

# Monterey Bay Aquarium Seafood Watch®

## Aquaculture Stewardship Council *Pangasius (Version 1.0)*



Benchmarking equivalency results assessed against the Seafood  
Watch Aquaculture Criteria

May 2013

## Final Seafood Recommendation

ASC Pangasius

Criterion	Score (0-10)	Rank	Critical?
C1 Data	9.75	GREEN	
C2 Effluent	6.00	YELLOW	NO
C3 Habitat	3.22	RED	NO
C4 Chemicals	4.00	YELLOW	NO
C5 Feed	7.27	GREEN	NO
C6 Escapes	4.00	YELLOW	NO
C7 Disease	4.00	YELLOW	NO
C8 Source	10.00	GREEN	
3.3X Wildlife mortalities	-2.00	GREEN	NO
6.2X Introduced species escape	0.00	GREEN	
<b>Total</b>	<b>45.24</b>		
<b>Final score</b>	<b>5.65</b>		

Final Score	5.65
Initial rank	YELLOW
Red criteria	1
Final rank	YELLOW
Critical Criteria?	NO

FINAL RANK
<b>YELLOW</b>

*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 is yellow, and with only one red criterion, the final recommendation remains a yellow “Good Alternative”.

## **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 final result of the ASC Pangasius equivalence assessment is a yellow “Good Alternative” recommendation. We do not consider all certified farms to be at that level, but the standards could allow a farm equivalent to a yellow Seafood Watch recommendation to be certified. This means we can defer to ASC Pangasius certification as an assurance that certified products meet at least a yellow “Good Alternative” recommendation.

Although some production in cages continues, the assessment was based on production in high-exchange ponds located where the species is non-native. This represented the “realistic worst case scenario” for each criterion and factor unless the standards specified otherwise.

In general, the ASC Pangasius standards:

- cover significantly different production systems, i.e. ponds and cages
- score moderate or good on all criteria except habitat
- like all farm-level standards do not robustly address cumulative impacts of multiple neighboring, local or regional farms.
- score well in some instances due to the nature of the species rather than the robustness of the standards.

Specifically, the ASC Pangasius standards:

- like all certification, require considerable data collection and combined with the farm-level certification process result in a good data score,
- specify a limit of total nitrogen (and phosphorous) discharge and include measures intended to address cumulative impacts of total production
- allow pond farms to be located in high value habitats as long as they were built more than ten years ago, and do not address the cumulative habitat impacts of multiple neighboring, local or regional farms.
- prohibit the use of antibiotics critically important to human health, but otherwise chemicals are still permitted in unrestricted quantities and can be released into the surrounding environment from cage/pen/pond culture.
- specify a robust limit on fish in to fish out in feed, allow a significant net loss in edible protein, but result in a good overall feed score
- only allow production where the species is established, but can’t robustly prevent escapes or the ecological impacts of those escapees regardless of their establishment status.

- can't robustly prevent the introduction of local pathogens and parasites (e.g., from water, broodstock, eggs, fry, feed, local wildlife, etc.) and the discharge of potentially higher virulence pathogens.
- prohibit lethal control of wildlife and/or predators

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## **Introduction**

### ***Scope of the analysis and ensuing recommendation***

#### **Species**

ASC standards apply to *Pangasianodon hypophthalmus* and *Pangasius bocourti*.

#### **Geographic coverage**

The ASC Pangasius Standard applies globally to all locations and any scale of pangasius aquaculture production system.

#### **Production Methods**

The ASC Pangasius Standard applies to all production systems currently used for pangasius production, such as ponds, pens and cages. The worst case scenario is considered to be ponds because of the potential for habitat (wetland) interactions, and cage production is now relatively minor.

## **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 (3.3x and 6.2X), 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](#)<sup>1</sup>.**
- **The full data values and scoring calculations are available in Appendix 1**

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<sup>1</sup> [http://www.montereybayaquarium.org/cr/cr\\_seafoodwatch/sfw\\_aboutsfw.aspx](http://www.montereybayaquarium.org/cr/cr_seafoodwatch/sfw_aboutsfw.aspx)

## **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 ASC Pangasius**

<b>Data Category</b>	<b>Relevance (Y/N)</b>	<b>Data Quality</b>	<b>Score (0-10)</b>
Industry or production statistics	Yes	10	10
Effluent	Yes	10	10
Locations/habitats	Yes	10	10
Predators and wildlife	Yes	10	10
Chemical use	Yes	10	10
Feed	Yes	10	10
Escapes, animal movements	Yes	7.5	7.5
Disease	Yes	10	10
Source of stock	Yes	10	10
Other – (e.g. GHG emissions)	Yes	10	10
<b>Total</b>			<b>97.5</b>

<b>C1 Data Final Score</b>	<b>9.75</b>	<b>GREEN</b>
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### **Justification of Ranking**

#### Assumptions:

- The “Source of stock” and “Energy use” categories were 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.

While there are few specific data collection requirements, certification to the standards necessitates monitoring and data collection on all aspects relevant to the Seafood Watch criteria. The escapes category is scored 7.5 because of the inherent uncertainty in counting.

The final score (average of relevant category scores) is 9.72

## **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 ASC Pangasius**

<b>Effluent parameters</b>	<b>Value</b>	<b>Score</b>	
F2.1a Biological waste (nitrogen) production per of fish (kg N ton-1)	27.5		
F2.1b Waste discharged from farm (%)	100		
F2 .1 Waste discharge score (0-10)		7	
F2.2a Content of regulations (0-5)	1.75		
F2.2b Enforcement of regulations (0-5)	4.25		
F2.2 Regulatory or management effectiveness score (0-10)		2.975	
<b>C2 Effluent Final Score</b>		<b>5.00</b>	<b>YELLOW</b>
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 remaining ASC standards regarding cumulative impacts and specific requirements for oligotrophic conditions have been used in Factor 2.2.

### **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
<p>3.1.1 For cages and pens, maximum amount of total phosphorus (TP) added as feed per metric ton of fish produced <b>20kg/ton</b></p> <p>3.1.2 For cages and pens, maximum amount of total nitrogen (TN) added as feed per metric ton of fish produced <b>70kg/ton</b></p> <p>3.1.3 For ponds, amount of TP discharged per metric ton of fish produced <b>7.2 kg/ton</b></p> <p>3.1.4 For ponds, amount of TN discharged per metric ton of fish produced <b>27.5kg/ton</b></p> <p>3.3.1 Maximum average percentage change of TP between inlet and outlet (See TP measurement methodology and TP discharge formula in Annex D) <b>100%</b></p> <p>3.3.2 Maximum average percentage change of TN between inlet<sup>25</sup> and outlet<sup>26</sup> (See TN measurement methodology and TN discharge formula in Annex D) <b>70%</b></p> <p>3.3.3 Minimum dissolved oxygen (DO) concentration in water discharged (See DO measurement methodology in Annex D) <b>3mg/l</b></p> <p>3.4.1 Evidence that sludge is not discharged directly into receiving waters or natural ecosystems <b>- Yes</b></p>	<p>Used 27.5kg N per ton of production (from standard 3.1.4), as this parameter is the end result of the approximate calculations required in the Seafood Watch criteria.</p>

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

Relevant ASC Shrimp Standards	How we applied it
As above for standard 3.1.4	27.5 kg N is per ton is used as the limit of discharge, so the Seafood Watch Factor 2.1b is not needed

	(i.e. it is effectively 100% of 27.5 kg)
Waste discharged per ton of pangasius is 27.5 kg N and an initial score of 7 out of 10. For reference, the full Seafood Watch calculation for pangasius and taking account of the sludge disposal etc in the ASC standards produces a very similar value of 28.4 kg N per ton of production.	

Factor 2.2 then addresses the management measures in the standards to control the potential impact of the total farm tonnage and the cumulative impacts of neighboring farms.

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

Factor 2.2 assesses the effectiveness of management measure 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

<b>Relevant Content of Standards</b>	<b>How we applied it</b>
Standards 3.1.1 to 3.1.4 and 3.3.1 to 3.3.3 as above	Score of 1 for Factor 2.2a question 1 because the measures are specific to pangasius aquaculture
All standards	Score of 0 for Factor 2.2a question 2 because the standards are universally applicable and do not lead to site-specific effluent limits.
No standards relating to cumulative impacts of multiple farms	Score of 0 for Factor 2.2a question 3
Standards 3.1.1 to 3.1.4 and 3.3.1 to 3.3.3 as above	Score of 0.5 for Factor 2.2a question 4 because the standards are considered scientifically robust, but are only set according to production system, not to the ecological status of the receiving water body.
Annex D DO [dissolved oxygen] to be measured fortnightly by the farmer from the time of stocking and regularly for the whole period the farm is certified	Score of 0.25 for Factor 2.2a question 5 because water quality monitoring frequency is not specified and dissolved oxygen monitoring can avoid periods of high discharge such as harvest, cleaning, or pond preparation.

The total for Factor 2.2a is 1.75 (out of 5)

Factor 2.2b assesses the enforcement of the above measures.

<b>Relevant Content of Standards</b>	<b>How we applied it</b>
The requirements for audit and full compliance for all ASC 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 0.25 as monitoring may avoid peak discharge events	

Factor 2.2b score is 4.25 out of 5

ASC Pangasius

The Factor 2.2 score for the effectiveness of the management is 3 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 out 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 ASC Pangasius**

Habitat parameters	Value	Score	
F3.1 Habitat conversion and function		4.00	
F3.2a Content of habitat regulations	1.50		
F3.2b Enforcement of habitat regulations	2.75		
F3.2 Regulatory or management effectiveness score		1.65	
<b>C3 Habitat Final Score</b>		<b>3.22</b>	<b>RED</b>
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
2.2.1 For ponds, evidence that only land that has been allocated to agriculture or aquaculture for 10 years prior is used for new pond development or for farm expansion <b>Yes</b>	ASC standards prevent siting in high value habitats within the last ten years, 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
2.2.2 Evidence that a contribution of at least USD \$0.50 per ton of fish produced has been paid to the environmental and social restoration fund annually <b>Yes</b>	
2.2.3 Evidence that no earth has been discharged into common water bodies <b>Yes</b>	
2.2.4 Evidence of no negative impacts on endangered species <b>Yes</b>	

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
2.1.1 Farm located in approved aquaculture development areas – <b>Yes</b>	Score of 0 for Factor 3.2a question 1 because no standards requiring siting according to ecological principles or requiring EIAs
2.3.1 Farm does not impede navigation, aquatic animals or water movement - <b>Yes</b>	
No standards relating to cumulative habitat impacts of multiple farms impacts except for cages (standards 2.32 to 2.34)	Score of 0 for Factor 3.2a question 2
2.1.1 Farm located in approved aquaculture development areas – <b>Yes</b>	Score of 0.5 for Factor 3.2a question 3 because sites can continue to be built or expand in former high value habitats as long as it was converted ten years previously, or according to unknown aquaculture development areas.
2.2.1 For ponds, evidence that only land that has been allocated to agriculture or aquaculture for 10 years prior is used for new pond development or for farm expansion <b>Yes</b>	
Standards 2.2.1 as above.	Score of 0.75 for Factor 3.2a question 4 because sites can still be

	in high value habitats if converted more than ten years ago.
2.2.2 Evidence that a contribution of at least USD \$0.50 per ton of fish produced has been paid to the environmental and social restoration fund annually <b>Yes</b>	Score of 0.25 for Factor 3.2a question 5 because even if a restoration fund is in place, there are no controls specified on the quality of that restoration.

The final score for Factor 3.2a is 1.5 out 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
2.1.1 Farm located in approved aquaculture development areas – <b>Yes</b>	Score of 0.25 for Factor 3.2b question 2 because the enforcement relies on the previous unknown enforcement of unknown local regulations for aquaculture.
Enforcement relating to cumulative impacts of multiple farms <b>Not addressed by initiative</b>	Score of 0 for Factor 3.2b question 3 because certification has no control over neighboring, local or regional farms contributing to cumulative habitat impacts.
Transparency of enforcement (certification) process	Score of 0.5 for Factor 3.2b question 4 because it is not yet known how transparent the ASC certification and audit process will be.
Achievement of control measures	Score of 1 for Factor 3.2b question 5 because all measures in the standards are requirements that must be met at audit.

The final score for Factor 3.2b is 2.75 out of 5

The final score for Factor 3.2 combines 3.2a and b to give a score of 1.65 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 3.22 out of 10

### Factor 3.3X: 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 3.3X Summary of scores for ASC Pangasius

Wildlife and predator mortality parameters	Score	
<b>F3.3X Wildlife and predator mortality Final Score</b>	<b>-2.00</b>	<b>GREEN</b>
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.

F3.3X Wildlife and predator score. Explanatory tables can be found on page 18 of the assessment criteria.

Relevant Content of Standards	How we applied it
6.6.1 Use of lethal predator control - <b>No</b>	Score as -2; - Aquaculture operation may attract or interact with predators or other wildlife, but effective management and prevention measures limit mortalities to exceptional cases.
6.6.2 Mortality of IUCN red listed species- <b>Zero</b>	

Final score for 3.3X is -2 out 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 ASC Pangasius**

<b>Chemical Use parameters</b>	<b>Score</b>	
C4 Chemical Use Score	<b>4.00</b>	
<b>C4 Chemical Use Final Score</b>	<b>4.00</b>	<b>YELLOW</b>
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>6.2.1 Use only veterinary medicines, chemicals and biological products approved for aquaculture by relevant national authorities and not banned for food fish use in the potential importing country <b>Yes</b></p> <p>6.2.2 Use only veterinary medicines and chemicals for therapeutic use prescribed by an aquatic animal health specialist based on a verified condition; follow the label specifications concerning the use of the substance for the given purpose <b>Yes</b></p> <p>6.2.3 Follow the aquatic animal health specialist recommendations on: 6.2.3.1 How to apply the veterinary medicine and chemicals prescribed 6.2.3.2 How to handle and store the veterinary medicines and chemicals prescribed 6.2.3.3 Who needs to be informed about the disease and how 6.2.3.4 How to limit the spread of the disease to neighboring wild or farmed populations</p> <p>6.2.5 Allowance for the use of antibiotics critical for human medicine, as categorized by the World Health Organization <b>None</b></p> <p>6.2.6 Allowance for prophylactic use of veterinary medicines (excluding vaccines) prior to any evidence of a specific disease problem <b>None</b></p> <p>6.2.7 Allowance for use of veterinary medicine (excluding vaccines) to serve as growth promoters <b>None</b></p>	<p>Scored 4 because chemicals are still permitted in unrestricted quantities and can be released into the surrounding environment in cage/pen/pond culture.</p>

The final score for Criterion 4 is 4 out 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 ASC Pangasius**

<b>Feed parameters</b>	<b>Value</b>	<b>Score</b>	
F5.1a Fish In: Fish Out ratio (FIFO)	0.50	8.74	
F5.1b Source fishery sustainability score		-4.00	
F5.1: Wild Fish Use		8.54	
F5.2a Protein IN	32.54		
F5.2b Protein OUT	9.98		
F5.2: Net Protein Gain or Loss (%)	-69.3	3	
F5.3: Feed Footprint (hectares)	2.49	9	
<b>C5 Feed Final Score</b>		<b>7.27</b>	<b>GREEN</b>
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.

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

Relevant Content of Standards	How we applied it
5.2.2 Maximum Fish Feed Equivalence Ratio (FFER) - 0.5	The ASC's FFER calculation is the same as the FIFO calculation in the Seafood Watch criteria. The maximum value of 0.5

Using these values in the criteria calculations generates a FIFO value of 0.5 which equates to a score of 8.74 out of 10

#### Factor 5.1b Fishery source sustainability

Relevant Content of Standards	How we applied it
5.1.3 Fish products used in feed are not in the —threatened categories on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species - <b>Yes</b>	Scored a s -4 for no Fishsource scores <6 (Standard 5.1.7)
5.1.4 Fish products used in feed are not from species listed in the Convention on International Trade in Endangered Species (CITES) Appendices I, II and III - <b>Yes</b>	
5.1.5 ISEAL-certified fishmeal and fish oil products must be used in feed - Within 3 years of becoming available in a region	
5.1.6 ISEAL certified fishmeal and fish oil products must be used in feed - Within 5 years from the publication date of the PAD standards	
5.1.7 Up to when standard 5.1.5 or 5.1.6 can be met: Interim Option A: Fishmeal or fish oil products used in feed have been sourced from fisheries with an average FishSource (FS) score Interim - $\geq 6.0$ with no individual score < 6.0 or an N/A in the stock assessment category Interim Option B: Fish Products used in feed have been sourced from facilities certified as being in compliance with Sections 11 (Responsible Sourcing), 2 (Traceability), and 3 (Responsible Manufacturing) of the International Fishmeal and Fish Oil Organisation’s (IFFO) —Responsible Sourcing Program for Certification of Responsible Practice for Fishmeal and Fish Oil Production - <b>Yes</b>	

The source sustainability score (F5.1b) is -4 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 8.54 out 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 <b>Not addressed by initiative</b>	30% from FAO (2010)
Percentage of feed protein from non-edible sources <b>Not addressed by initiative</b>	Assumed zero
Percentage of feed protein from edible crop sources <b>Not addressed by initiative</b>	Assumed remainder of non-fishmeal protein = 96.8%, based on 5% global average fishmeal from Tacon et al (2011)

FCR 5.2.1 Maximum weighted average of economic Feed Conversion Ratio (eFCR) for the complete production cycle - <b>1.68</b>	1.5 from Tacon et al (2011) for global average because it is better than requirements of the standards (maximum permitted in standards not used for consistency with other benchmarking assessments).
Protein content of harvested pangasius <b>Not addressed by initiative</b>	14.9% from Boyd et al (2007)
Edible yield of harvested pangasius <b>Not addressed by initiative</b>	34% from FAO (1989)
Percentage of non-edible byproducts from harvested pangasius utilized <b>Not addressed by initiative</b>	Assumed 50% for consistency all benchmarking assessments as not addressed in any standards.

Protein input in feeds is 32.54

Protein output in harvested pangasius is 9.98

Net edible protein loss is 69.3% 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 <b>Not addressed by initiative</b>	5% from Tacon et al (2011)
Inclusion level of crop ingredients <b>Not addressed by initiative</b>	Assumed remainder of non-aquatic ingredients = 95%
Inclusion level of land animal ingredients <b>Not addressed by initiative</b>	Assumed zero.

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

Final feed footprint is 2.49 hectares per ton which equates to a score of 9 out 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 7.27 out 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.*

## ASC Pangasius

- *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 ASC Pangasius**

Escape parameters	Value	Score	
F6.1 Escape Risk		4.00	
F6.1a Recapture and mortality (%)	0		
F6.1b Invasiveness		5.5	
<b>C6 Escape Final Score</b>		<b>4.00</b>	<b>YELLOW</b>
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
4.5.1 Evidence that inlets and outlets to culture systems and all confinements are equipped with net mesh or grills appropriately sized to retain the stocks in culture preventing fish of any size (in the holding unit being assessed) to escape - <b>Yes</b>	The measures in place for the production cycle improve an initial basic escape score (Factor 6.1a) of 2 for exchanging systems to 4 according to the Seafood Watch criteria for “Ponds that drain at harvest”. ASC standards do not clearly address this key escape risk (i.e. escape when draining ponds at harvest).
4.5.2 Evidence of regular, timely inspections (at least once a day); mitigation and repairs are performed on net mesh or grills and recorded in a permanent register (available for inspection) - <b>Yes</b>	
4.5.3 Bund height sufficient to prevent water spillage, along with escapees, in the rainy season when flooding occurs - <b>Yes</b>	
4.5.4 Presence of trapping devices placed in effluent/drainage canals or on water outlets to capture escapees; a record of findings and actions taken (available for inspection) – <b>Yes</b>	
4.6.1 Evidence that the bund has remained intact throughout the culture cycle - <b>Yes</b>	
4.6.2 Evidence assuring there has been no intentional release - <b>Yes</b>	

The initial escape risk score is 4 out of 10

### Recaptures and mortality

Relevant Content of Standards	How we applied it
4.5.4 Presence of trapping devices placed in effluent/drainage canals or on water outlets to capture escapees; a record of findings and actions taken (available for inspection) – <b>Yes</b>	Standards do not demonstrably lead to reduced escapes for which a score can be applied, but this aspect has been taken into consideration in the improved escape score (6.1a) above. Zero percent recapture used for scoring.

The recaptures and mortality score can improve the escape risk score. The final escape risk score is 4 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
4.1.1 Farm is located in a river basin where the farmed species is indigenous or has a self-recruiting stock established before January 2005 - <b>Yes</b>	Considered fully established for a non-native species and score of 2.5 in Part B for non-native species
4.4.1 No use of genetically engineered (transgenic) or hybrid seed - <b>Yes</b>	
4.2.1 Demonstration that the seed has been generated from the pangasius population naturally reproducing in the river basin - <b>Yes</b>	

Part A (or B) score is 2.5 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 5.5 out 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

## Factor 6.2X: 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 6.2X Summary of scores for ASC Pangasius

Escape of unintentionally introduced species parameters	Score	
F6.2Xa International or trans-waterbody live animal shipments (%)	0.00	
F6.2Xb Biosecurity of source/destination	n/a	
<b>C6 Escape of unintentionally introduced species Final Score</b>	<b>0.00</b>	<b>GREEN</b>

### Justification of Ranking

Assumptions

- Assume zero international shipping of livestock for finfish and shrimp

### Factor 6.2Xa 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
4.2.1 Demonstration that the seed has been generated from the pangasius population naturally reproducing in the river basin - <b>Yes</b>	Standard 4.2.1 and the above assumption mean that no international shipping of live animals is considered. Score 10

### Factor 6.2Xb Biosecurity of source/destination

Not relevant with zero shipment assumption

The score for Factor 6.2X is a deduction of 0 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 ASC Pangasius

Pathogen and parasite parameters	Score	
C7 Biosecurity	4.00	
<b>C7 Disease; pathogen and parasite Final Score</b>	<b>4.00</b>	<b>YELLOW</b>
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
6.1.1 Maximum average real percentage mortality, from stocking to harvest, during the grow-out period (See Real Percent Mortality formula in Annex D) - <b>20%</b>	Score as "4" - The production system has biosecurity regulation or protocols in place, yet is still open to introduction 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.
6.4.3 Daily records showing regular monitoring of fish for signs of stress or disease are kept - <b>Yes</b> Health Plan Checklist includes 14) Protocols for preventing disease spread (e.g., through water discharge and fish)	

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 ASC Pangasius**

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

### **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
4.3.1 Allowance for use of wild-caught seed for grow out - <b>None</b>	Potential for wild broodstock is considered minimal, and score is 10.

The final source of stock score (C8) is 10 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  $\geq 6.6$  AND no individual criteria are Red (i.e.  $< 3.3$ )
- **Good Alternative** = Final score  $\geq 3.3$  AND  $< 6.6$ , OR Final score  $\geq 6.6$  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.

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Criterion	Score (0-10)	Rank	Critical?
C1 Data	9.75	GREEN	
C2 Effluent	6.00	YELLOW	NO
C3 Habitat	3.22	RED	NO
C4 Chemicals	4.00	YELLOW	NO
C5 Feed	7.27	GREEN	NO
C6 Escapes	4.00	YELLOW	NO
C7 Disease	4.00	YELLOW	NO
C8 Source	10.00	GREEN	
3.3X Wildlife mortalities	-2.00	GREEN	NO
6.2X Introduced species escape	0.00	GREEN	
<b>Total</b>	<b>45.24</b>		
<b>Final score</b>	<b>5.65</b>		

Final Score	5.65
Initial rank	YELLOW
Red criteria	1
Final rank	YELLOW
Critical Criteria?	NO

FINAL RANK
<b>YELLOW</b>

## 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	10	10
Predators and wildlife	Yes	10	10
Chemical use	Yes	10	10
Feed	Yes	10	10
Escapes, animal movements	Yes	7.5	7.5
Disease	Yes	10	10
Source of stock	Yes	10	10
Other – (e.g. GHG emissions)	Yes	10	10
<b>Total</b>			<b>97.5</b>

<b>C1 Data Final Score</b>	9.75	<b>GREEN</b>
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### Criterion 2: Effluents

#### Factor 2.1a - Biological waste production score

Protein content of feed (%)	Used 27.5kg N from standards
eFCR	Used 27.5kg N from standards
Fertilizer N input (kg N/ton fish)	0
Protein content of harvested fish (%)	Used 27.5kg N from standards
N content factor (fixed)	0.16
N input per ton of fish produced (kg)	Used 27.5kg N from standards
N in each ton of fish harvested (kg)	Used 27.5kg N from standards
<b>Waste N produced per ton of fish (kg)</b>	Used 27.5kg N from standards

#### Factor 2.1b - Production System discharge score

Basic production system score	1
Adjustment 1 (if applicable)	0

Adjustment 2 (if applicable)	0
Adjustment 3 (if applicable)	0
<b>Discharge (Factor 2.1b) score</b>	<b>1</b>

## 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?	No	0
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
5 - Do the control measures cover or prescribe including peak biomass, harvest, sludge disposal, cleaning etc?	Partly	0.25
		<b>1.75</b>

### 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)?	Partly	0.25
4 - Does enforcement demonstrably result in compliance with set limits?	Yes	1
5 - Is there evidence of robust penalties for infringements?	Yes	1
		<b>4.25</b>

<b>F2.2 Score (2.2a*2.2b/2.5)</b>	<b>2.975</b>
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<b>C2 Effluent Final Score</b>	<b>5.00</b>	<b>YELLOW</b>
	Critical?	NO

## Criterion 3: Habitat

### 3.1. Habitat conversion and function

F3.1 Score	4
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### 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
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?	Moderately	0.5
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)	Mostly	0.75
5 - Do control measures include requirements for the restoration of important or critical habitats or ecosystem services?	Partly	0.25
		1.5

#### 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?	Partly	0.25
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?	Moderately	0.5
5 - Is there evidence that the restrictions or limits defined in the control measures are being achieved?	Yes	1
		2.75

F3.2 Score (2.2a*2.2b/2.5)	1.65
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C3 Habitat Final Score	3.22	RED
	Critical?	NO

### Exceptional Factor 3.3X: Wildlife and predator mortalities

Wildlife and predator mortality parameters	Score	
F3.3X Wildlife and Predator Final Score	-2.00	GREEN
Critical?	NO	

## Criterion 4: Evidence or Risk of Chemical Use

Chemical Use parameters	Score	
C4 Chemical Use Score	4.00	
C4 Chemical Use Final Score	4.00	YELLOW
Critical?	NO	

## Criterion 5: Feed

### 5.1. Wild Fish Use

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

Fishmeal inclusion level (%)	6.7
Fishmeal from by-products (%)	0
% FM	6.7
Fish oil inclusion level (%)	1.5
Fish oil from by-products (%)	0
% FO	1.5
Fishmeal yield (%)	22.5
Fish oil yield (%)	5
eFCR	1.68
FIFO fishmeal	0.50
FIFO fish oil	0.50
Greater of the 2 FIFO scores	0.50
<b>FIFO Score</b>	<b>8.74</b>

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

SSWF	-4
SSWF Factor	-0.2016

<b>F5.1 Wild Fish Use Score</b>	<b>8.54</b>
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### 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 (%)	96.75
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	32.55
Protein OUT	9.983
<b>Net protein gain or loss (%)</b>	<b>69.3286</b>
	Critical?
	NO
<b>F5.2 Net protein Score</b>	<b>3.00</b>

### 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 (%)	5
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
<b>Ocean area appropriated (ha/ton fish)</b>	<b>1.95</b>

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

Inclusion level of crop feed ingredients (%)	95
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
<b>Land area appropriated (ha per ton of fish)</b>	<b>0.54</b>

<b>Value (Ocean + Land Area)</b>	<b>2.49</b>
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<b>F5.3 Feed Footprint Score</b>	<b>9.00</b>
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<b>C5 Feed Final Score</b>	<b>7.27</b>	<b>GREEN</b>
	Critical?	<b>NO</b>

## Criterion 6: Escapes

### 6.1a. Escape Risk

<b>Escape Risk</b>	<b>4</b>
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<b>Recapture &amp; Mortality Score (RMS)</b>	
Estimated % recapture rate or direct mortality at the escape site	0
Recapture & Mortality Score	0
<b>Factor 6.1a Escape Risk Score</b>	<b>4</b>

### 6.1b. Invasiveness

#### Part A – Native species

<b>Score</b>	<b>0</b>
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#### Part B – Non-Native species

<b>Score</b>	<b>2.5</b>
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#### Part C – Native and Non-native species

<b>Question</b>	<b>Score</b>
Do escapees compete with wild native populations for food or habitat?	Yes
Do escapees act as additional predation pressure on wild native populations?	No
Do escapees compete with wild native populations for breeding partners or disturb breeding behavior of the same or other species?	Yes
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?	No
	<b>3</b>

<b>F 6.1b Score</b>	<b>5.5</b>
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<b>Final C6 Score</b>	<b>4.00</b>	<b>YELLOW</b>
	Critical?	<b>NO</b>

## Exceptional Factor 6.2X: Escape of unintentionally introduced

**species**

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

**Criterion 7: Diseases**

Pathogen and parasite parameters	Score	
C7 Biosecurity	4.00	
<b>C7 Disease; pathogen and parasite Final Score</b>	<b>4.00</b>	<b>YELLOW</b>
Critical?	NO	

**Criterion 8: Source of Stock**

Source of stock parameters	Score	
C8 % of production from hatchery-raised broodstock or natural (passive) settlement	100	
<b>C8 Source of stock Final Score</b>	<b>10</b>	<b>GREEN</b>