Seafood Watch® Criteria for Aquaculture

The Monterey Bay Aquarium is committed to inspiring conservation of the oceans. To this end, Seafood Watch®, a program of the Monterey Bay Aquarium, researches and evaluates the sustainability of aquaculture products and shares these seafood recommendations with the public and other interested parties in several forms, including regionally specific Seafood Watch pocket guides, smartphone apps and online at www.seafoodwatch.org

This document contains the sustainability criteria by which aquaculture species and production systems are evaluated for the purpose of developing a seafood recommendation for consumers and businesses. Accompanying documents include a calculation and scoring tool and rationale document, both available online at www.seafoodwatch.org Wild capture seafood sources are evaluated with a different set of criteria.

Aquaculture is the process of converting resources from one form to another more desirable form via aquatic animals and plants. This process offers the potential for substantial economic and social benefits but has complex ecological, social and economic costs. The long-term sustainability of aquaculture depends on a balance and synergy of these costs and benefits. Overall, maximizing the social and economic benefits of aquaculture continues to be the driver for, and focus of, both subsistence and industrial production. These criteria focus on the environmental aspects of aquaculture and provide a tool to assess and highlight the ecological impacts and costs, thereby helping to inform and understand the ecological sustainability of different aquaculture systems.

Scoring principles

The criteria herein apply to all aquaculture species and production systems at all scales from individual farms to regional, national and international industries. Reference is made to 'fish' throughout for clarity, with the recognition that this term applies to all species of fish, shellfish, crustacea and aquatic plants.

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Criterion 1 – Data

Impact, unit of sustainability and principle

- *Impact:* Poor data quality and availability limits the ability to assess and understand the impacts of aquaculture production. It also does not enable informed choices for seafood purchasers or enable businesses to be held accountable for their impacts.
- *Unit of sustainability:* The ability to make a robust sustainability assessment.
- *Principle:* Robust and up-to-date information on production practices and their impacts is available to relevant stakeholders.

Assessment scale

Farm-level assessments – apply this criterion to the farm being assessed, or at a broader level, where relevant (e.g., national regulations or enforcement).
Regional or national assessments – apply to regional or national statistics, or relevant impacts. Use "typical" or "average" farms within the region or country, where necessary.

Data: Factor 1.1 – Data relevance

Confirm which data categories are relevant to the aquaculture operations being assessed.

Specify in the scoring table below which of the following categories (A–J) are relevant to the assessment (Category A is always considered relevant).
For example, Category F would not be relevant for a non-fed (e.g., extensive) aquaculture system or rope-grown shellfish.

	Data category
A	Production data – industry or farm size and production volumes, species, number and locations of farms or sites
B	Effluent – water quality testing, impact monitoring, regulatory control and enforcement
C	Habitat – farm locations, habitat types, impact assessments, history of conversion, habitat monitoring, habitat regulatory control and enforcement
D	Predator and wildlife mortality rates and population impacts
E	Chemical use – type, frequency, dose and discharge
F	Feed use – ingredients and sources, eFCR, inclusion rates of fishmeal and oil (including by-products), vegetable or crop meals and oils, land animal products and by-products
G	Escape numbers and size of animals, recapture or survival rates, international live animal movements, species and domestication status
H	Disease outbreaks, mortalities, pathogen and parasite levels and treatments, biosecurity characteristics
I	Source of farm stocks, use of wild fisheries for broodstock, larvae or juveniles
J	Other – e.g., energy use for water pumping or aeration

Data: Factor 1.2 – Data quality

A measure of the availability and quality of relevant data.

For each of the relevant categories A–J above, select the appropriate data confidence score according to the following definitions or guidelines, and fill in the scoring table below. While every eventuality may not be covered in the table, use the examples as guidelines to determine the most appropriate score.

Quality	Examples of data availability, quality and confidence	Score
High	▪ Independently verified, peer-reviewed research, official regulatory monitoring results or government statistics ▪ Complete, detailed, and available without averaging or aggregation ▪ Up to date within reason, and covering relevant timeframes ▪ Collected using appropriate methods (e.g., frequency of collection, number of data points, etc.) ▪ Overall, assessor confidence is high that the operation and its impacts are fully understood	10
Moderate-high	▪ Data quality does not meet the 'High' standards above but are complete and accurate in relation to this assessment ▪ Up to date within reason, and covering relevant timeframes; data gaps may be present but are non-critical ▪ Some non-critical aggregation or averaging may have taken place ▪ Data collection methods (e.g., frequency of collection, number of data points, etc.) are considered robust ▪ Overall, data are still considered to give a reliable representation of the operation(s) and/or impacts	7.5
Moderate	▪ Data may not be verified ▪ Some loss of relevant information may have occurred through data gaps, averaging or aggregation ▪ Data collection methods are questionable or unknown ▪ Data provides some useful information, but the assessor (subjectively) is uncertain whether data fully represent the farming operations	5
Low-moderate	▪ Data probably not verified ▪ Weaknesses in time frames or collection methods; data gaps or aggregation and averaging mean that critical interpretation is not possible ▪ Data provide little useful information and are not sufficient to give confidence that the operation and its impacts are well understood	2.5
Low	▪ Data are incomplete or out of date, unverified, or collection methods are inappropriate ▪ Data do not provide useful information and are not considered to represent the operation(s) and/or impacts	0.0

Data: Scoring table

For each relevant category, enter the data quality value in the 'Score' column.

	Data category	Relevance Y / N	Quality 0-10	Score
A	Industry/farm statistics	Y[1]		
B	Effluent			
C	Locations/habitats			
D	Predator and wildlife			
E	Chemical use			
F	Feed			
G	Escapes, animal movements			
H	Disease			
I	Source of stock			
J	Other (e.g., energy use)			
			Total	

$$\text{Data Score} = \left(\frac{\text{Total}}{\text{Number of relevant categories A-J}} \right)$$

Final data criterion score = _____ (range 0–10)

Note: In the majority of cases, the Seafood Watch Aquaculture Criteria have been constructed so that increasing data availability leads to a more robust assessment, but is also rewarded with the potential for better scores.

Criterion 2 - Effluent

Impact, unit of sustainability and principle

- *Impact:* Aquaculture species, production systems and management methods vary in the amount of waste produced per unit of production. The combined discharge of farms, groups of farms or industries contribute to local and regional nutrient loads.
- *Unit of sustainability:* The carrying or assimilative capacity of the local and regional receiving waters beyond the farm or its allowable zone of effect.
- *Principle:* Aquaculture operations minimize or avoid the production and discharge of wastes at the farm level in combination with an effective management or regulatory system to control the location, scale and cumulative impacts of the industry's waste discharges beyond the immediate vicinity of the farm.

[1] Industry/farm production statistics are always a relevant category.

Assessment guide

- This criterion applies to effluent effects outside the farm boundary or beyond an allowable zone of effect. Effluent impacts within the farm's boundary, immediate area or allowable zone of effect are addressed in Criterion 3 – Habitat.
- If good research or data are available, you may use either the evidence-based Rapid Assessment table below OR the full assessment in Factor 2.1 and 2.2.
- If the assessed operations do not have good effluent and/or impact data, or they cannot be easily addressed using the evidence-based table below, use Factor 2.1 and 2.2 below:

Effluent: Rapid assessment option (based on good data)

If good research or data are available, select the most appropriate score from the examples in the table below.

In the table, 'impacts' are defined as evidence of eutrophication, low dissolved oxygen, high sulphide contents, low redox potential, algae blooms, changes in species diversity or community structure associated with excess nutrients, salination or other relevant measurements or indicators of exceeding the nutrient carrying capacity of the local or regional environment at any time over multiple production cycles, particularly including periods of peak biomass, harvest and occasional operations (e.g., pond flushing or cleaning).

Impacts "beyond the immediate vicinity of the farm or discharge point" are suggested as beyond 30 m from the farm boundary or discharge point, or beyond an allowable zone of effect.

While every eventuality may not be covered in the table, use the examples as guidelines to determine the most appropriate score.

Effluent concern	Effluent or pollution examples	Score
No concern	▪ The species produced is extractive, or not provided external feed or nutrient fertilization and has no other effluent or waste impacts ▪ The production system does not discharge[2] wastes, or data show all wastes are treated on site, or collected and disposed of appropriately ▪ Data show the effluent discharged is of the same quality as the influent water supply	10
Low	▪ Data show no evidence that effluent discharges cause (or contribute to cumulative) local or regional impacts	8
Low-moderate	▪ Data show no evidence that discharges cause (or contribute to cumulative) impacts beyond the immediate vicinity of the farm or discharge point[3]	6
Moderate	▪ Data show only occasional, temporary or minor[4] evidence of impacts beyond the immediate vicinity of the farm or discharge point, or contributions to cumulative local or regional impacts	4
Moderate-high	• Data show evidence of frequent impacts beyond the immediate vicinity of the farm or discharge point, or contributions to cumulative local or regional impacts	2
High	▪ Data show discharges consistently cause impacts beyond the immediate vicinity of the farm or discharge point, and/or contribute to cumulative local or regional impacts	0
Critical	▪ Data show discharges from aquaculture operations lead to population declines in key indicator species beyond the immediate vicinity of the farm or discharge point, or result in mortality of protected or endangered species	C

Note: intermediate values (i.e., 1,3,5,7 or 9) may be used if needed.

Effluent criterion score = _____ (range 0–10)

If the assessed operation(s) cannot be addressed using these categories, continue to Factor 2.1 and 2.2 below:

[2] Soluble and solid nutrient wastes – including solids such as pond sludge, filter solids, etc.

[3] Immediate vicinity – as a guide, beyond 30 m from the farm, or beyond an allowable zone of effect

[4] Occasional, temporary or minor – as a guide, exceedences of regulatory limits or other values occur in less than 10% of the measurements within a year or less than 10% of the total duration of a year, and are not considered to have any lasting impact beyond the exceedence period.

Effluent: Factor 2.1 – Waste discharged per ton of fish

A measure of the amount of waste discharged from the farm per ton of fish produced, using nitrogen as the most data-rich proxy indicator.

Factor 2.1 is a combination of the waste produced per ton of fish (2.1a) and the proportion of that waste discharged from the farm (2.1b).

Factor 2.1a – Biological waste production per ton of fish

A measure of the amount of nitrogenous waste[5] produced for each ton of fish produced.

a) Protein content of feed = _____ %
b) Economic feed conversion ratio (eFCR[6]) = _____
c) Fertilizer nitrogen input per ton fish produced = _____ kg N t^{-1}
d) Protein content of harvested whole fish = _____ %
e) Protein nitrogen content factor = 0.16 (fixed value; protein is 16% nitrogen)

Nitrogen input per ton of fish produced = (a x 0.16 x b x 10) + c = _____ kg N t^{-1}

Harvested nitrogen per ton of fish produced = (d x 0.16 x 10) = _____ kg N t^{-1}

Waste N produced per ton of fish = N input - harvested N = ____ kg N t^{-1}
Factor 2.1a score = _____ kg N t^{-1}

Factor 2.1b – Production system discharge

This factor assesses how much of the waste produced by the fish is actually discharged from the farm; it acts as a multiplier value (between 0 and 1) for Factor 2.1a. A score of 1 means 100% of the waste produced is discharged; a score of zero means none of the waste is discharged (e.g., a system that assimilates, collects, treats or otherwise appropriately disposes of all wastes).

Select the basic scores and adjustments for the production system from the table below. If data are available on waste loss, waste treatment, waste collection or other aspects of the production system that reduce the loss of the nutrients, use them where possible (marked by 'X'). If no data are available, use the pre-selected values[7].

[5] Although phosphorous is also important, particularly in freshwater, nitrogen data is much more accessible and therefore used as an overall proxy for waste.
[6] eFCR = total feed inputs divided by total harvested fish output over the entire production cycle. It should ideally be averaged over multiple production cycles and take account of seasonal differences (e.g., wet or dry season, age of fish). If these data are not readily available, be precautionary and use the best data available.
[7] Based on the scientific literature for farm-level discharges.

System characteristic	Basic score	Adjust
Nets, cages and pens		
Open exchange net pens or cages	0.8	
Modified cages (e.g., 'diapers') – provide data on waste collection	X	
Adjustment – other – provide data		-X
Ponds		
Ponds – unknown operation, or operating as a flow-through raceway system	1.0	
Ponds – daily exchange	0.51	
Ponds – discharge once per cycle, exchange at harvest	0.34	
Zero exchange ponds over multiple cycles	0.24	
Ponds – other – provide data	X	
Adjustment – settling pond adjustment (daily use with discharged water; minimum 12 hours retention time)		-0.17
Adjustment – use of settling pond for discharged harvest water		-0.1
Adjustment – proper sludge disposal adjustment		-0.24
Adjustment – other – provide data		-X
Raceways or tanks		
Raceways, tanks – operating as flow-through	1.0	
Raceways, tanks – flow-through with solids filtration, collection and appropriate disposal	0.8	
Raceways, tanks – recirculation system, solids collection plus biofiltration treatment (or other) for soluble wastes; minimal water exchange	0.2	
Raceways, tanks – other treatment system – provide data	X	
Adjustment – inappropriate disposal of collected solid wastes		+ 0.2
Adjustment – other – provide data		-X
Other systems		
Provide data	X	- X
Other adjustments		
Adjustment - use of IMTA or other nutrient uptake system – provide data on N uptake		- X
Other adjustments		X

Basic (unadjusted) production system discharge score = _____
Adjustment 1 = _____ (leave blank if no adjustments)
Adjustment 2 = _____
Adjustment 3 = _____
Factor 2.1b – Discharge score = _____ (range 0-1)
Note: the final discharge score must be between 0 and 1 (i.e., between 0 and 100% of the waste produced is discharged).

Factor 2.1 score:

Waste discharged = Waste produced x Production system discharge score
Waste discharged per ton of fish = 2.1a x 2.1b = _____ kg N ton^{-1}

Discharge description	Value (kg N ton^{-1})	Score
	0	10
Low	0 – 10	9
	10 – 20	8
Low-moderate	20 – 30	7
	30 – 40	6
Moderate	40 – 50	5
	50 – 60	4
Moderate-high	60 – 70	3
	70 – 80	2
High	80 – 90	1
	> 90	0

Factor 2.1 score = _____ (range 0–10)

Effluent: Factor 2.2 – Management of farm-level and cumulative impacts

This factor is a measure of the presence and effectiveness of laws, regulations and management control measures (appropriate to the scale of the industry) to limit the *total* discharge of wastes from farms and the *cumulative* impacts of aquaculture effluent from multiple farms to within the carrying capacity of the receiving environment.

The above waste score (Factor 2.1) is on a "per ton of production" basis, and therefore does not directly measure the total amount of waste discharged from one or more farms, or the impacts of these wastes. Even aquaculture operations that produce a lot of waste per ton of production can have a minimal overall impact if the farm's size and location, or the concentration and connectivity of multiple farms are well managed or regulated. Similarly, aquaculture operations that discharge relatively small amounts of waste per ton of production could have substantial impacts if the farms are large and/or concentrated.

Assessment scale

Farm level – apply at the farm level, if applicable farm level certification or management practices are present, otherwise apply at the regional or country level according to the relevant control measures.
Regional or country – apply the relevant regional or national control measure to the "average" farm.

Note: It is considered unacceptable for farms, industries or countries that export farm-raised seafood to be less than fully transparent about the environmental management measures and regulations that control the way the exported seafood was produced. This includes making those measures and regulations available in the language of the importing countries.

Factor 2.2a – Intent and content of effluent regulations and management measures

Using the relevant FAO National Aquaculture Legislation Overview (NALO) country factsheet, answer the following questions on effluent regulations. If the relevant country factsheet is not available, search the FAO's FAOLEX legislative database.

NALO - http://www.fao.org/fishery/collection/nalo/en
FAOLEX - http://faolex.fao.org/faolex/index.htm

An additional search should be made (or contact initiated with relevant country experts) to check for recent legislation enacted since the last update of these databases.

For third party certified farms or other independently verified standards, it is acceptable to answer the questions relating to the relevant standards and inspection/audit process where these are considered to be more robust than the regulatory (or other) system.

Note: "Control measures" referes to policies, legislation or regulations, and/or independently verified management measures, codes of practice, Best Management Practices or certification schemes that have the appropriate language[8] and authority for enactment. The next factor (2.2b) assesses the enactment and enforcement of such measures.

Scoring answers: Yes = 1; Mostly = 0.75; Moderately = 0.5; Partly = 0.25; No = 0

Questions	Score
1 – Are effluent regulations or control measures present that are designed for or are applicable to aquaculture[9]?	
2 – Are the control measures applied according to site-specific conditions and/or do they lead to site-specific effluent, biomass or other discharge limits?	
3 – Do the control measures address or relate to the cumulative impacts of multiple farms?	
4 – Are the limits considered scientifically robust and set according to the ecological status of the receiving water body?	
5 – Do the control measures cover or prescribe monitoring of all aspects of the production cycle including peak biomass, harvest, sludge disposal, cleaning, etc?	
Total = (0–5)	

Factor 2.2a score = _____ (0–5)

Factor 2.2b – Enforcement of effluent regulations and management measures

The most comprehensive regulations or management measures are worthless without effective enactment and enforcement, yet these aspects are typically difficult to assess. Contact enforcement agencies and in-country NGO, academic or industry experts to answer the following questions.

If the assessed operation's third-party certification is the most relevant example of good management, then apply the questions to the inspection/auditing and certification process.

[8] Appropriate language – avoidance of 'should', 'minimize', etc.
[9] Designed for or applicable to aquaculture – as opposed to regulations designed for fisheries, agriculture or other activities or industries that are poorly related to the needs of aquaculture regulation. Aquaculture certification standards should receive a 'yes' score.

Scoring answers: Yes = 1; Mostly = 0.75; Partly = 0.5; Slightly = 0.25; No = 0

Questions	Score
1 – Are the enforcement organizations and/or resources identifiable and contactable and appropriate to the scale of the industry?	
2 – Do monitoring data or other available information demonstrate active enforcement of the control measures?	
3 – Does enforcement cover the entire production cycle (i.e., are peak discharges such as peak biomass, harvest, sludge disposal and cleaning included)?	
4 – Does enforcement demonstrably result in compliance with set limits?	
5 – Is there evidence of robust penalties for infringements?	
Total = (0–5)	

Factor 2.2b score = _____ (0–5)
Factor 2.2 score = (2.2a x 2.2b) / 2.5

Factor 2.2 effluent management score = _____ (range 0–10)

Final effluent criterion score

Although reducing waste produced per ton of production is important, the total or cumulative amount of waste produced by the farms and the industry is typically more important.

The effectiveness and enforcement of the management regime is most relevant to controlling farm size, total waste discharge and cumulative industry impact. The scoring matrix below therefore favors a low waste discharge per ton of production, but also values the effectiveness of management to control cumulative impacts.

Select the final effluent score from the table using the waste discharge (Factor 2.1) and management (Factor 2.2) scores.

		Management score (Factor 2.2)										
		10	< 10	< 9	< 8	< 7	< 6	< 5	< 4	< 3	< 2	< 1
Waste discharge score (Factor 2.1)	10	10	10	10	10	10	10	10	10	10	10	10
	9	10	10	9	9	9	8	8	7	7	7	6
	8	10	9	9	8	8	7	7	6	6	5	5
	7	10	9	8	7	7	6	6	5	5	4	4
	6	10	9	8	7	6	6	5	5	5	4	3
	5	10	8	7	6	6	5	5	5	4	4	3
	4	10	8	7	6	5	5	4	4	4	3	2
	3	10	8	7	6	5	4	4	4	3	2	1
	2	10	7	6	5	4	4	3	3	2	1	0
	1	10	7	6	4	3	3	2	2	1	0	0
	0	10	6	5	3	2	2	1	1	0	0	0

Final effluent criterion score = _____ (range 0–10) (Zero score = critical)

Criterion 3 – Habitat

Impact, unit of sustainability and principle

- *Impact:* Aquaculture farms can be located in a wide variety of aquatic and terrestrial habitat types and have greatly varying levels of impact to both pristine and previously modified habitats as well as to the critical "ecosystem services" they provide.
- *Unit of sustainability:* The ability to maintain the critical ecosystem services relevant to the habitat type.
- *Principle:* Aquaculture operations are located at sites, scales and intensities that cumulatively maintain the functionality of ecologically valuable habitats.

Habitat: Factor 3.1 – Habitat conversion and function

A categorical measure of habitat impact taking account of the ongoing functionality of affected habitats and the historic or ongoing nature of the habitat conversion for aquaculture.

This factor is based on the following definitions:

- Maintaining functionality – aquaculture has not caused the loss of any critical ecosystem services.
- Loss of functionality – aquaculture has caused 'major' habitat impacts, defined as the loss of one or more critical ecosystem services.
- Critical ecosystem services are those that:
    - society depends on or values;
    - are undergoing (or are vulnerable to) rapid change;
    - have no technological or off-site substitutes (see Rationale for more information).

Assessment guide:

Step 1

- Determine the appropriate habitat type for the farm, farms, region or industry being assessed. Use "average" habitat types where necessary, or split the assessment into different recommendations if habitat types lead to different scores and overall ranks.

Step 2

- Determine if key ecosystem services continue to function, and the degree of functionality remaining.
    - If all critical ecosystem services are maintained, the habitat is considered to be "maintaining full functionality".
    - If all critical ecosystem services are maintained to some degree, the habitat is considered to be "maintaining functionality" and the score will depend on the degree of impact.
    - If any critical ecosystem service has been lost, the habitat is considered to have lost functionality.
- If the habitats are considered to be maintaining functionality, then use Table 1 and the examples in the Appendix to determine the appropriate score.
- If the habitat is considered to have lost functionality, go to Step 3.

Step 3

- If the habitats are considered to have lost functionality, then consider the scores in Table 2 and use the habitat values in Table 3 where necessary.

For additional guidance, consider the examples in the Appendix.

Habitat: Table 1 – Maintaining habitat functionality

Habitat functionality	Impact on habitat functionality	Score
Maintaining functionality	Maintaining full functionality	10
	Minimal impacts	9
	Minor-moderate impacts	8
	Moderate impacts	7
Loss of functionality	Major impacts	Go to Table 2

Habitat: Table 2 – Loss of habitat functionality

Timeframe of habitat loss	Habitat value	Score
Historic, > 10 years	Low	6
Historic, > 10 years	Moderate	5
Historic, > 10 years	High	4
< 10 years or ongoing	Low	3
< 10 years or ongoing	Moderate	2
< 10 years	High	1
Ongoing	High	0

Habitat: Table 3 – Habitat value

High	Moderate	Low
Coastal intertidal Coastal/terrestrial shoreline Estuaries Tidal wetlands and forests Freshwater wetlands Coral reefs Seagrass/algae beds Freshwater lakes Rivers and streams Tropical broadleaf and mixed forests	Coastal inshore sub-tidal[10] Riparian land and floodplains Temperate broadleaf and mixed forests	Open ocean/offshore[11] Coniferous forests Grasslands, savanna and shrublands Desert and dry shrublands

Factor 3.1 score = _____ (range 0–10)

[10] Inshore sub-tidal = approximately from zero to three nautical miles from the main coastline.
[11] Open ocean/offshore = greater than three nautical miles offshore.

Habitat: Factor 3.2 – Farm siting management effectiveness

The above habitat conversion factor relates to a specific farm or to the 'typical' or 'average' farm in a region or country. Ecosystem impacts are driven largely by the cumulative impact of multiple farms in a location, habitat type, region or a country. This factor (3.2) is a measure of the presence and effectiveness of regulatory or management controls appropriate to the scale of the industry, and therefore a measure of confidence that the cumulative impacts of farms sited in the habitats declared in Factor 3.1 above are at appropriate spatial scales.

Using the relevant FAO National Aquaculture Legislation Overview (NALO) country factsheet, answer the following questions on siting and habitat regulations. If the relevant country sheet is not available, search the FAO's FAOLEX legislative database.

NALO - http://www.fao.org/fishery/collection/nalo/en
FAOLEX - http://faolex.fao.org/faolex/index.htm

An additional search should be made (or contact initiated with relevant country experts) to check for any recent legislation enacted since these databases were last updated.

For third party certified farms or other independently verified standards, it is acceptable to answer the questions relating to the relevant standards and inspection/audit process where these are considered to be more robust than the regulatory (or other) system at controlling impacts from multiple farms (considering that these farms may not themselves be certified).

Note: "Control measures" relates to policies, legislation or regulations, and/or independently verified management measures, codes of practice, Best Management Practices or certification schemes that have the appropriate language[12] and authority for enactment. The next factor (3.2b) assesses the enactment or enforcement of such measures.

[12] Designed for, or applicable to aquaculture – as opposed to regulations designed for fisheries, agriculture or other activities or industries that are poorly related to the needs of aquaculture regulation. Aquaculture certification standards would be scored as 'yes'. Appropriate language – avoidance of 'should', 'minimize', etc.

Factor 3.2a – Regulatory or management effectiveness

Scoring answers: Yes = 1; Mostly = 0.75; Partly = 0.5; Slightly = 0.25; No = 0

Questions:	Score
1 – Is the farm location, siting and/or licensing process based on ecological principles, including an Environmental Impact Assessment requirement for new sites?	
2 – Is the industry's total size and concentration based on its cumulative impacts and the maintenance of ecosystem function?	
3 – Is the industry's ongoing and future expansion limited to an appropriate scale and/or to appropriate locations, and thereby preventing the future loss of ecosystem services?	
4 - Are high-value habitats being avoided for aquaculture siting? (i.e., avoidance of areas critical to vulnerable wild populations; effective zoning, or compliance with international agreements such as the Ramsar treaty)	
5 - Do control measures include requirements for the restoration of important or critical habitats or ecosystem services?	
Total = (0–5)	

Factor 3.2a score = _____ (range 0–5)

Factor 3.2b – Siting regulatory or management enforcement

Scoring answers: Yes = 1; Mostly = 0.75; Partly = 0.5; Slightly = 0.25; No = 0

Questions:	Score
1 – Are enforcement organizations or individuals identifiable and contactable, and are they appropriate to the scale of the industry?	
2 – Does the farm siting or permitting process function according to the zoning or other ecosystem-based management plans articulated in the control measures?	
3 – Does the farm siting or permitting process take account of other farms and their cumulative impacts?	
4 – Is the enforcement process transparent – e.g., public availability of farm locations and sizes, EIA reports, zoning plans, etc?	
5 – Is there evidence that the restrictions or limits defined in the control measures are being achieved (see example[13])?	
Total = (0–5)	

Factor 3.2b score = _____ (range 0–5)

Factor 3.2 Siting management score = (3.2a x 3.2b) / 2.5 = _____ (range 0–10)

Final habitat criterion score = (2 x Factor 3.1) + Factor 3.2) / 3

Habitat criterion score = _____ (Range 0–10) (Zero score = critical)

[13] For example if mangrove cover is supposed to be maintained at greater than 60%, is there evidence that this is achieved? Or are Allowable Zones of Affect reactively monitored?

Habitat: Factor 3.3X – Predator and wildlife mortalities

A measure of the effects of deliberate or accidental mortality on the populations of affected species of predators or other wildlife.

Although different aquaculture operations attract a variety of different predators and wildlife (e.g., starfish and crabs to shellfish aquaculture, birds to ponds, and otters, seals and other marine mammals to sea cages), the impacts of mortalities (from shooting, trapping, entanglement, drowning, etc.) vary depending on the population status, species vulnerability or productivity, and the numbers killed. Substantial numbers of fish may also be trapped as juveniles and grow within the farm until harvest.

This factor (3.3X) is defined as an exceptional factor that may not be relevant to all aquaculture production, yet it can be a significant concern for those production practices where it is relevant. Whereas all other criteria or factors score positively and contribute to the overall score total, the exceptional factors are given a negative score which is subtracted from the final total score for those aquaculture operations where it is a concern.

Select the most appropriate score from the table below. Select the lowest (worst) score that is applicable to the aquaculture operations being assessed. Use time frames relevant to the impacted wild species. As a guide, use the number of years to reach first maturity (for example, consider average mortalities of Stellar sea lions over the last five years).

Assessment scale

Farm level assessments – apply this factor to the farm being assessed
Regional or national assessments – apply to relevant regional or national statistics or impacts, or use data from “typical” or “average” farms.

While every eventuality may not be covered in the table, use the examples as guidelines to determine the most appropriate score.

Concern	Examples of impacts on predators or other wildlife	Score
No concern	• No direct or accidental mortality of predators or wildlife • Passive non-harmful barriers or deterrents are used	-0
Low	▪ Aquaculture operation may attract or interact with predators or other wildlife, but effective management and prevention measures limit mortalities to exceptional cases	-2
Low-moderate	▪ Wildlife mortalities occur (beyond exceptional cases), but due to high population size[14] and/or high productivity[15] and/or low mortality numbers[16], they do not significantly impact[17] the affected species' population size	-4
Moderate	▪ Mortalities are known to occur but the species' status or impacts on the population size are unknown or considered 'moderate' between the definitions of Low-moderate and Moderate-high.	-6
Moderate-high	• Wildlife mortalities occur; due to low population size[18] and/or low productivity (or other measure of vulnerability), and/or high mortality numbers, they negatively impact the affected species' population size or its ability to recover.	-8
High (critical)	▪ Affected species are protected, endangered, threatened (or other relevant classification) and mortalities significantly[19] contribute to further declines or prohibit recovery.	-10

Note: Intermediate values (i.e., 1,3,5,7 or 9) may be used when justified or needed.

Factor 3.3X score = -_____ (range 0 to -10)

[14] Population is at or near its historic high or virgin biomass, or the population size is above the point where recruitment or productivity is impaired.
[15] Marine mammals, turtles, sharks, seabirds and other birds are considered to have low productivity.
[16] Mortality is low compared to natural mortality or mortality from other sources.
[17] Mortalities are at or below a level that will not reduce population productivity.
[18] The population size is below the point where recruitment or productivity is impaired.
[19] Significantly – as a guide, mortalities rates significantly (statistically) contribute to population declines, or are comparable to natural mortality rates or mortality from other causes, or they can be demonstrated to be significantly impeding recovery.

Criterion 4 – Chemical use

Impact, unit of sustainability and principle

- *Impact:* Improper use of chemical treatments impacts non-target organisms and leads to production losses and human health concerns due to the development of chemical-resistant organisms.
- *Unit of sustainability:* Non-target organisms in the local or regional environment, presence of pathogens or parasites resistant to important treatments.
- *Principle:* Aquaculture operations by design, management or regulation avoids the discharge of chemicals toxic to aquatic life and/or effectively controls the frequency, risk of environmental impact, and risk to human health of their use.

Chemical use: Criterion 4 – Evidence or risk of chemicals use

A measure of the likelihood of chemical use and discharge to the environment, taking account of the fundamentally poor availability of and low confidence in chemical use data.

Chemicals treatments of concern relevant to this criterion are broadly defined as those products used in aquaculture to kill or control aquatic organisms, and/or whose use may impact non-target organisms or raise concerns relevant to human health. It does not include chemicals such as mercury, PCBs, dioxins or other environmental contaminants associated with feed ingredients. Chemicals such as antifoulants, anesthetics and others can be accounted for in this assessment when there is evidence of impacts.

Assessment scale

Farm level assessments – apply this criterion to the farm being assessed
Regional or national assessments – apply to relevant regional or national statistics or impacts, or use data from “typical” or “average” farms.

Consider ALL the options in the following table and determine the appropriate level of concern before scoring. If chemical use and/or impacts are unknown, use the production system-based options. While every eventuality may not be covered in the table, use the examples as guidelines to determine the most appropriate score.

Concern	Chemical use examples	Score
No concern	▪ The production system is closed and does not discharge active chemicals or by-products (e.g., antibiotic resistant bacteria) ▪ The data score for chemical use is 0.75 or 1.0 and data show that chemical treatments have not been used over multiple production cycles ▪ The method of treatment does not allow active chemicals or by-products to be discharged	10
Low	▪ The data score for chemical use is 0.75 or 1.0 and data show that chemical treatments are used on average less than once per production cycle or once per year for longer production cycles ▪ The production system does not discharge water over multiple production cycles	8
Low-moderate	▪ No evidence of impacts on non-target organisms ▪ No evidence of resistance to key treatments ▪ Specific data may be limited, but the species or production systems have a demonstrably low need for chemical use ▪ The production system has very infrequent or limited discharge of water (e.g., once per production cycle or < 1% per day)	6
Moderate	▪ Evidence of impacts on non-target species within an allowable zone of effect ▪ Chemical use and/or impacts are unknown, the species or production system typically requires chemical use, and the treatment method allows the release of chemicals to the environment ▪ Some evidence or concern of resistance to chemical treatments ▪ No evidence of impacts on non-target species, but chemical use is known to be high and the production system allows active chemicals or by-products to be discharged[20]	4
Moderate-high	▪ Confirmed cases of resistance to chemical treatments ▪ Occasional, temporary or minor evidence of impacts to non-target organisms beyond an allowable zone of effect ▪ Chemicals highly important to human health are being used[21]	2
High	▪ Banned or illegal chemicals have been used ▪ Chemicals critically important to human health are being used[22] ▪ Negative impacts of chemical use seen on non-target organisms beyond an allowable zone of effect	0
Critical	▪ Evidence of pathogens with developed resistance to chemicals that are highly important or critically important to human health	C

[20] High – chemicals are used on multiple occasions each production cycle, or the production viability is considered to be dependent on chemical intervention.

[21] Highly important chemicals listed in - http://www.who.int/foodborne_disease/resistance/antimicrobials_human.pdf Table 1 have been used in the current or previous production cycle.

[22] Critically important chemicals listed in - http://www.who.int/foodborne_disease/resistance/antimicrobials_human.pdf Table 1 have been used in the current or previous production cycle.

Note: Intermediate values (i.e., 1,3,5,7 or 9) may be used when justified or needed.

Final chemical use criterion score = _____ (range 0–10 or critical)

Criterion 5 - Feed

Impact, unit of sustainability and principle

- *Impact:* Feed consumption, feed type, ingredients used and the net nutritional gains or losses vary dramatically between farmed species and production systems. Producing feeds and their ingredients has complex global ecological impacts, and the efficiency of conversion can result in net food gains or dramatic net losses of nutrients. Feed use is considered to be one of the defining factors of aquaculture sustainability.
- *Unit of sustainability:* The amount and sustainability of wild fish caught for feeding to farmed fish, the global impacts of harvesting or cultivating feed ingredients, and the net nutritional gains or losses from the farming operation.
- *Principle:* Aquaculture operations source only sustainable feed ingredients, convert them efficiently and responsibly, and minimize and utilize the non-edible portion of farmed fish.

This criterion intends to:

- Promote data transparency on feed use and ingredients
- Support the reduction of wild-caught fish used in feeds
- When wild-caught fish are used, support sourcing from sustainable fisheries
- Promote the use of non-edible (to humans) feed ingredients, and recognize the conversion of non-edible feed ingredients to edible aquaculture products
- Recognize the conversion of plant proteins to animal proteins through aquaculture
- Promote a net protein gain from aquaculture operations
- Promote post-harvest use of by-products from processed (e.g., filleted) aquaculture products

Assessment scale

- Farm level assessments – apply this criterion to the farm being assessed, or to typical or average data for the species raised if specific data is unavailable.
- Regional or national assessments – apply to relevant regional or national statistics or impacts, or use data from "typical" or "average" farms, or use typical or average data for the species raised.

Feed: Rapid assessment

The feed criterion score is 10 if no external feed is provided to the cultured organisms.
All other aquaculture operations (i.e. those that use feed) are assessed using Factors 5.1 – 5.3.

Feed: Factor 5.1 – Wild fish use

A measure of the amount of wild fish used to produce farmed fish, combined with the sustainability of the fisheries from which they are sourced.

Factor 5.1a – Fish in to fish out ratio (FI:FO)

A measure of the dependency on wild fisheries for feed ingredients using the ratio of the amount of wild fish used in feeds ('fish in') to the harvested farmed fish ('fish out').[23]

Data

Recognizing that data from feed companies may not be available, use the best available (most recent or relevant) data on a precautionary basis:

a) Fishmeal inclusion level* = _____ %
b) Fish Oil Inclusion level* = _____ %
c) Fishmeal yield % = _____ (use 22.5[24] if value is unknown)
d) Fish oil yield % = _____ (use 5.0 if value is unknown)
e) Economic FCR[25] = _____

Note on fish processing by-products, trimmings, etc. – Feed ingredients from trimmings, by-products or other processing wastes are NOT scored in this equation as it measures direct dependence on wild fisheries. If data are available for these ingredients, they can be subtracted from the inclusion levels used in the FI:FO calculation. E.g., if total fishmeal inclusion level is 40% and a quarter of the fishmeal comes from trimmings or by-products, the final inclusion level = 30%.

Note on the use of whole (unprocessed) or 'trash' fish for feed – If whole fish are used as feed, the eFCR effectively determines the FI:FO value. Use eFCR as the FI:FO value (or entering 22.5 as the FM inclusion level and 5 for FO in the equations along with the eFCR will give the same result).

FI:FO equations

A variety of equations are available for calculating FI:FO. The Seafood Watch equation is the same as that selected by the multi-stakeholder Aquaculture Dialogue process and will therefore continue to be used by Seafood Watch.

$$FI:FO_{FishMEAL} = \frac{a \times e}{c} = \_\_\_\_\_$$

$$FI:FO_{Fish\ OIL} = \frac{b \times e}{d} = \_\_\_\_\_$$

Final FI:FO value = the greater value of $FI:FO_{FishMEAL}$ or $FI:FO_{Fish\ OIL}$
Final FI:FO value = _____

FIFO score = 10 - (2.5 x FI:FO)
FIFO score = _____ (range 0–10)

Factor 5.1b – Source fishery sustainability

[23] Also commonly referred to as FFER – Forage Fish Efficiency Ratio, or FFDR – Forage Fish Dependency Ratio.
[24] Yield values from Tacon and Metian (2008). Other (similar) values are possible from Peron et al. (2010), but data clarity is not sufficient for a robust quantification of fishery landings.
[25] Economic FCR or eFCR = total feed used divided by total harvest of fish.

A simple measure of the sustainability of the fisheries providing fishmeal and fish oil.

This factor applies a negative adjustment to the FIFO score with an increasing penalty for decreasing sustainability. Using sustainable sources results in no penalty.

Note: This factor relies only on available third-party references[26] to fishery sustainability. It is not the intention of a Seafood Watch aquaculture assessment to undertake a full fishery assessment.
Note: If the source is unknown due to reasons beyond reasonable control of the operations being assessed (e.g., small-scale farmers that do not have the power to demand this information from their feed company), the penalty is smaller than if the source is unknown because the information is deliberately withheld.

Using an average, or annual weighted mass-balance estimate of the fishery sources used in a typical feed, decide the appropriate sustainability score according to the following descriptions and examples.

Score	Fishery sustainability examples
0	Sustainable[27] MSC certified without conditions Fishsource scores all > 8 SFW Green Fishery exceeds all reference points and has no significant concerns
-2	MSC certified with minor conditions All Fishsource scores ≥ 6, and one or more scores ≥ 8 Fishery meets or is close to all reference points with only minor concerns
-4	All Fishsource scores ≥ 6 MSC certified with major conditions SFW Yellow Fishery does not meet all reference points or has some significant concerns
-6	Unknown source fishery Unknown sustainability IFFO certified 'Responsible' FAO Code of Conduct compliant (independently verified) One Fishsource score < 6
-8	More than one Fishsource score < 6 SFW Red Fishery does not meet reference points or has significant concerns regarding bycatch or ecosystem impacts
-10	Demonstrably unsustainable (e.g., overfished with overfishing occurring) SFW Red Illegal, unregulated or unmanaged Unacceptable bycatch or ecosystem impacts Fishery source information deliberately withheld

[26] Third party sources – e.g., MSC, Fishsource, ICES, IFFO Responsible sourcing, other certification programs (FAO Code of Conduct), etc.
[27] On a realistic and pragmatic basis – i.e., the best current understanding of fishery sustainability (accepting that ecosystem-based forage fishery management is not yet fully developed).

Source fishery sustainability score = _____ (range 0 to -10)

Factor 5.1 Wild fish use score = FIFO score + [(FI:FO value x Sustainability score) / 10

Note: Negative values are possible with this equation, but in these cases the score is zero.

Factor 5.1 – Wild fish use score = _____ (range 0–10)

Factor 5.1 is critical if the value is zero.

Feed: Factor 5.2 – Net protein gain or loss

A measure of the net protein gained or lost during the fish farming process.

Aquaculture has the potential to be a net producer of protein, but when external feed is used in any significant quantity, there is typically a net loss of protein when feed is converted into farmed fish.

The equations below will function with very limited data, if necessary, but will reward transparency and a greater amount of data availability from the aquaculture producers or their feed companies with higher scores as follows:

- Data on the amount of feed protein coming from sources unsuitable for human consumption will reduce the protein IN score (rewarding their use).
- Data on the amount of crop ingredients used will allow an adjustment to be made for the improved protein quality of harvested fish (rewarding the use of crop alternatives to fishmeal).
- Data on the beneficial use of the non-edible by-products of harvested fish will improve the protein OUT score (rewarding the use of harvest by-products as further protein sources).

Basic data (required)

a) Protein content of feed = _____ %
b) FCR = _____
c) Protein content of whole harvested farmed fish = _____ %
d) Edible yield of harvested farmed fish[28] = _____ %

Optional data if available from the producers or their feed companies

To encourage greater transparency, these data points will all lead to improved final scores. Values for (e), (f), and (g) are zero if unknown.

e) Percentage of feed protein from sources *unsuitable* for human consumption (e.g., fish, animal or crop by-products or other processing wastes)* = _____ %
f) Percentage of feed protein from crop ingredients *suitable* for human consumption if known = _____ %
g) Percentage of the non-edible by-products from harvested farmed fish used for other food production = _____ %

[28] Enter the edible yield even if the harvested farmed fish are sold whole.

**Note:* This does not include protein from fishmeal made from whole fish.

For the purposes of this assessment, (a) to (g) are allocated into protein inputs and outputs as follows (see rationale for an explanation of this equation):

Factor 5.2a -- Protein IN = [a – (a x (e + (0.286 x f)) / 100)] x FCR
Factor 5.2b -- Protein OUT = (c / 100) x [(d + (g x (100-d)) / 100]

Net protein gain or loss % = (Protein OUT – Protein IN) / Protein IN

Net protein gain = _____ % (indicated by positive result)
OR
Net protein loss = _____ % (indicated by negative result)

	Protein gain or loss (%)	Score
Net protein gain	> 0	10
Net protein loss	0–10	9
	10–20	8
	20–30	7
	30–40	6
	40–50	5
	50–60	4
	60–70	3
	70–80	2
	80–90	1
	> 90	0

Factor 5.2 score = _____ (range 0–10). This is critical if the score = zero

Feed: Factor 5.3 – Feed footprint

An approximate measure of the global resources used to produce aquaculture feeds based on the global ocean and land area used to produce the feed ingredients necessary to grow one ton of farmed fish.

Factor 5.3a – Ocean area of primary productivity appropriated by feed ingredients per ton of farmed seafood

a) Inclusion level of aquatic feed ingredients* = FM% + FO% = ____ %
b) FCR = _____
c) Average primary productivity (carbon) required for aquatic feed ingredients = 69.7 tC t^{-1}
d) Average ocean productivity for continental shelf area = 2.68 t C ha^{-1}

*Include all aquatic ingredients; i.e., by-products or other processing wastes ARE INCLUDED in this calculation.

Ocean area appropriated = [(a x 0.01) x b x c] / d = _____ ha ton^{-1} of farmed fish

Factor 5.3b - Land area appropriated by feed ingredients per ton of production

a) Inclusion level of crop feed ingredients = ____ %
b) Inclusion level of land animal products = ____ %
c) Conversion ratio of crop ingredients to land animal products (e.g., feather meal, pig by-product meal) = 2.88 (fixed value)
d) FCR of the farmed fish = _____
e) Average yield of major feed ingredient crops = 2.64 tons crops ha^{-1} (fixed value)

Land area appropriated (per ton of farmed fish) = [(a + (b x c)) x 0.01 x d] / e

Land area appropriated = _____ ha ton^{-1} of farmed fish

Total global area appropriated per ton of farmed fish = Ocean area + Land area

Total area = _____ ha ton^{-1} of farmed fish

Total area	ha ton^{-1}	Score
Zero	0	10
Low	0–3	9
	3–6	8
Low-moderate	6–9	7
	9–12	6
Moderate	12–15	5
	15–18	4
Moderate-high	18–21	3
	21–24	2
High	24–27	1
Very high	> 27	0

Factor 5.3 score = _____ (range 0–10)

Final feed criterion score = [(2 x Factor 5.1 score) + Factor 5.2 score + Factor 5.3 score] / 4
= _____ (range 0–10)

The feed criterion is critical if:

- Wild fish use score is zero
- Net protein gain/loss score is 0, or
- FI:FO > 3 and net protein score <= 1.

Criterion 6 – Escapes and introduced species

Impact, unit of sustainability and principle

- *Impact:* Competition, genetic loss, predation, habitat damage , spawning disruption, and other impacts on wild fish and ecosystems resulting from the escape of native, non-native and/or genetically distinct fish or other unintended species from aquaculture operations.
- *Unit of sustainability:* Affected ecosystems and/or associated wild populations.
- *Principle:* Aquaculture operations pose no substantial risk of deleterious effects to wild populations associated with the escape of farmed fish or other unintentionally introduced species.

Assessment scale

Farm level assessments – apply this criterion to the farm being assessed, or use average or typical data from similar production systems and species if necessary.
Regional or national assessments – apply to relevant regional or national statistics or impacts, or use typical or average data for the production system or species.

Escapes: Factor 6.1 – Escape of principal farmed species

A combined measure of the physical risk of escape, with the ecological risk of impact for the species being farmed.

Factor 6.1a - Escape risk score

A measure of the escape risk (for the species being farmed) inherent in the production system.

Robust data on escape numbers are rarely available due the difficulty of counting total numbers of fish at stocking and harvest and knowing what proportion of any loss is due to mortalities versus escapes. Data collection and reporting of escapes (both escape 'events' and chronic trickle losses) is very rarely robust.

The following assessment is therefore based on risk associated with the characteristics of the production system, but the score can be adjusted (up or down) where available evidence or data[29] justifies such.

Considering the characteristics of the assessed or typical production system and any available data on escapes, select the most appropriate score from the following table of examples. While every eventuality may not be covered in the table, use the examples as guidelines to determine the most appropriate score.

[29] As a guide, the WWF salmon dialogue is proposing 200 fish as an "escape event" and 300 maximum escapes per production cycle.

Concern	Escape risk examples	Score
Very low	▪ No connection to natural water bodies (i.e., fully biosecure)	10
Low	▪ Tank based recirculation systems with appropriate (multiple) screens, water treatment, or secondary capture devices ▪ Static ponds with no water discharge (including at harvest) over multiple production cycles; not vulnerable[30] to flood, storm or tsunami damage	8
Low-moderate	▪ Any "Moderate risk" system with multiple or fail-safe escape prevention methods, or active Best Management Practices for design, construction, and management of escape prevention (biosecurity) ▪ Any "Low risk" system with uncertainty or evidence questioning the robustness of escape prevention measures ▪ Ponds with low exchange 0–3% per day	6
Moderate	▪ Ponds with moderate exchange 3–10% per day ▪ Ponds that drain externally at harvest ▪ Ponds with a moderate risk[31] of vulnerability to flooding events ▪ Flow-through tanks or raceways	4
Moderate-high	▪ Any "High risk" system with effective Best Management Practices for design, construction, and management of escape prevention (biosecurity) ▪ Any "Moderate risk" system with uncertainty or evidence questioning the robustness of escape prevention measures ▪ Ponds with high exchange > 10% per day	2
High	▪ Open systems (e.g., net pens, cages, ropes) without effective Best Management Practices for design, construction and management of escape prevention (biosecurity) ▪ Trickle losses occur in every production cycle, and/or a high risk of a large escape event exists ▪ Ponds in flood prone areas or vulnerable to flooding events ▪ Production systems that do not safeguard against reproduction (egg/fry/juvenile) escapes ▪ System highly vulnerable (with evidence) to predator damage and subsequent escape	0

Note: Intermediate values (i.e., 1,3,5,7 or 9) may be used if needed.

Escape score = _____ (range 0–10)

Recapture & mortality score (RMS)

Estimated typical recapture or direct mortality rate at the escape site or before any potential impact occurs[32]. This allows the escape score to improve if some (or all) escapees are recaptured or do not survive beyond the immediate vicinity of the farm.

[30] Not vulnerable – as a guide, not located in areas vulnerable to floods or tsunamis (including increasing risk due to sea level rise or storm severity), e.g., above or beyond 100 year flood event boundaries, or construction is based on 100 year flooding events

[31] Moderate risk – ponds or tanks may be located at the limits or edges of flood or tsunami zones, or constructed to withstand 50 year events

Estimated recapture rate = _____ % (zero if unknown)
Estimated direct mortality rate = _____ % (zero if unknown)

Recapture & mortality score (RMS) = (recapture % + mortality %) / 100
= _____ (range 0–1, zero if unknown)

Factor 6.1a score

Escape risk score = Escape score + [(10 – escape score) x RMS]
=_____ (range 0–10)

Factor 6.1b – Invasiveness

A trait-based measure of the likelihood of ecological disturbance from escapees based on their native or non-native status, and/or their domestication and ecological characteristics.

If the species is native, complete Part A and then Part C
If the species is non-native, go to Part B and then Part C

Part A – Native species

Current farmed stock is:	Score
Wild caught or naturally settled from the same water body, or are unable to breed with wild populations (e.g., sterile)	5
Hatchery raised for one generation (parents are wild caught)	4
Hatchery raised for two generations	3
Minor evidence of phenotypic differences[33] from selective breeding, or hatchery raised for three generations	2
Clear evidence of selected characteristics, or hatchery raised for four or more generations	1
Evidence of loss of genetic fitness in wild populations	0

Part B – Non-native species

Current farmed stock is:	Score
Already *fully* established in the production region	2.5
Not established and highly unlikely to survive or establish viable populations	2
Not present, or present and not established, and not likely[34] to establish viable populations	1.5
Partly established, with the potential to extend the species range or coverage	1
Not present but establishment is possible, or similar species have already established elsewhere	0.5
On the invasive species lists[35] and establishment is theoretically possible	0

[32] Recapture rate and direct mortality – at the escape site, in the immediate vicinity of the farm, or before escapees will potentially cause an impact beyond the farm (e.g., if the main impact from farmed salmon that escape from marine farms actually occurs in rivers, then any recapture or mortality before reaching rivers should be counted). To be applied conservatively.
[33] For example, changes in growth rate, disease resistance, body shape, behavior or other changes.
[34] As a guide, introductions of the species have been unsuccessful more often than successful or the species reproductive tolerance, behavior or habitat requirements are not suited to the escape location.

Part C – Native and non-native species

Regardless of the native, non-native or genetic status of the farmed species, score each of the following questions in relation to the ongoing impacts of escapees.

Each evidence-based 'Yes' answer = 0
Each theoretical 'Yes' or partial evidence = 0.5
Each 'No' answer = 1

Do escapees have a significant impact on any wild species by:	Score
Competing for food or habitat?	
Providing additional predation pressure?	
Competing for breeding partners or disturbing breeding behavior of the same or other species?	
Modifying habitats (e.g., by feeding, foraging, settlement or other)?	
Some other impact on species or habitats?	
Total score (0–5)	

Factor 6.1b score

Invasiveness score = (Part A or B) + Part C = _____ (range 0–10)

Final escape criterion score

Select the final escape score from the table using the 'Risk of escape' (6.1a) and the 'Invasiveness' (6.1b) scores (e.g., if the invasiveness score = 7.5, look in the < 8 column).

		Invasiveness (Factor 6.1b)										
		10	<10	<9	<8	<7	<6	<5	<4	<3	<2	<1
Risk of escape (Factor 6.1a)	10	10	10	10	10	10	10	10	10	10	10	10
	9	10	9	8	8	7	6	6	5	4	4	3
	8	10	8	8	7	7	6	6	5	4	4	3
	7	10	8	7	7	6	6	5	5	4	3	2
	6	10	7	7	6	6	5	4	4	3	3	2
	5	10	7	6	6	5	5	4	4	3	2	1
	4	10	6	6	6	5	4	4	3	3	2	1
	3	10	6	5	5	4	3	3	3	2	2	1
	2	10	5	5	4	4	3	3	2	2	1	0
	1	10	5	4	4	3	3	2	2	1	1	0
	0	10	5	4	4	3	2	1	0	0	0	0

Final escape criterion score = _____ (range 0–10)
Escape criterion is critical if the score is ≤ 1.

[35] The Global Invasive Species Database (GISD) http://www.issg.org/database/welcome/

Escapes: Factor 6.2X – Escape of unintentionally introduced species

A measure of the escape risk (introduction to the wild) of alien species *other than the principal farmed species* unintentionally transported during live animal shipments.

This factor (6.2X) is defined as an exceptional factor and will not be relevant to the majority of aquaculture production, yet it can be a significant concern for those production practices where it is relevant. Whereas all other criteria and factors score positively and contribute to the overall score total, the exceptional factors are given a negative score, which is subtracted from the final score for those aquaculture operations where it is a concern.

Factor 6.2Xa – International or trans-waterbody live animal shipments

Approximate percentage of production reliant on the ongoing international or trans-waterbody movement of broodstock, eggs, larvae, or juveniles within one generation of the farmed product.

Note: Trans-waterbody movement is defined with the source water body being ecologically distinct from the destination (farming) water body such that the live animal movements represent a risk of introducing non-native species.

Do not include historic introductions of broodstock for establishing domesticated stocks, etc.

Reliance on animal movements	% of production	Score
Zero	0	10
Low	0–10	9
	10–20	8
Low-moderate	20–30	7
	30–40	6
Moderate	40–50	5
	50–60	4
Moderate-high	60–70	3
	70–80	2
High	80–90	1
	> 90	0

Factor 6.2Xa score = _____ (range 0–10)

Factor 6.2Xb – Biosecurity of source and destination (for introduced species)

Considering the types of species (or life stages) potentially being transported unintentionally during international or trans-waterbody movements of the principal farmed species, use the table below *twice* to assess the biosecurity risk of both the source of animal movements (e.g., hatchery or wild seed bed, etc.) and the farm destination. Consider that biosecurity procedures for the principal farmed species may not prevent the escape of smaller unintentionally transported pathogens, parasites, plants, animals or their various life stages arriving with live fish shipments.

The score for this factor is the highest score (i.e., most biosecure) of either the source or destination. While every eventuality may not be covered in the table, use the examples as guidelines to determine the most appropriate score.

Concern	Biosecurity and escape risk examples for source and destination	Score
Very low	▪ No connection to natural water bodies (i.e., fully biosecure)	10
Low	▪ Tank based recirculation systems with appropriate (multiple) screens, water treatment for inflowing or outflowing water. ▪ Static ponds with no water discharge (including at harvest) over multiple production cycles, not vulnerable to flood/storm/tsunami damage	8
Low-moderate	▪ Any "Moderate risk" system with multiple or fail-safe escape or entry prevention methods, or active Best Management Practices for design, construction, and management of escape and entry prevention (biosecurity) ▪ Any "Low risk" system with uncertainty or evidence questioning the robustness of entry or escape prevention measures ▪ Ponds with low exchange 0–3% per day	6
Moderate	▪ Ponds with moderate exchange 3–10% per day ▪ Static ponds that drain externally at harvest or do not screen inflow water ▪ Any ponds with a moderate risk[36] or vulnerability to flooding events ▪ Flow-through tank or raceways	4
Moderate-high	▪ Any "High risk" system with effective Best Management Practices for design, construction, and management of escape or entry prevention (biosecurity) ▪ Any "Moderate risk" system with uncertainty or evidence questioning the robustness of escape or entry prevention measures ▪ High exchange ponds > 10% per day	2
High	▪ Open systems (e.g., net pens) or wild caught sources (e.g., dredged mussel spat) ▪ Ponds in flood prone[37] areas or vulnerable to flooding events ▪ High exchange ponds > 10% per day ▪ Systems that do not safeguard against reproduction based egg/fry escapes ▪ System vulnerable (with evidence) to predator damage	0

Note: Intermediate values (i.e., 1,3,5,7 or 9) may be used if needed.

Biosecurity score of the source of animal movements = _____ (range 0–10)
Biosecurity score of the farm destination of animal movements = _____ (range 0–10)

[36] Moderate risk – ponds or tanks may be located at the limits or edges of flood or tsunami zones, or constructed to withstand 50 year events.
[37] Flood prone – as a guide, ponds in low-lying valley areas, wetlands, river flood plains, or coastal tsunami zones.

Factor 6.2Xb score = highest biosecurity score = _____ (range 0-10)

Factor 6.2X score = [(10 - 6.2Xa) x (10 - 6.2Xb)] / 10 = -_____ (range 0 to -10)
Note: This is a negative score that will be subtracted from the overall final score total of the other criteria.

Exceptional Factor 6.2X score = - _____ (range 0 to -10)

Criterion 7 – Disease, pathogen and parasite interaction

Impact, unit of sustainability and principle

- *Impact:* Amplification of local pathogens and parasites on fish farms and their retransmission to local wild species that share the same water body.
- *Unit of sustainability:* Wild populations susceptible to elevated levels of pathogens and parasites.
- *Principle:* Aquaculture operations pose no substantial risk of deleterious effects to wild populations through the amplification and retransmission of pathogens or parasites.

Disease: Pathogen and parasite interaction risk (biosecurity)

A measure of the infection risk between farm and wild populations, assuming that farms, by their nature, typically act as amplifiers of local naturally occurring and introduced pathogens and parasites. Most pathogens or parasites on farms are considered to originate from the surrounding water and therefore are of concern to surrounding populations when amplified.

Assessment scale

Farm level assessments – apply this criterion to the farm being assessed, or use data from similar production systems and species if necessary.
Regional or national assessments – apply to relevant regional or national statistics or use "typical" or "average" data for the production system or species.

Consider ALL the descriptions or examples below and select the most appropriate score. While every eventuality may not be covered in the table, use the examples as guidelines to determine the most appropriate score.

Concern	Pathogen and parasite interaction risk examples	Score
No concern	▪ The production system is fully biosecure, all discharged water is treated or has no possibility for further impact ▪ The farm has no connection to wild populations	10
Low	▪ The farm does not discharge water over multiple production cycles[38]. ▪ Production practices do not increase the likelihood of pathogen amplification compared to natural populations, e.g., natural stocking density, water quality, feed type, behavior, etc.[39] ▪ Data show that the farm does not amplify pathogens or parasite numbers above background levels ▪ Data shows no evidence of increased infection rates in wild fish	8
Low-moderate	▪ Data show low, temporary or infrequent[40] occurrences of on-farm infections or mortalities ▪ The farm only discharges water once per production cycle ▪ Independently audited, scientifically robust limits[41] are in place, and data show that pathogen or parasite levels are consistently below the limits over multiple production cycles	6
Moderate	▪ The production system has biosecurity regulations or protocols in place, yet is still open to introductions of local pathogens and parasites (e.g., from water, broodstock, eggs, fry, feed, local wildlife, etc.) and is also open to the discharge of pathogens ▪ Disease-related mortalities occur and farms discharge water on multiple occasions during the production cycle without relevant treatment ▪ Regulations or best practice standards do not exist, or are in place but enforcement is unknown ▪ Amplification of pathogens or parasites on the farm results in increased infection in wild fish, shellfish or other populations in the farming locality or region	4
Moderate-high	▪ The farming system is open to the environment, or exchanges water on multiple occasions during the production cycle and suffers from high disease or pathogen related infection and/or mortality	2
High	• Amplification of pathogens or parasites on the farm leads to significant population declines in wild species	0
Critical	▪ There is a high disease concern and the affected wild stocks are considered vulnerable, endangered, IUCN red list, etc.	C

Note: Intermediate values (i.e., 1,3,5,7 or 9) may be used if needed.

Final disease criterion score = _____ (range 0–10 or critical)

[38] Multiple production cycles – as a guide, the normal production practice is to maintain the same water on the farm throughout one complete production cycle and reuse it for the next production cycle without discharge at any time.

[39] Consider examples of naturally settled shellfish, or extensive fish or shrimp ponds.

[40] Low, temporary or infrequent – as a guide, data show diagnosed clinical disease is present in less than 5% of stock, for less than 5% of the time, or combined diagnosed plus undiagnosed mortalities do not exceed 5% over multiple production cycles.

[41] Scientifically robust limits – controls on the number or occurrence of pathogens or parasites are primarily intended to protect wild populations or other ecosystem functions, or to apply a precautionary approach where research is inconclusive. The values are not contested by conservation organizations.

Criterion 8 – Source of stock – Independence from wild fish stocks

Impact, unit of sustainability and principle

- *Impact:* The removal of fish from wild populations for growing to harvest size in farms
- *Unit of Sustainability:* Wild fish populations
- *Principle:* Aquaculture operations use eggs, larvae, or juvenile fish produced from farm-raised broodstocks and thereby avoiding the need for wild capture

Source of Stock: Criterion 8 – Independence from wild capture fisheries

A measure of the aquaculture operation's independence from active capture of wild fish for on-growing or broodstock.

Source of stock score = % of production that originates from hatchery-raised broodstocks[42] or from passive influx or natural settlement (e.g., shellfish) of wild seed.

Assessment scale

Farm level assessments – apply this criterion to the farm being assessed, or use data from similar production systems and species if necessary.
Regional or national assessments – apply to relevant regional or national statistics, or use "typical" or "average" data for the production system or species.

Production from hatchery-raised broodstock or natural (passive) settlement (%)	Source of stock score
100	10
90–100	9
80–90	8
70–80	7
60–70	6
50–60	5
40–50	4
30–40	3
20–30	2
10–20	1
0–10	0

Final source of stock criterion score = _____ (range 0–10)

[42] Domesticated broodstocks – more than one generation from the wild is considered to be independent from wild fisheries in this criterion. That is, if the parents of the fish currently in commercial production were themselves produced in a hatchery then they are considered hatchery-raised broodstock and therefore independent of wild fisheries.

Note: The sustainability of the wild source stocks is not assessed in this criterion. There is little demand for the farming of highly abundant wild species, therefore collection of wild fingerlings, seed or other life stages for growout in farms will generally always be from depressed species or fisheries. Seafood Watch considers that regardless of the sustainability of the stock, it is preferable for wild aquatic resources to continue to be part of a functioning natural ecosystem (while still maintaining a sustainable fishery, where possible) than to remove them and raise them solely in farms.

Overall score and final ranking

Numerical score

The Final numerical score = [(Sum of C1–C8 scores) – (F3.3X + F6.2X)]/8
= _____ (range 0–10)

Number of Red Criteria

Any criterion (C1–C8) with a score lower than 3.3 (or less than -6.6 for F3.3X and F6.2X) is considered "Red".

Total number of Red criteria or factors = _____ (0–10)

Number of Critical Scores

A number of criteria or factors have one or more "Critical" characteristics:

- Effluent C2 score = 0 (i.e., waste discharge is high and management of cumulative impacts is weak)
- Effluent rapid assessment score = "Critical"
- Habitat C3 score = 0 (i.e., ongoing damage to high value habitats)
- Habitat F3.3X Predators score = "Critical"
- Chemical use C4 score = 0 (i.e., evidence of pathogens with developed resistance to chemicals important to human health)
- Feed F5.1 FIFO value is greater than 4 (actual FIFO value, not the FIFO score)
- Feed F5.2 PRE score = 0 (i.e., > 90% of the protein provided in the feed is wasted)
- Feed F5.1 FIFO value (not score) > 3 and F5.3 PRE score < 2 (i.e., a lot of wild fish is used in the feed and most of the fed nutrients are wasted)
- Escapes F6.1 < 1 (i.e., escape numbers are very high and damaging to wild populations) and the affected wild populations are vulnerable, endangered, IUCN listed, etc.
- Escapes F6.2 = 0 (i.e., a very high risk of introduced non-native species)
- Disease C7 = Critical (a high disease concern for the affected wild stocks that are considered vulnerable, endangered, IUCN red list, etc.)

Number of Critical scores = _____

Criterion	Score (0-10)	Red? (Y/N)	Critical? (Y/N)
C1 Data			N/A
C2 Effluent			
C3 Habitat			
C4 Chemical use			
C5 Feed			
C6 Escapes			
C7 Disease			
C8 Source of stock			
F3.3X Wildlife	-		
F6.2X Introductions	-		
Overal score = (0-10)			
Number of Red Criteria =			
Number of Critical Scores =			

Final Seafood Watch Rank

- Red: Final score between 0 and 3.333, or more than one Red criterion, or one or more Critical scores.
- Yellow: Final score between 3.333 and 6.666, and/or one Red criterion, and no Critical scores.
- Green: Final score between 6.666 and 10, and no Red criteria, and no Critical scores

Final Rank = _____

Appendix – Habitat examples

The following additional examples or indicators are provided to help the assessor determine the maintenance or loss of habitat functionality, and/or the level of impact to functioning habitats. Indicators of habitat damage vary between habitat types, are difficult to quantify for some habitats, and may not provide linear measures of damage or scores. Use any relevant indicator of habitat impact for which data or evidence are available.

Wetland ecosystems (mangroves, brackish and freshwater)

Type of conversion	Remaining mangrove/wetland area (%)	Other example or indicators
Maintains full functionality	100	Undisturbed
Minimal impact	90–100	Little impact on fisheries catch
Minor impacts	70–90	Decrease in fisheries catch Reduced effect on hazard control Loss of juvenile habitat
Moderate impacts	50–70	Changes in species abundance
Major impacts – loss of functionality	0–50	Loss of hazard control capacity Changes in species diversity Significant amount of C release Loss of fisheries Loss of functional diversity

Ocean/ marine ecosystems

Note: benthic marine impacts are typically rapidly reversible, therefore impacts are considered relatively less severe and allocated to different impact groups accordingly.

Type of conversion	Examples or indicators				
	(EcoQ)[43]	H'	AMBI	Diversity	Effects
Maintains full functionality	High	H'>4	AMBI>=1.2	90–100% of reference station value	Undisturbed
Minimal impacts	Good	3<H'<=4	1.2<AMBI=< 3.3	70–90% of reference station value	Slightly disturbed
Minor impacts	Moderate	2<H'<=3	3.3<AMBI=< 4.3	50–70% of reference station value	Moderately disturbed

[43] EcoQ = Biotic biodiversity status

Moderate impacts	Poor	1<H'<=2	4.3<AMBI=< 5.5	30–50% of reference station value	No irreversible impacts on benthic communities (disturbance is rapidly reversed by fallowing) Oxygen depletion Toxic effect of H_2S
Major impact – loss of functionality	Bad	H'<=1	AMBI>5.5	Less than 30% of reference station value	Some evidence of far-field effects Irreversible impacts

Freshwater ecosystems

Note: benthic freshwater impacts are typically rapidly reversible, therefore impacts are considered less severe and allocated accordingly.

Type of conversion	Index of biotic integrity	Effects
Maintains full functionality	>90%	Undisturbed
Minimal impacts	75–90%	Slightly disturbed
Minor impacts	70–75%	Moderately disturbed
Moderate impacts	65–70%	No irreversible impacts (disturbance is rapidly reversed by fallowing)
Major impact – loss of functionality	<65%	Some evidence of far-field effects

Terrestrial ecosystems

Type of conversion	Land cover	Salinization	Effects
Maintains full functionality	70–100 %		
Minor impacts	50–70 %		Reduced C sequestration
Moderate impact	30–50%	Higher soil conductivity	Significant habitat fragmentation
Major impact – loss of functionality	0–30%	Reduced crop yields Loss of soil fertility	

Appendix – Additional guidance for the habitat criterion

Historic loss of functionality

- If the farms were established historically (more than ten years ago), the score will be between 4 and 6, depending on the original habitat value.
- If the farms were established less than ten years ago in habitats that had previously lost functionality more than ten years ago, the score will be between 4 and 6, depending on the original habitat value.
- If the farms or industry are still expanding into habitats that had previously lost functionality more than ten years ago, the score will be between 4 and 6, depending on the original habitat value.
-

Recent and ongoing habitat damage resulting in loss of functionality

- If the farms have recently been established (less than ten years ago) without maintaining critical ecosystem services, the score will be between 1 and 3, depending on the original habitat value.
- If the farms are still expanding into functioning habitat (i.e., there is a continuing loss of ecosystem services), then the score will be between 0 and 3, depending on original habitat value.
- If the farms were recently established, or are still expanding into habitat that had previously lost functionality more than ten years ago, the score will be between 4 and 6, depending on the original habitat value.