3.3 The person feeding must check that fish on the periphery of the tank or enclosure receive adequate amounts of food.
    - F 3.4 Overfeeding must be avoided.
- **Stunning & Slaughter (1.8):**
    - All fish must be humanely stunned/killed.
    - S 1.4 The method of stunning/killing used must rapidly, and without pain and distress, render the fish insensible, until death supervenes.
    - S 1.4.1 Permitted stunning/killing methods for marine sourced trout are:
        - a) an effectively applied percussive blow
        - b) electronarcosis followed by bleeding or,
        - c) electrocution.

- S 1.4.2 Humane mechanical devices must be used in preference to a manual percussive blow (except for emergency killing).
- S 1.4.3 When used, the use of mechanical devices must be monitored to ensure that they are working properly and that they are delivering the stun at the correct location.
- S 2.12 A back-up manual percussion stunner must be available at all times to humanely dispatch fish which are showing signs of consciousness.
- S 2.4 Fish must be carefully observed throughout the process to ensure that none of them are showing any signs of recovery before any further handling of them.
- S 2.5 The following welfare outcomes relating to assessing the effectiveness of the stun must be carried out at the end of the process and recorded:
    - a) no eye movement
    - b) no rhythmic opercular movement
    - c) only mild short-term involuntary muscular twitches
    - d) fish turn over and remain upside down
    - e) no sign of fish attempting to swim
- S 2.6 All personnel must be able to identify when fish have been properly stunned/are dead.
- S 2.7 All personnel must be competent and able to operate the electrical system safely.
- H 2.1 Any seriously sick or injured fish, or fish found not to be recovering, must be humanely killed without delay. Records of this must be made available on request.
- H 2.2 During the seawater stage, in addition to anesthetic overdose, the following are permitted for the emergency killing of fish:
    - a) a priest of appropriate size for the fish
    - b) a mechanical percussive device.
- H 2.2.1 Use of the emergency killing methods listed under H 2.2 a) and b) must result in a non-recoverable percussive blow to the head of the fish to render it immediately insensible.
- H 2.3 Under no circumstances must seriously injured or sick fish be left to die in the air.
- H 2.4 Culling of sick or injured fish must only be conducted by suitably trained and competent people."

Naturland: Total = 6.34

- **Environmental Enrichment (0.9375):**
    - Naturland's holistic approach encourages extensive to semi-intensive production and inclusion of biodiversity promoting modifications. Depending

on the species, the ecological modifications lead to natural feed availability and natural habitat structure.
    - 4.1 The husbandry conditions must enable the animal to behave in a way natural to the species; this refers, in particular, to behavioral needs regarding movement, resting and feeding as well as social and reproduction habits. The husbandry systems shall be designed keeping all this in view, e.g. in respect of stocking density, soil, shelter, shade and flow conditions.
    - 4.1 If there is sufficient evidence that artificial illumination is necessary, then the simulated day length shall not exceed 14 hours, unless longer periods are required to induce reproductive effects (e. g. to prevent cod from spawning and salmon from smoltification).
    - Carp: 2. On average, at least 30% of embankment line shall represent the natural biotope structure to at least 2 m depth in the form of a helophytic zone, reed and/or overhanging trees/shrubs.
    - Tropical Fish: 2.5 In pond farms, on at least 10% of production area, the natural vegetation shall be allowed to develop undisturbed (as a refuge for native animal species).
- **Water Quality (0.8):**
    - 4.1 The water quality (e.g. temperature, pH, salinity, oxygen, ammonium and nitrate concentrations) must conform to the natural requirements of the species in question.
    - More specific water quality requirements given by species in the appendices. However many of these focus on pollution levels rather than other important parameters for welfare.
    - Tropical Fishes 2.1 The water quality of source water shall not become significantly deteriorated (standard value <10% of the parameters determined, see footnote) due to the farming operation. In the case of pond farms, this shall be secured by sedimentation ponds and/or filtering plants dimensioned adequately. Settled particulate organic matter (products of metabolism, feed residues) shall be removed and brought to adequate reusage (e.g. as fertilizer in agriculture).
- **Space Requirements & Stocking Density (2):**
    - 3.2 In the case of crayfish (Astacus astacus, Pacifastacus leniusculus) the following maximum stocking densities are to be observed: For small-sized crayfish (< 20 mm): 100 crayfish per m2 . For medium-sized crayfish (20 - 50 mm): 30 crayfish per m2 . For adult crayfish (> 50 mm): 5 crayfish per m2 , provided that adequate hiding places are available. Shelters etc. may be included when calculating the area to be complied with. When farm Pacifastacus leniusculus in particular, precautionary measures must be taken and the legal requirements complied with in order to prevent the crayfish plague being transmitted to crayfish living in their natural environment.
    - 3. Stocking density of salmon (Salmo salar) shall not exceed 10 kg fish/m3 . The maximum stocking density of brook trout (Salvelinus fontinalis) and whitefish (Coregonus) is 15 kg/m^3. The maximum stocking density of trout (Oncorhynchus, Trutta) and arctic charr (Salvelinus alpinus) is 20 kg/m^3. Where salmonids are kept in net cages, the maximum stocking density is 10 kg/m^3. In no case shall

the animals display any injuries (e.g. to their fins) indicating too high stocking densities.
    - 4. Stocking density The stocking density may not exceed 10 kg/m3 in ponds and net cages (pens, enclosures), this being the upper limit. In no case may the fish show evidence of injuries (e.g. to their fins) which would indicate excessive stocking density.
    - 3. Stocking density In the case of members of the species Perciformes, Carangiformes and Gadiformes, the stocking density shall not exceed 10 kg fish/m3 . In no case shall the animals display any injuries (e.g. of the fins) indicating too high stocking densities.
- **Feed Composition (1.3):**
    - 8.3 Type, quantity and composition of feed must take into account the natural feeding methods of the concerned animal species. The activity level and the condition of the animals mainly give indications in this respect (e.g. corpulence factor, fat tissue). The proportion of animal feed components is to be replaced by vegetable products wherever nutritionally justifiable. For this reason, maximum values for the use of fish meal/oil may be determined for specific species (ref. B. Supplementary Regulations for specific farming systems and animal species).
    - 2.7 Unsatisfactory feed conversion is an indication of increased nutrient outflow, which is why the feed conversion ratio must be measured several times during the life cycle and adapted where necessary.
    - 8.7 For certain farming systems, an upper limit for the quantities of feed introduced may be determined (ref. B.Supplementary Regulations for specific farming systems and animal species).
    - 8.4 Special requirements are made as to the origin of fish meal/oil (ref. Appendix 1) "The following sources are permissible: 1. products from organic aquaculture 2. Fishmeal/-oil from trimmings of wild fish processed for human consumption 3. Fishmeal/-oil from by-catches of captures for human consumption in line with corresponding regulations and initiatives.
- **Stunning & Slaughter (1.45):**
    - 9.2 Slaughtering of fishes shall be carried out by means of incision of gills or immediate evisceration. Prior to this, fishes have to be stunned (by means of concussion, electrocution and, if need be, by natural plant anesthetics, tropical and subtropical fish and invertebrates also by using ice, provided that it is not otherwise specified for certain species in the Special Part).
    - 9. A reporting protocol for slaughter which governs the proceedings adopted in connection with catching, sorting, caging, stunning and killing in detail is to be submitted prior to initial certification and co-ordinated with Naturland and must be brought up to date as required. It must include the following details: responsibilities, proof of expertise of those carrying out the procedures, the timing of all processes and the place where they are performed, from catch to slaughter, equipment and substances used, stunning (e. g. type of procedure, type of facility, setting and maintenance of apparatuses), monitoring of success of stunning, measures to be taken in the case of unsuccessful stunning, repeat

stunning, kill (e. g. cutting line), environmentally sound disposal of slaughtering waste.

Friend of the Sea: Total = 4.48

- **Environmental Enrichment (0.3):**
  - 1.8 Structural enrichment should be provided. If deemed impossible or harmful, other type of enrichment should be implemented (occupational, dietary, social, sensorial).
  - 1.5 Optimal photoperiod for fish welfare must be determined on a site-by-site basis using practical experience, research and welfare specialist advice. Maximum range: 12:12 to 8:16 L:D.
- **Water Quality (1.2):**
  - 8.1 The unit of certification has measures to reduce adverse impacts on water quality. A water sampling plan is in place to ensure that farming practices reduce adverse impacts on water quality. This plan is established in accordance with the risk assessment and includes at least the following key parameters:
  - 2.1 A contingency plan must exist to correct water quality parameters when they deviate from reference values.
  - 2.2 Temperature should be verifiable at all times and must be between X to X (depending on species).
  - 2.3 Oxygen levels must be verifiable at all times and must be > 70% oxygen saturation. or 2.3 Oxygen levels must be verifiable at all times and must be > 9 mg/L for eggs, 4 mg/L for juveniles < 15°C, 6 mg/L > 15°C. (Specific requirements vary depending on species).
  - 13.2 Stocking density should be monitored in relation to fish health and behaviour indicators (see Section 3 Animal Health and Welfare and Section 12 Welfare Assessment). Water quality must be monitored frequently and on demand (see Aqua-inland point 8 and Section 2 Water).
- **Space Requirements & Stocking Density (1):**
  - 13.1 Fish stock numbers, average weight and total biomass must be monitored weekly. Records for monitoring and documentation must be available for inspection.
  - 13.2 Density of fish must be between x and x kg/m3 (dependent on species).
- **Feed Composition (0.3):**
  - 4.2 The farm must ensure that feeding regimes are according to manufacturer's guidelines, farmer experience, and feeding behavior. Adjustments of feeding regimes should be based on fish behavior, appetite, expected biomass, and minimisation of feed waste.
  - 4.3 Feed must be dispensed and spread throughout the rearing space to minimize the risk of over- and under-feeding and to reduce feeding competition.

    - 4.4 Fish must be observed at least once per day during feeding, and feeding behavior should be registered. Records must be available for inspection.
- **Stunning & Slaughter (1.675):**
    - 11.1 Any seriously sick or injured fish, or fish found not to be recovering, must be immediately removed and humanely killed without delay.
    - 11.2 Fish must only be culled using overdose of anesthetic.
    - 11.3 Culling of any fish must only be conducted by suitably trained and competent people.
    - 13.8 Operators must be able to demonstrate their proficiency in procedures that have the potential to cause pain or distress including, handling, crowding and culling.
    - 14.2 The only permitted stunning and subsequent killing methods are: a) an effectively applied percussive blow, b) electronarcosis followed by bleeding, asphyxia or other slaughter method that must be applied while the fish unconscious, c) electrocution (i.e. killing by electrical current).
    - 14.3 A backup system e.g. 'priest' must be available throughout the killing process.
    - 14.6 All staff involved with the stunning and killing process must have received full training.
    - 14.9 Video recordings of harvesting, stunning and slaughtering must be performed regularly (once per month or every time there is any change in protocols).

GLOBALG.A.P: Total = 3.88

- **Environmental Enrichment (0.5):**
    - AQ 20.2.2: Equipment shall be designed and fit for purpose to avoid physical damage and to ensure minimal stress to the stock.
    - AQ 20.2.16: Based on the increased understanding of the husbandry of aquatic species, consideration shall be given to enhancing physiological and behavioral needs E.g. environmental enrichments. Due to the large variety of aquaculture species, research has only been focussed in the main farmed finfish species and in limited farming conditions. As a result, no specifics or conditions are given.
- **Water Quality (0.9):**
    - AQ 20.2.9: A written hygiene plan detailing the most important elements regarding farmed aquatic species health:
        - Water quality
        - Cleaning methods
        - Cleaning agents (labeled for food contact surfaces when appropriate)
        - Disinfectants
        - Application period
        - Application frequency

        - Collection and handling of mortalities
    - AQ 20.2.17: A risk assessment is undertaken to demonstrate that water quality does not compromise food safety and animal health and welfare.
    - AQ 20.2.17: A documented risk assessment shall be in place covering all potential water pollution sources affecting food safety and animal health and welfare. Where risks have been identified, measures are taken such as water treatment, filtration, disinfection, etc. Water sources not suitable for the aquaculture process, shall, where available, be clearly marked.
    - AQ 20.2.19: The farm/hatchery/transport and holding facilities have a routine water quality monitoring and control program based on a risk assessment and taking into account potential contamination, farmed aquatic species health and welfare, and the production system.
    - AQ 20.2.19: The farm shall have in place a risk-based monitoring and control system for water quality to ensure the health and welfare of the farmed aquatic species is not compromised. The risk assessment (refer to AQ 20.2.17) shall include relevant water quality parameters, fluctuations, and sampling points (at farm or production unit level), such as temperature, dissolved oxygen, carbon dioxide, dissolved nitrogen (over-saturation), pH, ammonia, nitrate, nitrite, and suspended solids and microbiological parameters (e.g. fecal indicators), among others identified in the risk assessment as necessary. Records for each site shall be in place. Frequency shall be related to the aquaculture system used and is established by the risk assessment. Laboratory testing occurs in a manner consistent with industry requirements and prevailing regulations.
- **Space Requirements & Stocking Density (0.75):**
    - AQ 20.2.10: Farmed aquatic species stock numbers, average weight, and total biomass shall be monitored at production unit level. Records for monitoring and documentation shall be available.
    - AQ 20.2.14: The farm/hatchery/transport operate according to set densities.
    - AQ 20.2.14: A density shall be established in relation to farmed aquatic species, size, production stage, environment and production system. Where no legislative requirements exist, the farm shall show that limits are based on scientific evidence or industry best practice regarding health and welfare and food safety. Density limits shall not be set as an average for the system, or as a production cycle average. Set densities shall not be exceeded. Stocking densities shall be calculated, and records shall be in place.
- **Feed Composition (0.575):**
    - AQ 20.2.13: The farm has a system in place to assure appropriate feeding levels and feed usage records.
    - AQ 20.2.13: The farm shall have a system in place to ensure that feeding levels are in accordance with needs based on e.g. feed manufacturer's guidelines or farming experience. The system shall ensure an evenly distribution of the feed to the population, and have a mechanism for the adjustment of feeding levels depending on appetite and expected biomass and to minimize feed waste, avoid competition and aggression. Feeding records shall be present and shall demonstrate monitoring of feed efficiency.

    - AQ 22: While the aquaculture industry is expected to grow in the future, reliance on forage fish use in feed should not. Sustainable sourcing, efficient use of the marine ingredients and the use of alternatives to forage fish are fundamental steps to reduce and eliminate detrimental effects in the marine ecosystem. Refer to the GLOBALG.A.P. Compound Feed Manufacturing standard.
    - AQ 22.1.2: All compound feed used at the farm, for targeted species and cohabitant species, have been manufactured by and obtained from a recognized source.
    - AQ 22.2.3: Farms obtain from their feed suppliers a declaration that the formulation of each diet conforms to the GLOBALG.A.P. specifications.
    - AQ 22.2.3: Statements specifying conformity shall be in place. The compound feed supplier shall provide information of the fishmeal composition upon request, including fish meal percentage and when possible, origin (wild catch, industrial by-products, other). Farms shall have in place Fish In vs Fish Out information.
- **Stunning & Slaughter (1.15):**
    - AQ 20.2.23: Culling of farmed aquatic species is done according to prescribed methods respecting animal welfare and the AHP.
    - AQ 26.1.2: The slaughter method used is specified in the AHP with consideration to the farmed aquatic species welfare.
    - AQ 26.1.3: All harvesting staff receive farmed aquatic species welfare training in relation to the slaughter process. Records of training in farmed aquatic species welfare in relation to the slaughter process including specific training in the stunning and bleeding (when applicable) techniques are in place. Workers shall be able to demonstrate awareness at interview.
    - AQ 26.1.4: Farmed aquatic species are effectively stunned, with consideration of animal welfare.
    - AQ 26.1.4: Farmed aquatic species are stunned using an effective stunning method and immediately become unconscious. Monitoring procedures shall be in place. Monitoring procedures shall include manufacturer guidance, when applicable, and effectiveness of the stunner. Refer to the OIE Aquatic Animal Health Code/Stunning and killing methods (www.oie.int).

Best Aquaculture Practices: Total = 3.18

- **Environmental Enrichment (0):**
    - Standards or requirements are nonexistent.
- **Water Quality (1.1):**
    - Finfish and Crustacean Farms Appendix A has some values for water quality that apply to both the water body and the effluent. Most farms measure dissolved-oxygen levels frequently or continuously to ensure the well-being of

their fish, but determination of metabolites such as phosphates and ammonia is not considered necessary for BAP certification.
    - It's not clear how they are derived, e.g. from literature review or some other process. They are not species specific.
    - Aquaculture Facility Certification: Finfish and Crustacean Farms 14.4: *Facility staff shall make regular inspections of the culture facility, water quality, and behavior and condition of crustaceans or fish*.
- **Space Requirements & Stocking Density (0.5):**
    - Aquaculture Facility Certification: Finfish and Crustacean Farms 14.1: *The applicant's facility shall apply a maximum biomass limit based on performance measures for aquatic animal health and survival records, and any applicable national regulations*.
    - Aquaculture Facility Certification: Finfish, Crustacean and Mollusk Hatcheries and Nurseries: 2.7: *The AWS shall explain, set and keep under review stocking density limits appropriate to the species and size of animals being reared. Documents shall be available to verify these limits are observed*.
    - Aquaculture Facility Certification: Salmon Farms: 9.9: *The applicant shall apply stocking density criteria based on local conditions, which shall normally be at or below an average 25 kilograms per cubic meter, but may rise higher than this for 5 percent of the production cycle if the fish show other good welfare indicators, and water quality is good*.
- **Feed Composition (0.625):**
    - Some mention of nutrient efficiency (as in, making sure you're putting in and getting out roughly the right amounts) and one of the standards had a minimum growth rate but no mention apart from those.
    - Since the standards encourage FMFO to be reduced, inherently there may be some substitution towards plant-based ingredients. But this is not explicit.
    - 4.2.2 Fish Oil Forage Fish Dependency Ratio (FFDRo) for grow-out (calculated using formulas in Appendix 2) and the numbers seem to be based on literature reviews and stakeholder outreach which is promising.
- **Stunning & Slaughter (0.95):**
    - Aquaculture Facility Certification: Finfish and Crustacean Farms 14.6: *Humane slaughter techniques shall be used that are appropriate for the culture species*.
    - Aquaculture Facility Certification: Finfish, Crustacean and Mollusk Hatcheries and Nurseries 12.3: *The AWS shall include procedures for the humane treatment of brood animals during spawning and/or taking of eggs and sperm (whether induced or naturally occurring), and for slaughter where this is required. The procedures shall be designed to minimize unnecessary or inadvertent animal suffering, and records shall be available to demonstrate compliance with the procedures*.
    - Aquaculture Facility Certification: Salmon Farms: 9.12: *Prior to slaughter, fish shall be stunned humanely*.

Annexe 1: Criteria Explanation & Additional Concerns