

Monterey Bay Aquarium Seafood Watch®

Global Aquaculture Alliance

Finfish and Crustacean Farms BAP Standards, Guidelines (Rev. 3/2014)

Applied to 2, 3, 4-star Pangasius



Benchmarking equivalency results assessed against the Seafood
Watch Aquaculture Criteria

September 2014

Final Seafood Recommendation

GAA 2, 3, 4-star pangasius

| Criterion | Score (0-10) | Rank | Critical? |
|--------------------------------|--------------|--------|-----------|
| C1 Data | 9.17 | GREEN | |
| C2 Effluent | 5.00 | YELLOW | NO |
| C3 Habitat | 3.50 | YELLOW | NO |
| C4 Chemicals | 0.00 | RED | NO |
| C5 Feed | 6.79 | GREEN | NO |
| C6 Escapes | 6.00 | YELLOW | NO |
| C7 Disease | 4.00 | YELLOW | NO |
| C8 Source | 10.00 | GREEN | |
| | | | |
| 3.3X Wildlife mortalities | -4.00 | YELLOW | NO |
| 6.2X Introduced species escape | 0.00 | GREEN | |
| Total | 38.46 | | |
| Final score | 4.81 | | |

| | |
|--------------------|--------|
| Final Score | 4.81 |
| Initial rank | YELLOW |
| Red criteria | 1 |
| Final rank | YELLOW |
| Critical Criteria? | NO |

| |
|---------------|
| FINAL RANK |
| YELLOW |

Scoring note – scores range from zero to ten where zero indicates very poor performance and ten indicates the aquaculture operations have no significant impact, except for the two exceptional “X” criteria for which a score of -10 is very poor and zero is good.

Summary

The final numerical score of 4.81 is yellow, and with one red criterion the final result is a yellow “Good Alternative” recommendation.

Executive Summary

The benchmarking equivalence assessment was undertaken on the basis of a positive application of a realistic worst-case scenario:

- “Positive” – Seafood Watch wants to be able to defer to equivalent certification schemes
- “Realistic” – we are not actively pursuing the theoretical worst case score. It has to represent reality and realistic aquaculture production.
- “Worst-case scenario” – we need to know that the worst-performing farm capable of being certified to any one standard is equivalent to a minimum of a Seafood Watch “Good alternative” or “Yellow” rank.

The Global Aquaculture Alliance “Finfish and Crustacean Farm” Best Aquaculture Standards have broad applicability; they state:

- *The following Best Aquaculture Practices standards and guidelines apply to the farming of all crustacean and finfish species except salmonids reared in cages and net pens (refer to BAP’s Salmon Standards). They cover all production methods, including flowthrough, partial exchange, and closed or recirculating water systems operated in ponds, cages, net pens, tanks, raceways or closed-containment vessels.*

From a benchmarking perspective, this broad scope means the standards must be very robust to ensure they are applicable and effective across the broad range of species, farming systems and countries that could apply for certification. Unfortunately this is not the case; in reality it is relatively easy to envisage an aquaculture system that could be certified to these standards that would be ranked red in a Seafood Watch assessment (e.g. an intensive cage farm with a risk of escapes of a non-native species with high fish meal feeds, with significant chemical use, disease problems, and located in sensitive habitats in a developing country with poor environmental regulations). Therefore to be more pragmatic, Seafood Watch has benchmarked GAA’s standards with known key aquaculture species in order to try and identify species for which Seafood Watch could defer to GAA’s certification. The assessment has considered 2, 3 and 4-star GAA-certified farms.

This assessment is for Pangasius farmed in ponds in Vietnam only. Currently all pangasius certified by GAA BAP is produced in Vietnam, with the majority produced in ponds with daily exchange of water. In the event that pangasius farming becomes established in an area where the species is non-native or not already established this benchmarking will not apply. A separate benchmarking study will need to be done in order for Seafood Watch to defer to pangasius from those 2, 3 and 4-star GAA BAP-certified farms.

In general, the current¹ GAA standards:

- in many cases defer to (i.e. require compliance with) unknown local regulations without setting robust requirements for the intended outcomes of certification
- have lengthy supporting or implementation information which may not be supported by specific or robust standards requirements
- like all farm-level standards do not robustly address cumulative impacts of multiple neighboring, local or regional farms
- have substantial weaknesses compared to one Seafood Watch criterion (Chemical Use) resulting in a yellow final recommendation.

Specifically for each criterion, the GAA Finfish and Crustacean Farm standards (applied to native Pangasius in Vietnam):

- like all certification, require considerable data collection and combined with the farm-level certification process result in a good data score (9.17 out of 10).
- have water quality restrictions to limit the effluent concentrations but do not limit effluent volumes and limits are not based on ecological characteristics of the surrounding environment. Therefore they do not limit the total nutrient loads discharged. Sediment/sludge treatment is required but the standards do not address potential cumulative impacts of effluents from multiple farms. The Effluent score is 5 out of 10.
- do not allow certification of farms in mangrove or wetland habitats if built after 1999, but can certify farms located in these habitats if constructed before then. The farm-specific standards do not deal with cumulative impacts of neighboring farms. Restoration is required to mitigate conversion of wetlands or mangrove areas that has occurred for “allowable causes.” The Habitat Criterion score is 3.50 out of 10.
- contain no effective measures to limit the frequency or quantity of antibiotics or other chemical use (e.g. pesticides). Antibiotics highly- or critically-important to human health, or pesticides may be used in unrestricted amounts (e.g. the antibiotic oxytetracycline widely used in aquaculture and permitted in the U.S. import market). The Chemical Use score is 0 out of 10, and is the one red criterion.
- Use a different “industry” calculation for “Fish In:Fish Out ratio than the “academic” calculation used by Seafood Watch. Taking into account the differences in calculations the score for the Feed Criterion is 6.79 out of 10.
- have limited escape requirements for a native species with genetic differences from wild populations. There are requirements related to harvest, as well as flooding and other types of weather related events. The Escape Criterion score is 4 out of 10.
- have no requirements relating to disease or pathogen discharges. With limited evidence of environmental impacts, yet an ongoing concern, the score for the Disease Criterion 4 of 10.
- prevent the use of wild postlarvae, but not that of wild broodstock (however this is not penalized in this assessment for *P. hypophthalmus* which is considered to be all domesticated). The score is 10 of 10.

¹ Finfish and Crustacean Farms BAP Standards, Guidelines. Rev 3/14.

GAA Pangasius 2, 3, 4-Star

- encourage non-lethal predator control but have no robust restrictions. The Predator mortality score is a penalty of -4 out of -10 assuming mortalities occur but the numbers are not sufficient to have population level impacts on the predator species.
- have no robust requirements for international live animal movements, relying on potentially non-existent in-country regulations. However the benchmarking assumes no shipping for consistency across standards. The score is a deduction of 0 of -10.

The final numerical score is in the yellow category, and with only one red criterion, the final result is yellow overall and Seafood Watch can defer to GAA certified pangasius as being equivalent to at least a yellow Seafood Watch “Good Alternative” recommendation.

Table of Contents

| | |
|---|----|
| Final Seafood Recommendation | 2 |
| Executive Summary | 3 |
| Introduction..... | 7 |
| Analysis..... | 7 |
| Scoring guide | 8 |
| Criterion 1: Data quality and availability | 9 |
| Criterion 2: Effluents | 11 |
| Criterion 3: Habitat | 16 |
| Criterion 4: Evidence or Risk of Chemical Use | 21 |
| Criterion 5: Feed | 22 |
| Criterion 6: Escapes | 26 |
| Criterion 7. Disease; pathogen and parasite interactions | 28 |
| Criterion 8. Source of Stock – independence from wild fisheries | 29 |
| Factor 9X: Wildlife and predator mortalities..... | 30 |
| Factor 10X: Escape of unintentionally introduced species..... | 31 |
| Overall Recommendation | 34 |
| Guiding Principles | 35 |
| Appendix 1 - Data points and all scoring calculations | 37 |

Introduction

Scope of the analysis and ensuing recommendation

The GAA has not yet developed pangasius hatchery standards, so the assessment focused on the farm-level and feed mill aspects of the three-star system (the processing aspect was not considered).

Species

The Finfish and Crustacean Farm standard is a multi-species standard. This benchmark looks solely at a realistic worst case scenario application of the standard to a pangasius farm. In this case, the standard has been applied to native pangasius farmed in ponds only in Vietnam.

Geographic coverage

The standards apply globally to all locations and any scale of pangasius aquaculture production system. This benchmarking exercise applies solely to pangasius farmed in ponds in Vietnam. If production begins to grow in regions where pangasius is a non-native species this benchmark will not apply to those countries.

Production Methods

GAA Finfish and Crustacean Farm standards cover all types of production systems. This benchmarking exercise focuses on pond production of pangasius (i.e. not cages).

Analysis

Benchmarking principles

The benchmarking equivalence assessment was undertaken on the basis of a positive application of a realistic worst-case scenario

- “Positive” – Seafood Watch wants to be able to defer to equivalent certification schemes
- “Realistic” – we are not actively pursuing the theoretical worst case score. It has to represent reality and realistic aquaculture production.
- “Worst-case scenario” – we need to know that the worst farm capable of being certified to any one standard is equivalent to a minimum of a Seafood Watch “Good alternative” or “Yellow” rank.

Benchmarking assumptions

A number of assumptions were made to enable an equivalence assessment to be made either in the face of differing language or units etc., or in the case of missing information or gaps in the standards. The assumptions enable consistency across all the standards being assessed.

Specific assumptions have been noted where relevant in the individual criteria sections below, but the following were applied to all standards:

- Anything referred to as “should”, “recommend”, “prefer”, “minimize”, “minor must” or any similarly non-specific language was ignored
- Any deferral to local or national regulations in a standard of global scope was ignored.
- Any aspirational intent not supported by robust standards was ignored (for example “You must prevent escapes” was ignored if there were not effective supporting standards to actually prevent escapes).
- Any standards based on a future timeframe were ignored.
- Assume standards are applicable globally unless the standards or the scheme’s label specify or differentiate production regions. Assume the worst-case farm is in the worst country or region.
- Only “complete” production systems were assessed across all criteria – for example all criteria for tilapia are assessed for cages because this gives the lowest overall final score and rank, even though ponds would have a lower habitat criterion score.
- Requirements for animal health plans, veterinary supervision, or veterinary prescription of medications were ignored without further robust requirements in the standards

Scoring guide

- With the exception of the exceptional factors (9X and 10X), all scores result in a zero to ten final score for the criterion and the overall final rank. A zero score indicates poor performance, while a score of ten indicates high performance. In contrast, the two exceptional factors result in negative scores from zero to minus ten, and in these cases zero indicates no negative impact.

- **The full Seafood Watch Aquaculture Criteria that the following scores relate to are available [here](#)².**
- **The full data values and scoring calculations are available in Appendix 1**

² <http://www.seafoodwatch.org/-/m/sfw/pdf/criteria/mba-seafoodwatch-aquaculture-criteria-methodology.pdf>

Criterion 1: Data quality and availability

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, nor enable businesses to be held accountable for their impacts.*
- *Sustainability unit: 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.*

Criterion 1 Summary of scores for GAA 2, 3, 4-star pangasius

| Data Category | Relevance (Y/N) | Data Quality | Score (0-10) |
|-----------------------------------|------------------------|---------------------|---------------------|
| Industry or production statistics | Yes | 10 | 10 |
| Effluent | Yes | 10 | 10 |
| Locations/habitats | Yes | 7.5 | 7.5 |
| Predators and wildlife | Yes | 10 | 10 |
| Chemical use | Yes | 10 | 10 |
| Feed | Yes | 7.5 | 7.5 |
| Escapes, animal movements | Yes | 10 | 10 |
| Disease | Yes | 7.5 | 7.5 |
| Source of stock | Yes | 10 | 10 |
| Other – (e.g. GHG emissions) | No | n/a | n/a |
| Total | | | 82.5 |

| | | |
|----------------------------|------------|--------------|
| C1 Data Final Score | 9.2 | GREEN |
|----------------------------|------------|--------------|

Justification of Ranking

Assumptions:

- The “Energy use” category was considered “non-relevant” unless the scheme specifically required data collection on these aspects. Schemes could improve their score by requirements in this respect, but would not be penalized for not providing information on what would be considered universal practice.

There are few specific data collection requirements, however certification to the standards necessitates monitoring and data collection on all aspects relevant to the Seafood Watch criteria. All data categories received scores 10 of 10, except Habitat, Feed and Disease, all of which received 7.5 of 10. While there are explicit restrictions on siting of farms in mangroves and other wetland areas, in general the standards do not require documentation or records of habitat impacts to be kept. Success of any restoration efforts however must be documented and information provided at the time of any audit. The feed category is 7.5 of 10 because despite the feed mill standards, full disclosure of feed ingredient groups is not required. The

disease category received 7.5 of 10 because while it requires a biosecurity plan, there are no standards requiring the documentation of all disease outbreaks, and a requirement for record keeping of disease diagnoses only requires record keeping when antibiotic therapeutants are used.

| Data Category | Relevant content of standards |
|-----------------------------------|---|
| Industry or production statistics | <p>10.1 The facility shall maintain accurate records of the species farmed and, where relevant, any significant stock characteristics</p> <p>16.2 The facility shall keep complete and accurate records for each culture unit and production cycle, including the culture unit identification number, unit area and volume, species stocked and, if applicable, species specifications such as triploid or GMO</p> <p>16.7 Complete and accurate records regarding harvest date, harvest quantity... shall be maintained</p> |
| Effluent | <p>5.4 Records on intake water and effluent monitoring shall be maintained and available</p> |
| Habitat | <p>Implementation Guidelines: Whether the restoration is conducted by the farm or through an independent restoration program, the auditor will verify that the wetland is viable by confirming it is healthy, appropriately diverse and still healthy at subsequent annual audits. In cases where the auditor has not been able to inspect the restored wetlands in person, the farm shall provide the auditor with the evidence (e.g. maps, GPS coordinates, recent photographs and recent aerial photographs).</p> |
| Chemical use | <p>13.3 Records shall be maintained for every application of drugs and other chemicals that include the date, compound used, reason(s) for use, dose and harvest date for treated production lots</p> <p>16.3 The facility shall keep complete and accurate records concerning any antibiotic or other drug use at both the hatchery and the farm</p> |
| Feed | <p>9.2 The facility shall record the characteristics of all feeds used, the total amounts of each feed used each year and the total annual crustacean or fish production</p> <p>16.5 Complete and accurate records regarding manufacturer and lot number of each feed shall be maintained</p> |
| Escapes, animal movements | <p>10.9 Cages, nets and pens shall be tagged and maintained in good condition, and records of repairs shall be kept. Periodic inspections of mooring lines shall be documented.</p> <p>10.10 All incidents involving escapes of aquaculture animals shall be accurately documented</p> <p>16.6 The facility shall maintain complete and accurate records of the sources of postlarvae or fingerlings stocked, stocking dates, and all feeds used for each culture unit</p> |
| Disease | <p>13. Food Safety: Chemical and Drug Management: Critical Concerns for Antibiotic Use: Records for disease diagnoses should provide supporting</p> |

| | |
|--------------------------------|--|
| | evidence to justify cases where therapeutants are used 15. Biosecurity: Implementation: The likely vectors for these risks shall be identified in a detailed written biosecurity plan that... includes specific control measures and at a minimum... establishes protocols that allow the tracking of animal and equipment movements |
| Source of Stock | 10.3 The facility shall keep records of sources and purchases of stocking material, and record the number stocked in each culture unit for each crop 16.6 The facility shall maintain complete and accurate records of the sources of postlarvae or fingerlings stocked, stocking dates, and all feeds used for each culture unit |
| Wildlife/predator interactions | 10.13 The facility shall record, and report where required, the species and numbers of all avian, mammalian, and reptile mortalities |

The final score (average of relevant category scores) is 9.2 of 10.

Criterion 2: Effluents

Impact, unit of sustainability and principle

- *Impact: aquaculture species, production systems and management methods vary in the amount of waste produced and discharged per unit of production. The combined discharge of farms, groups of farms or industries contributes to local and regional nutrient loads.*
- *Sustainability unit: 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.*

Criterion 2 Summary of scores for GAA 2, 3, 4-star pangasius

| Effluent parameters | Value | Score | |
|---|--------------|--------------|---------------|
| F2.1a Biological waste (nitrogen) production per of fish (kg N ton-1) | 48.16 | | |
| F2.1b Waste discharged from farm (%) | 66 | | |
| F2 .1 Waste discharge score (0-10) | | 6 | |
| F2.2a Content of regulations (0-5) | 1.75 | | |
| F2.2b Enforcement of regulations (0-5) | 4.5 | | |
| F2.2 Regulatory or management effectiveness score (0-10) | | 3.15 | |
| C2 Effluent Final Score | | 5.00 | YELLOW |
| Critical? | NO | | |

Justification of Ranking

Assumptions

- For consistency, the full assessment was used across all species
- The cumulative impacts questions on regulations and enforcement were assessed according to the standards requirements in this respect
- No fertilizer use was considered unless specified in the standards
- Tilapia, salmon and cod effluent was assessed for cages, other species were assessed for high-exchange ponds as a worst-case scenario unless otherwise specified

Explanatory tables and scoring calculations can be found on page 8 of the assessment criteria.

The GAA Finfish and Crustacean Farm standards express water quality requirements in mg/l for nitrogen and phosphorous (among other water quality indicators), but do not have volume limitations. Annual loads must be calculated, but there are no restrictions or requirements relating to the results. Therefore the total load discharge is not restricted. The “Full assessment” in the Seafood Watch criteria was used to calculate the total waste produced and discharged per ton of production, combined with the effectiveness of management measures to control total and cumulative impacts.

Factor 2.1. Waste discharged from the farm

Factor 2.1a calculates the amount of (nitrogen) waste produced per ton of production

Note the full list of data points and intermediate calculations are provided in Appendix 1.
Bold text in tables indicates the requirement of the standard

| Relevant Content of Standards | How we applied it |
|---|-----------------------------|
| Protein content of feed Not addressed by initiative | 30% from FAO (2010) |
| Feed conversion ratio Not addressed by initiative | 1.5 from Tacon et al (2011) |
| Fertilizer input Not addressed by initiative | Assumed zero |
| Protein content of whole harvested pangasius Not addressed by imitative | 14.9 from Boyd et al (2007) |

These values result in a nitrogen waste production of 48.16 kg N per ton of pangasius (see Criteria - Factor 2.1a for calculations).

Factor 2.1b calculates the proportion of the waste produced that is discharged from the farm.

| Relevant Content of Standards | How we applied it |
|--|---|
| 8.7 Any accumulated sludge removed from ponds, reservoirs or sedimentation basins shall be confined within the farm property or consolidated and used | Initial discharge score of 1 for ponds with unknown operation or operating as a flow through system |

| | |
|---|---|
| <p>locally for landfill or agriculture 8.8 Removed sediment shall be properly contained and located to prevent the salinization of soil and groundwater and not cause other ecological nuisances 8.12 If the applicant’s facility produces more than 20 mt/ha/crop, the facility shall possess sufficient sedimentation basin capacity to handle the associated sludge/sediment. The facility shall process all sludge/sediment in sedimentation basins and not dump material in sensitive wetland or mangrove areas, or public water bodies.</p> | <p>is reduced to 0.66 for the use of settling ponds and proper sludge disposal. Meaning 66% of the waste produced is discharged from the farm. (1 was used based on the intensive nature of pangasius farming, not allowing sediment to settle in ponds as it normally does in ponds with smaller concentrations of fish)</p> |
|---|---|

F2.1b score 0.66 of 1

Factor 2.2. Effluent management effectiveness (appropriate to the scale of production)

Factor 2.2 assesses the effectiveness of management measures or regulations to control the total waste produced from the total tonnage of the farm and the cumulative impact of multiple neighboring farms. Explanatory tables and calculations can be found on page 14 of the assessment criteria.

Factor 2.2a assesses the content of the management measures

| Relevant Content of Standards | How we applied it |
|---|--|
| <p>5.5 Effluent water quality concentrations shall comply with BAP water quality criteria, or applicable regulations if they are equivalent or more rigorous, or if this is not possible because of high concentrations in the intake water, concentrations shall reflect no deterioration between intake and discharge.</p> | <p>Score of 1 for F2.2a question 1. Standards are specific to aquaculture</p> |
| <p>5.5 Effluent water quality concentrations shall comply with BAP water quality criteria, or applicable regulations if they are equivalent or more rigorous, or if this is not possible because of high concentrations in the intake water, concentrations shall reflect no deterioration between intake and discharge.</p> <p>8.12 If the applicant's facility produces more than 20 mt/ha/crop, the facility shall possess sufficient sedimentation basin capacity to handle associated sludge/sediment. The facility shall process all sludge/sediment in sedimentation basins and not dump material in sensitive wetland or mangrove areas, or public water bodies</p> | <p>Score of 0.25 of 5 for F2.2a question 2. Standards set limits for aquaculture effluent but are not site specific other than requiring sites producing >20 mt/ha/crop to have sedimentation basins</p> |
| <p>Cumulative impacts of multiple farms Not addressed by initiative</p> | <p>Score of 0 for F2.2a question 3. Standards do not assess the contributions to cumulative impacts of neighboring or local farms. Cumulative impacts are addressed in the context of marine cages, but are not applicable to ponds.</p> |
| <p>Appendix A: GAA BAP Water quality requirements</p> | <p>Score of 0 for Factor 2.2a question 4. BAP Water quality standards are not specific to the site's ecological status.</p> |
| <p>Appendix A: GAA BAP Water quality requirements</p> | <p>Score of 0.5 for F2.2a question 5. Water quality monitoring is required monthly or quarterly (based on type of effluent) and may miss periods of peak discharge such as harvest or pond cleaning etc</p> |

The total for Factor 2.2a is 1.5 of 5

Factor 2.2b assesses the enforcement of the above measures.

| Relevant Content of Standards | How we applied it |
|-------------------------------|---|
| | <p>The requirements for audit and full compliance for all GAA standards mean that questions 1, 2, 4 and 5 of Factor 2.2b are all scored 1 because enforcement is considered to be effective. Question 3 is scored 0.5 as monitoring may avoid peak discharge events</p> |

Factor 2.2b score is 4.5 out of 5

The Factor 2.2 score for the effectiveness of the management is 3.15 out of 10. The final effluent score is a combination of the waste discharged and the effectiveness of the management to control the total and cumulative impacts. The table on page 12 of the criteria document shows how this score is calculated, producing a final C2 score of 5 of 10.

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 and to the critical “ecosystem services” they provide.*
- *Sustainability unit: 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.*

Criterion 3 Summary of scores for GAA 2, 3, 4-star pangasius

| Habitat parameters | Value | Score | |
|---|--------------|--------------|---------------|
| F3.1 Habitat conversion and function | | 4.00 | |
| F3.2a Content of habitat regulations | 2.50 | | |
| F3.2b Enforcement of habitat regulations | 2.50 | | |
| F3.2 Regulatory or management effectiveness score | | 2.5 | |
| C3 Habitat Final Score | | 3.50 | YELLOW |
| Critical? | NO | | |

Justification of Ranking

Assumptions:

- Assume farm is in high-value (or former high-value) habitat unless standards specify otherwise
- The cumulative impacts questions on regulations and enforcement were assessed according to the standards requirements in this respect

Factor 3.1. Habitat conversion and function

Factor 3.1 assesses the impact on ecosystem services at the farm site, or within an allowable zone of effect. Explanatory tables and calculations can be found on page 14 of the assessment criteria.

| Relevant Content of Standards | How we applied it |
|---|--|
| <p>4.1 If net loss of sensitive wetland habitat (delineated by evaluation of hydrological conditions and the presence of wetland vegetation) occurred on facility property since 1999, the loss shall have been due to allowable purposes. (inlet and outlet canals, pump stations, docks)</p> <p>4.2 If net loss of sensitive wetland habitat occurred on facility property since 1999, the loss shall have been mitigated by restoring an area three times as large or by an equivalent donation to restoration projects.</p> <p>4.3 Farm activities shall not alter the hydrological conditions of the surrounding watershed, and the normal flow of brackish water to mangroves or freshwater to wetlands shall not be altered unless specific permits apply</p> <p>4.4 If wetland restoration has been conducted, the restored vegetation shall be maintained in a healthy state, viable and appropriately diverse</p> | <p>GAA standards prevent siting in high value habitats since 1999, but therefore allow farms if constructed prior to that date. Score Factor 3.1 as "4" for Historic, >10 yrs loss of habitat functionality of high value habitat</p> |

The final score for factor 3.1 is 4 out of 10

Factor 3.2. Habitat and farm siting management effectiveness (appropriate to the scale of production)

Factor 3.2a assesses the content of the management measures to manage site-specific and cumulative habitat impacts. See Appendix 1 for scoring questions.

| Relevant Content of Standards | How we applied it |
|--|---|
| <p>Environmental impact assessment Not required by initiative</p> <p>8.1 If ponds are constructed on permeable soil, measures such as the use of pond liners shall be taken to control seepage and avoid contamination of aquifers, lakes, streams and other natural bodies of freshwater.</p> <p>8.2 For inland brackish ponds, quarterly monitoring of neighboring well and surface water shall not show that chloride levels are increasing due to farm operations.</p> <p>8.3 If a farm is extracting groundwater, water levels in nearby wells shall be monitored at least annually during the dry season to establish that aquaculture is not lowering the water table.</p> <p>8.4 Use of water from wells, lakes, streams, springs or other natural sources shall not cause ecological damage or subsidence in surrounding areas.</p> <p>8.5 Farm operations shall not cause wetland vegetation at the facility perimeter to die off.</p> <p>8.6 Dredge and fill activities shall not be conducted in sensitive wetlands or wetland buffers to increase the area available for pond construction.</p> <p>8.8 Removed sediment shall be properly contained and located to prevent the salinization of soil and groundwater and not cause other ecological nuisances.</p> <p>8.9 Facilities shall avoid the creation of degraded areas such as borrow pits and piles of soil.</p> <p>8.10 Dredged material shall be properly contained and not placed in mangrove areas or other sensitive habitats.</p> <p>8.11 The applicant shall take measures to control erosion and other impacts caused by outfalls.</p> <p>8.12 If the applicant's facility produces more than 20 mt/ha/crop, the facility shall possess sufficient sedimentation basin capacity to handle the associated sludge/sediment. The facility shall process all sludge/sediment in sedimentation basins and not dump material in sensitive wetland or mangrove areas, or public water bodies.</p> | <p>Score of 0.25 in F3.2a Question 1 because the standards include siting/construction but do not require a comprehensive Environmental Impact Assessment or other licensing process based on ecological principles</p> |
| <p>Industry size and concentration Not addressed by initiative</p> | <p>Score of 0 for Factor 3.2a question 2 because standards do not relate to cumulative habitat impacts of multiple farms</p> |
| <p>4.1 If net loss of wetland habitat (delineated by</p> | <p>Score of 0.75 in 3.2a Question 3</p> |

| | |
|---|---|
| <p>evaluation of hydrological conditions and the presence of wetland vegetation) occurred on facility property since 1999, the loss shall have been due to allowable purposes</p> <p>Allowable purposes defined as: If a farm operation requires access to water resources, removal of wetland vegetation shall only be allowed for the installation of inlet and outlet canals, pump stations and docks. Wetland removed for such purposes shall be mitigated by restoring an appropriately diverse area of wetland three times the size of the area removed. This practice is only allowable if local regulations don't prohibit it.</p> | <p>because ongoing conversion of mangroves for specific uses is allowed. However standards for successful restoration mitigate most impacts from ongoing conversion of mangroves.</p> |
| <p>Avoidance of high value habitats</p> <p>8.6 Dredge and fill activities shall not be conducted in sensitive wetlands or wetland buffers to increase the area available for pond construction.</p> <p>8.10 Dredged material shall be properly contained and not placed in mangrove areas or other sensitive habitats.</p> <p>8.12 If the applicant's facility produces more than 20 mt/ha/crop, the facility shall possess sufficient sedimentation basin capacity to handle the associated sludge/sediment. The facility shall process all sludge/sediment in sedimentation basins and not dump material in sensitive wetland or mangrove areas, or public water bodies.</p> | <p>Score of 0.75 for F3.2a Question 4 because high value habitats are avoided, but not for sites constructed prior to 1999.</p> |
| <p>Habitat restoration</p> <p>4.2 If net loss of sensitive wetland habitat occurred on facility property since 1999, has the loss been mitigated by restoring an area three times as large or by a donation to restoration projects?</p> <p>4.4 If wetland restoration has been conducted, the restored vegetation shall be maintained in a healthy state, viable and appropriately diverse.</p> <p>Addition to implementation guidelines: Whether the restoration is conducted by the farm or through an independent restoration program, the auditor will verify that the wetland is viable by confirming it is healthy, appropriately diverse and still healthy at subsequent annual audits. In cases where the auditor has not been able to inspect the restored wetlands in person, the farm shall provide the auditor with the evidence (e.g. maps, GPS coordinates, recent photographs and recent aerial photographs).</p> | <p>Score of 0.75 for F3.2a Question 5 because siting is allowed in former mangrove areas with habitat restoration required for mangroves/wetlands converted after 1999.</p> |

The final score for Factor 3.2a is 2 of 5

Factor 3.2b assesses the enforcement of the above measures. See Appendix 1 for scoring questions.

| Relevant Content of Standards | How we applied it |
|--|---|
| Presence of the standards and certification process | Score of 1 for Factor 3.2b question 1 because certification is considered to enforce the measures required in the standards |
| Enforcement of siting according to zoning or ecosystem based management | Score of 0 for Factor 3.2b question 2 because standards rely on unknown local regulations and unknown enforcement |
| Enforcement relating to cumulative impacts of multiple farms Not addressed by initiative | Score of 0 for Factor 3.2b question 3 |
| Transparency of enforcement (certification) process | Score of 0.5 for F3.2b Question 4 as the transparency of the audit process and farm level information availability from certified farms is moderate |
| Achievement of control measures | Score of 1 for Factor 3.2b question 5 because certification requires enforcing the standards, but with some unknowns (e.g. regarding habitat restoration) |

The final score for Factor 3.2b is 2.5 out of 5

The final score for factor 3.2 combines the regulation content with the enforcement to give a score of 2.5 out of 10.

The final score for criterion 3 (C3) combines factors 3.1. and 3.2 (see criteria document for calculation) to give a score of 3.5 of 10

Criterion 4: Evidence or Risk of 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.*
- *Sustainability unit: 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 avoid the discharge of chemicals toxic to aquatic life, and/or effectively control the frequency, risk of environmental impact and risk to human health of their use*

Criterion 4 Summary of scores for GAA 2, 3, 4-star pangasius

| Chemical Use parameters | Score | |
|------------------------------------|-------------|------------|
| C4 Chemical Use Score | 0.00 | |
| C4 Chemical Use Final Score | 0.00 | RED |
| Critical? | NO | |

Justification of Ranking

Assumptions:

- Assume un-restricted use of critically important antibiotics unless specifically prohibited in the standards
- If antibiotics are prohibited but other chemicals are permitted, the score was based on any further standards limitations, or the typical use for the species and production system (whichever was lower).

Explanatory tables and calculations can be found on page 20 of the assessment criteria.

| Relevant Content of Standards | How we applied it |
|---|--|
| <p>13.2 If used, drug treatments shall be based on recommendations and authorization overseen by a fish health specialist only to treat diagnosed diseases in accordance with instructions on product labels and national regulations.</p> <p>13.3 Records shall be maintained for every application of drugs and other chemicals that include the date, compound used, reason(s) for use, dose and harvest date for treated production lots.</p> <p>13.4 Any use of antifouling agents must involve recognized applications of approved materials in a manner that can be monitored for potential</p> | <p>Standards contain no effective measures to limit antibiotic or other chemical use. Antibiotics critically important to human health may be used in unrestricted amounts (e.g. oxytetracycline widely used in aquaculture and permitted in the U.S.).</p> <p>Scored as 0 of 10</p> |

| | |
|---|--|
| <p>contamination of the aquacultured animals</p> <p>13.6 Antibiotics or chemicals that are proactively prohibited in the producing or importing country shall not be used in feeds, pond additives, or any other treatment</p> <p>13.8 For feed suppliers that are not BAP certified, statements are required attesting to the application of production procedures that exclude proactively prohibited drugs</p> <p>13.10 Antibiotics, antimicrobials or hormones shall not be used as growth promoters</p> | |
|---|--|

The final chemical score is 0 of 10.

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 their 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.*
- *Sustainability unit: 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.*

Criterion 5 Summary of scores for GAA 2, 3, 4-star pangasius

| Feed parameters | Value | Score | |
|---|--------------|--------------|--------------|
| F5.1a Fish In: Fish Out ratio (FIFO) | 0.62 | 8.45 | |
| F5.1b Source fishery sustainability score | | -6.00 | |
| F5.1: Wild Fish Use | | 8.08 | |
| F5.2a Protein IN | 32.71 | | |
| F5.2b Protein OUT | 9.98 | | |
| F5.2: Net Protein Gain or Loss (%) | -69.5 | 3 | |
| F5.3: Feed Footprint (hectares) | 4.14 | 8 | |
| C5 Feed Final Score | | 6.79 | GREEN |
| Critical? | NO | | |

Justification of Ranking

Assumptions

- If un-specified in the standards, assume the 2011 species-average FCR, fishmeal and oil levels from FAO (Tacon et al, 2011).
- Assume all non-aquatic feed ingredients are from edible crops (this generates the overall worst-case scenario score for feed in the criteria).
- If standards have some requirements for fishery sustainability but insufficient to deserve a better score, the sustainability score is -6 which assumes the very worst fisheries will be avoided. If there are no fishery sustainability standards then the score is -10.
- Assume a fishmeal protein content of 66.5% from FAO Technical paper 540 (2009). Assume remaining non-fishmeal protein comes from edible crops.
- Assume by-product ingredients in feed is zero unless specified in the standards
- For all species, assume 50% of by-products from harvested fish are utilized unless otherwise specified in the standards.

Explanatory score tables and calculations can be found on pages 22-26 of the assessment criteria. Breakdown of calculations and data points can be found in Appendix 1 of this report.

Factor 5.1. Wild Fish Use

Factor 5.1 combines a Fish In:Fish Out ratio (F5.1a) with a source sustainability factor (F5.1b) to give a “wild fish use” score. Explanatory tables and calculations can be found on page 22 of the assessment criteria.

GAA standards require a FI:FO value of 0.5 or less for pangasius, using an “industry” calculation which is different from the “academic” calculation used by Seafood Watch. The highest FM inclusion level (assuming 0% FO) that can be input to the “industry” calculation used by GAA while still obtaining a FIFO of 0.5 is 9.3% FM. When input to the “academic” calculation used by Seafood Watch a FM inclusion level of 9.3% and FO inclusion level of 0% results in a FIFO value of 0.62. This is the value that has been used in scoring of this benchmarking. The FI:FO score (F5.1a) is 8.45 of 10.

Factor 5.1a Fish In: Fish Out ratio (FIFO)

| Relevant Content of Standards | How we applied it |
|--|---|
| Fishmeal inclusion level 9.1 The applicant’s facility shall use feed for which the manufacturer has provided data on the wild fishmeal and fish oil content or feed fish inclusion ratio | Used 9.3% (highest value that can be input to the GAA FIFO calculation to reach 0.5 FIFO limit) |
| Fishmeal from by-products Not addressed by initiative | Assumed zero |
| Fish oil inclusion level Not addressed by initiative | Used 0% from Tacon et al (2011) |
| Fish oil from by-products Not addressed by initiative | Assumed zero |
| FCR 9.3 The facility shall calculate and record a yearly feed-conversion ratio for completed crops | Used 1.5 from Tacon et al (2011) |
| 9.4 The facility shall calculate and record a final yearly fish in:fish out ratio for completed crops 9.5 The fish in:fish out ratio shall not exceed 0.5 - pangasius | Final FIFO value 0.62 FIFO score 8.45 of 10 |

Using these values in the criteria calculations generates a FIFO value of 0.62 which equates to a score of 8.45 of 10

Factor 5.1b Fishery source sustainability

| Relevant Content of Standards | How we applied it |
|---|---|
| 9.6 The applicant shall obtain feed from a BAP-certified feed mill or a feed mill that declares and documents compliance with 3.1 through 3.3 of the BAP feed mill standards 9.7 If there is a lack of availability of marine ingredients from certified responsible sources, the feed supplier shall use ingredients from fishery improvement projects as these become available. Feedmill 3.1 The applicant shall obtain declarations from suppliers on the species and fishery origins of each batch of fishmeal and fish oil. Feedmill 3.2 The applicant shall indicate a feed fish inclusion factor on product labels, packaging, shipping documents or invoices, or in written declarations for all feeds produced. Feedmill 3.3 The applicant shall develop and implement a clear, written plan of action defining policies for | F5.1b scored -6 of -10 on the above assumption because the standards do not include any specific requirements, but written plans are assumed to avoid the very worst fisheries. |

| | |
|---|--|
| <p>responsibly sourcing fishmeal and fish oil.</p> <p>Applicable after June 2015</p> <p>Feedmill 3.4 For fishmeal and fish oil derived from reduction fisheries, at least 50% shall come from sources that are either MSC- or IFFO RS-certified. Alternatively, where MSC- or IFFO RS-certified fishmeal and fish oil are not produced nationally, the above minimum percentage can comprise material from active, approved improvers programs as verified by IFFO, SFP or WWF.</p> | |
|---|--|

The source sustainability score (F5.1b) is -6 out of 10

Factor 5.1b adjusts the score from 5.1a according to the criteria calculations to give a final wild fish score (Factor 5.1) of 8.08 of 10.

Factor 5.2. Net Protein Gain or Loss

Explanatory tables and calculations can be found on page 24 of the assessment criteria.

| Relevant Content of Standards | How we applied it |
|--|---|
| Protein content of feed Not addressed by initiative | 30% from FAO (2010) |
| Percentage of feed protein from non-edible sources Not addressed by initiative | Assumed zero |
| Percentage of feed protein from edible crop sources Not addressed by initiative | Assumed remainder of non-fishmeal protein = 95.5%, based on 7.5% FM content |
| FCR 9.3 The facility shall calculate and record a yearly feed-conversion ratio for completed crops | 1.5 from Tacon et al (2011) |
| Protein content of harvested pangasius Not addressed by initiative | 14.9 from Boyd et al (2007) |
| Edible yield of harvested pangasius Not addressed by initiative | 34% from FAO (1989) |
| Percentage of non-edible byproducts from harvested pangasius utilized Not addressed by initiative | Assumed 50% for consistency all benchmarking assessments as not addressed in any standards. |

Protein input in feeds is 32.71

Protein output in harvested pangasius is 9.98

Net edible protein loss is 69.5% which equates to a score of 3 out of 10.

Factor 5.3. Feed Footprint

| Relevant Content of Standards | How we applied it |
|--|--|
| Inclusion of aquatic ingredients Not addressed by initiative | 9.3% |
| Inclusion level of crop ingredients Not addressed by initiative | Assumed remainder of non-aquatic ingredients = 92.5% |
| Inclusion level of land animal ingredients Not addressed by initiative | Assumed zero |

Inclusion levels are translated to footprint areas using scoring calculations explained on page 25 of the criteria document.

Final feed footprint is 4.14 hectares per ton which equates to a score of 8 of 10.

The final feed criterion (C5) score is a combination of the three feed factors with a double weighting on FIFO. The final score is 6.79 of 10.

Criterion 6: Escapes

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*
- *Sustainability unit: 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.*

Criterion 6 Summary of scores for GAA 2, 3, 4-star pangasius

| Escape parameters | Value | Score | |
|-----------------------------------|-------|-------------|---------------|
| F6.1 Escape Risk | | 6.00 | |
| F6.1a Recapture and mortality (%) | 0 | | |
| F6.1b Invasiveness | | 3.5 | |
| C6 Escape Final Score | | 4.00 | YELLOW |
| Critical? | NO | | |

Justification of Ranking

Assumptions

- Assume high exchange ponds and cages are high escape risk unless the standards require realistically effective prevention measures above industry norms.
- Assume worst case scenario species/location (e.g. non-native or heavily domesticated native)

Factor 6.1a. Escape risk

Explanatory score table can be found on page 28 of the assessment criteria

| Relevant Content of Standards | How we applied it |
|---|--|
| <p>5.7 The farm shall provide the auditor with an estimated annual water use during the last calendar year, as illustrated in Appendix C, and the input data shall also be available for review</p> <p>10.6 All holding, transport and culture systems shall be designed, operated and maintained to minimize the release of eggs, larval forms, juveniles and adult animals.</p> <p>10.7 Screens and nets sized to retain the smallest farmed animals present shall be installed on water outlet pumps, pipes or sluices. Screens, nets or other controls shall be installed on or near pump intakes to minimize the introduction of local aquatic fauna.</p> <p>10.8 During harvesting and stock transfer operations, effective secondary containment measures shall be applied to control the escape of animals.</p> <p>10. Implementation guidelines Production facilities shall be constructed so as to prevent overtopping by storm surges, waves or flood water. When heavy rainfall is expected, pond levels should be drawn down to prevent the rain from raising water levels and overtopping embankments.</p> | <p>Scored as 6 out of 10. Standard requires ponds be built using standard BMPs for management of escapes. Standard also requires secondary containment at harvest and construction to account for flooding and other weather-related events.</p> |

The initial escape risk score is 6 out of 10

Recaptures and mortality

| Relevant Content of Standards | How we applied it |
|------------------------------------|----------------------|
| Not addressed by initiative | No adjustment (zero) |

The recaptures and mortality score can improve the escape risk score. The final escape risk score remains 6 out of 10.

Factor 6.1b. Invasiveness

See criteria document page 29 for explanation of the factors and scoring questions for native and non-native species

Part A or B

| Relevant Content of Standards | How we applied it |
|---|--|
| <p>There are no standards limiting the number of generations of domestication of hatchery raised stock of a native species.</p> <p>There are no standards that account for potential impact of genetic differences between farmed native stock and wild stocks.</p> | <p>Factor 6.1b PART A scored as 1 of 5 for native species (e.g. <i>P. hypophthalmus</i> in Vietnam): “Four or more generations hatchery-raised or clear evidence of phenotypic differences”.</p> |

Part A (or B) score is 1 out of 5

Part C

| Relevant Content of Standards | How we applied it |
|---|--|
| There are no standards to limit the direct impact of escapees (e.g. competition for food, predation on wild species, disturbance of breeding sites or other habitat modification) | Factor 6.1b PART C scored on basic species life history (see scores in Appendix 1). Total score is 3 out of 5. |

Part C score is 3 out of 5

Final invasiveness score combines Part A or B, and Part C and is 4 of 10

The final escapes score combines the escape risk score with the invasiveness score (explanatory score matrix can be found on page 30 of the assessment criteria) and is 4 out of 10.

Criterion 7. Disease; pathogen and parasite interactions

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*
- *Sustainability unit: 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.*

Criterion 7 Summary of scores for GAA 2, 3, 4-star pangasius

| Pathogen and parasite parameters | Score | |
|--|-------------|---------------|
| C7 Biosecurity | 4.00 | |
| C7 Disease; pathogen and parasite Final Score | 4.00 | YELLOW |
| Critical? | NO | |

Justification of Ranking

Assumptions

- Unless standards robustly specify otherwise, assume a score of 4 for species other than salmon based on the Seafood Watch criteria definition: *“Amplification of pathogens or parasites on the farm results in increased infection of wild fish, shellfish or other populations in the farming locality or region”*

Explanatory score table can be found on page 34 of the assessment criteria

| Relevant Content of Standards | How we applied it |
|---|--|
| <p>15.1 The applicant shall have in place biosecurity controls that seek to prevent the introduction and spread of disease agents and disease on the farm, including the sanitization of equipment and personnel when disease is suspected or confirmed at the farm site, and these shall be detailed in a biosecurity plan as described in the Implementation guidelines above.</p> <p>15.2 Farm staff shall be trained in biosecurity procedures and shall, along with all visitors, comply with them.</p> <p>15.3 A plan for prompt and responsible disposal of excessive mortalities of culture animals by incineration, burial, composting or removal by a competent contractor shall be available for inspection and applied.</p> <p>15.4 Where slaughtering is conducted at the farm, blood water and other effluents generated through processing shall be contained or treated so they do not contaminate the environment or present a biosecurity risk.</p> | <p>Scored 4 of 10 because while the standard has biosecurity protocols and minimum measures for a biosecurity plan, production systems are still open to introductions of local parasites and pathogens, and are also open to the discharge of pathogens</p> |

The final disease criterion (C7) score is 4 out of 10

Criterion 8. Source of Stock – independence from wild fisheries

Impact, unit of sustainability and principle

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

Criterion 8 Summary of scores for GAA 2, 3, 4-star pangasius

| Source of stock parameters | Score | |
|--|--------------|--------------|
| C8 % of production from hatchery-raised broodstock or natural (passive) settlement | 100 | |
| C8 Source of stock Final Score | 10.00 | GREEN |

Justification of Ranking

Assumptions

- For the species covered by the standards in this assessment, assume 100% is source from hatcheries (because almost all are) except shrimp standards that do not specifically prohibit capture of wild postlarvae.

Explanatory score table can be found on page 35 of the assessment criteria

| Relevant Content of Standards | How we applied it |
|--|---|
| 10.4 Wild juveniles shall not be stocked, other than as incidental introduction when extensive ponds are first filled. | Standard requires no use of wild stock for grow-out but does not include standards or requirements for use of broodstock from hatcheries. It is assumed there is no use of wild broodstock. Score 10 of 10. |

The final source of stock score (C8) is 10 out of 10.

Factor 9X: Wildlife and predator mortalities

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

This is an “exceptional” factor that may not apply in many circumstances. It generates a negative score that is deducted from the overall final score. A score of zero means there is no impact.

Factor 9X Summary of scores for GAA 2, 3, 4-star pangasius

| Wildlife and predator mortality parameters | Score | |
|---|-------|--------|
| F9X Wildlife and predator mortality Final Score | -4.00 | YELLOW |
| Critical? | NO | |

Justification of Ranking

Assumptions:

- Assume score of -4 unless standards specify otherwise. This is based on an assumption that wildlife mortalities will occur if the standards do not specifically require non-lethal controls, but that in the large majority of cases, the mortality numbers will not significantly impact the predator populations.

F9X Wildlife and predator score. Explanatory tables can be found on page 18 of the assessment criteria.

| Relevant Content of Standards | How we applied it |
|--|--|
| <p>10.11 The facility shall use humane methods of predator deterrents and actively favor non-lethal methods. No controls, other than non-lethal exclusion, shall be applied to species that are listed as endangered or highly endangered on the IUCN Red List or that are protected by local or national laws.</p> <p>10.12 The facility shall record, and report where required, the species and numbers of all avian, mammalian and reptilian mortalities</p> | Standards suggest but do not require non-lethal predator deterrents. Scored as -4 on the above assumption. |

Final score for 9X is -4 out of -10

Factor 10X: Escape of unintentionally introduced species

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

This is an “exceptional criterion that may not apply in many circumstances. It generates a negative score that is deducted from the overall final score.

Factor 10X Summary of scores for GAA 2, 3, 4-star pangasius

| Escape of unintentionally introduced species parameters | Score | |
|--|-------------|--------------|
| F10Xa International or trans-waterbody live animal shipments (%) | 10.00 | |
| F10Xb Biosecurity of source/destination | n/a | |
| C6 Escape of unintentionally introduced species Final Score | 0.00 | GREEN |

Justification of Ranking

Assumptions

- Assume zero international shipping of livestock for finfish and shrimp

Factor 10Xa International or trans-waterbody live animal shipments

Explanatory score table can be found on page 31 of the assessment criteria.

| Relevant Content of Standards | How we applied it |
|---|--|
| <p>10.3 The facility shall keep records of sources and purchases of stocking material, and record the number stocked in each culture unit for each crop.</p> | <p>Assumed zero reliance on international or trans-waterbody live animal shipments for consistency with other benchmarking exercises. Score 10 of 10</p> |

Factor 10Xb Biosecurity of source/destination

Not relevant with zero shipment assumption

Biosecurity of source

| Relevant Content of Standards | How we applied it |
|---|--|
| <p>15.1 The applicant shall have in place biosecurity controls that seek to prevent the introduction and spread of disease agents and disease on the farm, including the sanitization of equipment and personnel when disease is suspected or confirmed at the farm site, and these shall be detailed in a biosecurity plan as described in the Implementation guidelines above.</p> <p>15.2 Farm staff shall be trained in biosecurity procedures and shall, along with all visitors, comply with them.</p> <p>15.3 A plan for prompt and responsible disposal of excessive mortalities of culture animals by incineration, burial, composting or removal by a competent contractor shall be available for inspection and applied.</p> <p>15.4 Where slaughtering is conducted at the farm, blood water and other effluents generated through processing shall be contained or treated so they do not contaminate the environment or present a biosecurity risk.</p> | <p>Score 2 of 10 for a moderate risk system with uncertainty about the robustness of escape or entry prevention measures</p> |

Biosecurity of destination

| Relevant Content of Standards | How we applied it |
|---|---|
| <p>10.6 All holding, transport and culture systems shall be designed, operated and maintained to minimize the release of eggs, larval forms, juveniles and adult animals.</p> <p>10.7 Screens and nets sized to retain the smallest farmed animals present shall be installed on water outlet pumps, pipes or sluices. Screens, nets or other controls shall be installed on or near pump intakes to minimize the introduction of local aquatic fauna.</p> <p>10.8 During harvesting and stock transfer operations, effective secondary containment measures shall be applied to control the escape of animals.</p> <p>15.1 The applicant shall have in place biosecurity controls that seek to prevent the introduction and spread of disease agents and disease on the farm, including the sanitization of equipment and personnel when disease is suspected or confirmed at the farm site, and these shall be detailed in a biosecurity plan as described in the Implementation guidelines above.</p> <p>15.2 Farm staff shall be trained in biosecurity procedures and shall, along with all visitors, comply with them.</p> <p>15.3 A plan for prompt and responsible disposal of excessive mortalities of culture animals by incineration, burial, composting or removal by a competent contractor shall be available for inspection and applied.</p> <p>15.4 Where slaughtering is conducted at the farm, blood water and other effluents generated through processing shall be contained or treated so they do not contaminate the environment or present a biosecurity risk.</p> | <p>Score 6 of 10 for a moderate risk system with multiple fail-safe escape or entry prevention methods, and management of escape and entry prevention (biosecurity)</p> |

The score for Factor 10X is a deduction of 0 out of -10

Overall Recommendation

The overall recommendation is as follows:

The overall final score is the average of the individual criterion scores (after the two exceptional scores have been deducted from the total). The overall ranking is decided according to the final score, the number of red criteria, and the number of critical scores as follows:

- **Best Choice** = Final score ≥ 6.6 AND no individual criteria are Red (i.e. < 3.3)
- **Good Alternative** = Final score ≥ 3.3 AND < 6.6 , OR Final score ≥ 6.6 and there is one individual “Red” criterion.
- **Red** = Final score < 3.3 , OR there is more than one individual Red criterion, OR there is one or more Critical score.

GAA 2, 3, 4-star pangasius

| Criterion | Score (0-10) | Rank | Critical? |
|--------------------------------|--------------|--------|-----------|
| C1 Data | 9.17 | GREEN | |
| C2 Effluent | 5.00 | YELLOW | NO |
| C3 Habitat | 3.50 | YELLOW | NO |
| C4 Chemicals | 0.00 | RED | NO |
| C5 Feed | 6.79 | GREEN | NO |
| C6 Escapes | 4.00 | YELLOW | NO |
| C7 Disease | 4.00 | YELLOW | NO |
| C8 Source | 10.00 | GREEN | |
| | | | |
| 3.3X Wildlife mortalities | -4.00 | YELLOW | NO |
| 6.2X Introduced species escape | 0.00 | GREEN | |
| Total | 38.46 | | |
| Final score | 4.81 | | |

| | |
|--------------------|--------|
| Final Score | 4.81 |
| Initial rank | YELLOW |
| Red criteria | 1 |
| Final rank | YELLOW |
| Critical Criteria? | NO |

| |
|---------------|
| FINAL RANK |
| YELLOW |

Guiding Principles

Seafood Watch™ defines sustainable seafood as originating from sources, whether fished or farmed, that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

The following **guiding principles** illustrate the qualities that aquaculture must possess to be considered sustainable by the Seafood Watch program:

Seafood Watch will:

- Support data transparency and therefore aquaculture producers or industries that make information and data on production practices and their impacts available to relevant stakeholders.
- Promote aquaculture production that minimizes or avoids the 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.
- Promote aquaculture production at locations, scales and intensities that cumulatively maintain the functionality of ecologically valuable habitats without unreasonably penalizing historic habitat damage.
- Promote aquaculture production that by design, management or regulation avoids the use and 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
- Within the typically limited data availability, use understandable quantitative and relative indicators to recognize the global impacts of feed production and the efficiency of conversion of feed ingredients to farmed seafood.
- Promote aquaculture operations that pose no substantial risk of deleterious effects to wild fish or shellfish populations through competition, habitat damage, genetic introgression, hybridization, spawning disruption, changes in trophic structure or other impacts associated with the escape of farmed fish or other unintentionally introduced species.
- Promote aquaculture operations that pose no substantial risk of deleterious effects to wild populations through the amplification and retransmission of pathogens or parasites.
- promote the use of eggs, larvae, or juvenile fish produced in hatcheries using domesticated broodstocks thereby avoiding the need for wild capture
- recognize that energy use varies greatly among different production systems and can be a major impact category for some aquaculture operations, and also recognize that improving practices for some criteria may lead to more energy intensive production systems (e.g. promoting more energy-intensive closed recirculation systems)

Once a score and rank has been assigned to each criterion, an overall seafood recommendation is developed on additional evaluation guidelines. Criteria ranks and the overall recommendation are color-coded to correspond to the categories on the Seafood Watch pocket guide:

Best Choices/Green: Are well managed and caught or farmed in environmentally friendly ways.

Good Alternatives/Yellow: Buy, but be aware there are concerns with how they're caught or farmed.

Avoid/Red: Take a pass on these. These items are overfished or caught or farmed in ways that harm other marine life or the environment

References

Boyd, CE, C Tucker, A McNevin, K Bostick, J Clay (2007) Indicators of Resource Use Efficiency and Environmental Performance in Fish and Crustacean Aquaculture. *Reviews in Fisheries Science* 15: 327-360.

Tacon, A., Hasan, M. R., & Metian, M. (2011). Demand and supply of feed ingredients for farmed fish and crustaceans Trends and prospects. *FAO Fisheries and Aquaculture Technical Paper*, 564.

Appendix 1 - Data points and all scoring calculations

This is a condensed version of the criteria and scoring sheet to provide access to all data points and calculations. See the Seafood Watch Aquaculture Criteria document for a full explanation of the criteria, calculations and scores. Yellow cells represent data entry points.

Criterion 1: Data quality and availability

| Data Category | Relevance (Y/N) | Data Quality | Score (0-10) |
|-----------------------------------|-----------------|--------------|--------------|
| Industry or production statistics | Yes | 10 | 10 |
| Effluent | Yes | 10 | 10 |
| Locations/habitats | Yes | 7.5 | 7.5 |
| Predators and wildlife | Yes | 10 | 10 |
| Chemical use | Yes | 10 | 10 |
| Feed | Yes | 7.5 | 7.5 |
| Escapes, animal movements | Yes | 10 | 10 |
| Disease | Yes | 7.5 | 7.5 |
| Source of stock | Yes | 10 | 10 |
| Other – (e.g. GHG emissions) | No | n/a | n/a |
| Total | | | 82.5 |

| | | |
|----------------------------|------|-------|
| C1 Data Final Score | 9.17 | GREEN |
|----------------------------|------|-------|

Criterion 2: Effluents

Factor 2.1a - Biological waste production score

| | |
|--|--------------|
| Protein content of feed (%) | 30 |
| eFCR | 1.5 |
| Fertilizer N input (kg N/ton fish) | 0 |
| Protein content of harvested fish (%) | 14.9 |
| N content factor (fixed) | 0.16 |
| N input per ton of fish produced (kg) | 72 |
| N in each ton of fish harvested (kg) | 23.84 |
| Waste N produced per ton of fish (kg) | 48.16 |

Factor 2.1b - Production System discharge score

| | |
|-------------------------------|-------|
| Basic production system score | 1 |
| Adjustment 1 (if applicable) | -0.17 |
| Adjustment 2 (if applicable) | -0.24 |

| | |
|--------------------------------------|-------------|
| Adjustment 3 (if applicable) | 0 |
| Discharge (Factor 2.1b) score | 0.66 |

66 % of the waste produced by the fish is discharged from the farm

2.2 – Management of farm-level and cumulative impacts and appropriateness to the scale of the industry

Factor 2.2a - Regulatory or management effectiveness

| Question | Scoring | Score |
|--|------------|-------------|
| 1 - Are effluent regulations or control measures present that are designed for, or are applicable to aquaculture? | Yes | 1 |
| 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? | Moderately | 0.25 |
| 3 - Do the control measures address or relate to the cumulative impacts of multiple farms? | No | 0 |
| 4 - Are the limits considered scientifically robust and set according to the ecological status of the receiving water body? | Moderately | 0 |
| 5 - Do the control measures cover or prescribe including peak biomass, harvest, sludge disposal, cleaning etc? | Moderately | 0.5 |
| | | 1.75 |

Factor 2.2b - Enforcement level of effluent regulations or management

| Question | Scoring | Score |
|--|------------|------------|
| 1 - Are the enforcement organizations and/or resources identifiable and contactable, and appropriate to the scale of the industry? | Yes | 1 |
| 2 - Does monitoring data or other available information demonstrate active enforcement of the control measures? | Yes | 1 |
| 3 - Does enforcement cover the entire production cycle (i.e. are peak discharges such as peak biomass, harvest, sludge disposal, cleaning included)? | Moderately | 0.5 |
| 4 - Does enforcement demonstrably result in compliance with set limits? | Yes | 1 |
| 5 - Is there evidence of robust penalties for infringements? | Yes | 1 |
| | | 4.5 |

| | |
|-----------------------------------|-------------|
| F2.2 Score (2.2a*2.2b/2.5) | 3.15 |
|-----------------------------------|-------------|

| | | |
|--------------------------------|-------------|---------------|
| C2 Effluent Final Score | 5.00 | YELLOW |
| | Critical? | NO |

Criterion 3: Habitat

3.1. Habitat conversion and function

| | |
|-------------------|----------|
| F3.1 Score | 4 |
|-------------------|----------|

3.2 Habitat and farm siting management effectiveness (appropriate to the scale of the industry)**Factor 3.2a - Regulatory or management effectiveness**

| Question | Scoring | Score |
|--|------------|------------|
| 1 - Is the farm location, siting and/or licensing process based on ecological principles, including an EIAs requirement for new sites? | No | 0.25 |
| 2 - Is the industry's total size and concentration based on its cumulative impacts and the maintenance of ecosystem function? | No | 0 |
| 3 - Is the industry's ongoing and future expansion appropriate locations, and thereby preventing the future loss of ecosystem services? | Mostly | 0.75 |
| 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) | Moderately | 0.75 |
| 5 - Do control measures include requirements for the restoration of important or critical habitats or ecosystem services? | Moderately | 0.75 |
| | | 2.5 |

Factor 3.2b - Siting regulatory or management enforcement

| Question | Scoring | Score |
|--|---------|------------|
| 1 - Are enforcement organizations or individuals identifiable and contactable, and are they appropriate to the scale of the industry? | Yes | 1 |
| 2 - Does the farm siting or permitting process function according to the zoning or other ecosystem-based management plans articulated in the control measures? | No | 0 |
| 3 - Does the farm siting or permitting process take account of other farms and their cumulative impacts? | No | 0 |
| 4 - Is the enforcement process transparent - e.g. public availability of farm locations and sizes, EIA reports, zoning plans, etc? | Mostly | 0.5 |
| 5 - Is there evidence that the restrictions or limits defined in the control measures are being achieved? | Mostly | 1 |
| | | 2.5 |

| | |
|-----------------------------------|-------------|
| F3.2 Score (2.2a*2.2b/2.5) | 2.50 |
|-----------------------------------|-------------|

| | | |
|-------------------------------|-------------|---------------|
| C3 Habitat Final Score | 3.50 | YELLOW |
| | Critical? | NO |

Criterion 4: Evidence or Risk of Chemical Use

| Chemical Use parameters | Score |
|-------------------------|-------|
|-------------------------|-------|

| | | |
|------------------------------------|-------------|------------|
| C4 Chemical Use Score | 0.00 | |
| C4 Chemical Use Final Score | 0.00 | RED |
| Critical? | NO | |

Criterion 5: Feed

5.1. Wild Fish Use

Factor 5.1a - Fish In: Fish Out (FIFO)

| | |
|-------------------------------|-------------|
| Fishmeal inclusion level (%) | 9.3 |
| Fishmeal from by-products (%) | 0 |
| % FM | 9.3 |
| Fish oil inclusion level (%) | 0 |
| Fish oil from by-products (%) | 0 |
| % FO | 0 |
| Fishmeal yield (%) | 22.5 |
| Fish oil yield (%) | 5 |
| eFCR | 1.5 |
| FIFO fishmeal | 0.62 |
| FIFO fish oil | 0.00 |
| Greater of the 2 FIFO scores | 0.62 |
| FIFO Score | 8.45 |

Factor 5.1b - Sustainability of the Source of Wild Fish (SSWF)

| | |
|-------------|-------|
| SSWF | -6 |
| SSWF Factor | -0.37 |

| | |
|---------------------------------|-------------|
| F5.1 Wild Fish Use Score | 8.08 |
|---------------------------------|-------------|

5.2. Net protein Gain or Loss

| Protein INPUTS | |
|---|------|
| Protein content of feed | 30 |
| eFCR | 1.5 |
| Feed protein from NON-EDIBLE sources (%) | 0 |
| Feed protein from EDIBLE CROP sources (%) | 95.5 |
| Protein OUTPUTS | |
| Protein content of whole harvested fish (%) | 14.9 |
| Edible yield of harvested fish (%) | 34 |
| Non-edible by-products from harvested fish used for other food production | 50 |

| | | |
|-------------------------------------|-----------|---------------|
| | | |
| Protein IN | | 32.71 |
| Protein OUT | | 9.983 |
| Net protein gain or loss (%) | | -69.48 |
| | Critical? | NO |
| F5.2 Net protein Score | | 3.00 |

5.3. Feed Footprint

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

| | | |
|---|--|-------------|
| Inclusion level of aquatic feed ingredients (%) | | 9.3 |
| eFCR | | 1.5 |
| Average Primary Productivity (C) required for aquatic feed ingredients (ton C/ton fish) | | 69.7 |
| Average ocean productivity for continental shelf areas (ton C/ha) | | 2.68 |
| Ocean area appropriated (ha/ton fish) | | 3.63 |

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

| | | |
|--|--|-------------|
| Inclusion level of crop feed ingredients (%) | | 90.7 |
| Inclusion level of land animal products (%) | | 0 |
| Conversion ratio of crop ingredients to land animal products | | 2.88 |
| eFCR | | 1.5 |
| Average yield of major feed ingredient crops (t/ha) | | 2.64 |
| Land area appropriated (ha per ton of fish) | | 0.52 |

| | |
|----------------------------------|-------------|
| Value (Ocean + Land Area) | 4.14 |
|----------------------------------|-------------|

| | |
|----------------------------------|-------------|
| F5.3 Feed Footprint Score | 8.00 |
|----------------------------------|-------------|

| | | |
|----------------------------|-------------|--------------|
| C5 Feed Final Score | 6.79 | GREEN |
| | Critical? | NO |

Criterion 6: Escapes

6.1a. Escape Risk

| | |
|-------------|---|
| Escape Risk | 6 |
|-------------|---|

| |
|-----------------------------------|
| Recapture & Mortality Score (RMS) |
|-----------------------------------|

| | |
|---|----------|
| Estimated % recapture rate or direct mortality at the escape site | 0 |
| Recapture & Mortality Score | 0 |
| Factor 6.1a Escape Risk Score | 6 |

6.1b. Invasiveness

Part A – Native species

| | |
|--------------|----------|
| Score | 1 |
|--------------|----------|

Part B – Non-Native species

| | |
|--------------|----------|
| Score | 0 |
|--------------|----------|

Part C – Native and Non-native species

| Question | Score |
|---|----------------|
| Do escapees compete with wild native populations for food or habitat? | Yes |
| Do escapees act as additional predation pressure on wild native populations? | To some extent |
| Do escapees compete with wild native populations for breeding partners or disturb breeding behavior of the same or other species? | No |
| Do escapees modify habitats to the detriment of other species (e.g. by feeding, foraging, settlement or other)? | No |
| Do escapees have some other impact on other native species or habitats? | To some extent |
| | 3 |

| | |
|---------------------|----------|
| F 6.1b Score | 4 |
|---------------------|----------|

| | | |
|-----------------------|-------------|---------------|
| Final C6 Score | 4.00 | YELLOW |
| | Critical? | NO |

Criterion 7:Diseases

| Pathogen and parasite parameters | Score | |
|--|-------------|---------------|
| C7 Biosecurity | 4.00 | |
| C7 Disease; pathogen and parasite Final Score | 4.00 | YELLOW |
| | Critical? | NO |

Criterion 8: Source of Stock

| | |
|-----------------------------------|--------------|
| Source of stock parameters | Score |
|-----------------------------------|--------------|

| | | |
|--|-----------|--------------|
| C8 % of production from hatchery-raised broodstock or natural (passive) settlement | 100 | |
| C8 Source of stock Final Score | 10 | GREEN |

Exceptional Factor 9X: Wildlife and predator mortalities

| Wildlife and predator mortality parameters | Score | |
|--|-------|--------|
| F3.3X Wildlife and Predator Final Score | -4.00 | YELLOW |
| Critical? | NO | |

Exceptional Factor 10X: Escape of unintentionally introduced species

| Escape of unintentionally introduced species parameters | Score | |
|---|-------------|--------------|
| F6.2Xa International or trans-waterbody live animal shipments (%) | 10.00 | |
| F6.2Xb Biosecurity of source/destination | 0.00 | |
| F6.2X Escape of unintentionally introduced species Final Score | 0.00 | GREEN |