

Monterey Bay Aquarium Seafood Watch®

Global Aquaculture Alliance
Tilapia 2, 3 and 4-star



Benchmarking equivalency results assessed against the Seafood
Watch Aquaculture Criteria

May 2017

Final Seafood Recommendation

BAP Tilapia

Criterion	Score (0-10)	Rank	Critical?
C1 Data	9.09	GREEN	
C2 Effluent	4.00	YELLOW	NO
C3 Habitat	4.80	YELLOW	NO
C4 Chemicals	4.00	YELLOW	NO
C5 Feed	6.32	YELLOW	NO
C6 Escapes	3.00	RED	NO
C7 Disease	4.00	YELLOW	NO
C8X Source of stock	0.00	GREEN	NO
C9X Wildlife mortalities	-2.00	GREEN	NO
C10X Introduced species escape	0.00	GREEN	
Total	33.21		
Final score	4.74		

Final Score	4.74
Initial rank	YELLOW
Red criteria	1
Interim 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 three exceptional “X” criteria for which a score of -10 is very poor and zero is good.

Summary

The numerical final score is yellow, and the final recommendation is 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 equivalence assessment for BAP tilapia is a yellow “Good Alternative” recommendation.

The BAP Finfish and Crustacean standards were assessed against the Seafood Watch criteria using tilapia produced in cages in a country 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 current GAA tilapia standards:

- have lengthy supporting or implementation information which may not be supported by specific or robust standards requirements
- in many cases only defer to (i.e. require compliance with) unknown local regulations without setting robust requirements for the intended outcomes of certification
- cover significantly different production systems, i.e. ponds and cages for which cages were chosen as the worst case scenario
- are complicated by the presence of a limited number of critical (i.e. required) components and a majority of scored components for which not all need be met,

Specifically for each criterion, the GAA tilapia standards:

- like all certification, require considerable data collection and combined with the farm-level certification process result in a good data score,
- have water quality restrictions to limit the effluent concentrations but do not limit effluent volumes and therefore the total nutrient loads discharged. The standards do not address cumulative impacts of effluents from multiple farms,
- 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,
- do not have any restrictions for the location of cage farms in protected freshwater environments. The farm-specific standards do not deal with cumulative habitat impacts of neighboring farms,
- contain no effective measures to control 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. import market),

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- have no robust feed requirements. Sources of fishmeal and fish oil must be known, however the sustainability of these sources can be unknown,
- have moderate escape requirements for a highly invasive, non-native species,
- have no robust requirements relating to disease or pathogen discharges,
- only encourage non-lethal predator control and have no robust restrictions,
- have no robust requirements for international live animal movements, relying on potentially non-existent in-country regulations.

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Introduction

Scope of the analysis and ensuing recommendation

Species

Tilapia – any species produced where it is non-native

Geographic coverage

The BAP Finfish and Crustacean standards have global scope

Production Methods

Tilapia production in cages has been assessed as the realistic worst case scenario due to the potentially higher escape risk from this system

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 (8X, 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 Standard that the following scores relate to is available [here](#)¹.**
- **The full data values and scoring calculations are available in Appendix 1**

¹ 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 BAP Tilapia

Data Category	Relevance (Y/N)	Data Quality	Score (0-10)
Industry or production statistics	Yes	10	10
Management	Yes	10	10
Effluent	Yes	10	10
Habitats	Yes	5	5
Chemical use	Yes	10	10
Feed	Yes	10	10
Escapes	Yes	7.5	7.5
Disease	Yes	10	10
Source of stock	Yes	10	10
Wildlife interactions	Yes	10	10
Animal movements	Yes	10	10
Total			100

C1 Data Final Score	9.1	
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Justification of Ranking

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 in the implied standards.

Data Category	Relevant Content of Standards	Scoring
Industry or production statistics	10.1: The facility shall maintain accurate records of the species farmed and, where relevant, any significant stock characteristics, including but not limited to non-native, specific pathogen-free, specific pathogen-resistant, hybrid,	Score 10 out of 10

	triploid, sex-reversed or genetically modified (GMO) status.	
Management and regulations	The BAP Finfish and Crustacean Standard and the associated audit process are considered in this benchmark to be an effective management system to ensure that only farms meeting the requirements within the Standard are certified.	Score 10 out of 10
Effluent	BAP Standard does not include requirements for effluent record keeping for cages and net pens in lakes and reservoirs; only use of records. It is implied, but there is not a specific record-keeping requirement	Score 7.5 out of 10
Habitat	1.1: Current documents shall be available to prove legal land and water use by the applicant.	Score 5 out of 10
Chemicals	15.3: 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. 18.3: The facility shall keep complete and accurate records concerning any antibiotic or other drug use at both the hatchery and the farm. Guidance (Pg. 29) When hormones are used to produce all-male fry, records of hormone applications shall be maintained.	Score 10 out of 10
Feed	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 factor. 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. 9.3: The facility shall calculate and record a yearly feed-conversion ratio for completed crops. 9.4: The facility shall calculate and record a final yearly fish in: fish out ratio for completed crops.	Score 10 out of 10
Escapes	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. 11.4: All incidents involving escapes of aquaculture animals shall be accurately documented. 11.9: If an escape is suspected or has occurred since the last audit, the applicant shall provide reports and farm records to show that the incident was dealt with in a manner consistent with the Fish Containment Plan.	Score 7.5 out of 10
Disease	Guidance (Pg. 24) Records for disease diagnoses should provide supporting evidence to justify cases where therapeutants are used.	Score 10 out of 10

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.	Score 10 out of 10
Predators and wildlife	12.2: The facility shall record, and report where required, the species and numbers of all avian, mammalian and reptilian mortalities.	Score 10 out of 10
Introduced species	10.2: If government regulations control the use or importation of any of the species or stocks farmed, relevant permits shall be made available for inspection, even if imported fry were purchased from an intermediary.	Score 7.5 out of 10

The final Criterion 1 – Data score is 9.1 out 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 BAP Tilapia

Effluent parameters	Value	Score	
F2.1a Biological waste (nitrogen) production per ton of fish (kg N ton ⁻¹)	69.2		
F2.1b Waste discharged from farm (%)	80		
F2.1 Waste discharge score (0-10)		4	
F2.2a Content of regulations (0-5)	2		
F2.2b Enforcement of regulations (0-5)	4		
F2.2 Regulatory or management effectiveness score (0-10)		3.2	
C2 Effluent Final Score		4	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

The GAA BAP standards express water quality requirements in milligrams per liter (mg/l) for total ammonia nitrogen and soluble phosphorous, but do not have volume limitations. Therefore the total load discharge is not restricted. The “Risk-based assessment” in the Seafood Watch standard 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.

Explanatory tables and scoring calculations can be found on Page 8 of the Seafood Watch Aquaculture Standard.

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

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Relevant Content of Standards	How we applied it
Protein content of feed Not addressed by initiative	32% average value from Honduras, Indonesia, Mexico and Peru SFW assessments
Feed conversion ratio Not addressed by initiative	1.79 average from Honduras, Indonesia, Mexico and Peru SFW assessments
Fertilizer input	Assumed zero for consistency across all benchmarking assessments
Protein content of whole harvested tilapia Not addressed by initiative	14% from Boyd et al (2007)

These values result in a nitrogen waste production of 69.2 kg per ton of tilapia (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
Basic discharge score or percentage of waste discharged Not addressed by standards	Scored 0.8 (i.e. 80%) for open net pens/cages without any modifications for effluent management

Waste discharged per ton of tilapia is 55.4 kg N.

The combination of values from Factor 2.1a and Factor 2.1b result in an over Factor 2.1 score of 4 out of 10.

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 19 of the assessment criteria.

Factor 2.2a assesses the content of the management measures

Relevant Content of Standards	How we applied it
6.1: The water quality of the water body, including its discharge point if applicable, shall meet the BAP effluent water quality criteria, with sampling conducted following the implementation guidelines above.	Effluent limits (in mg/L) are based on a general Hydraulic Retention Time of the waterbody, and are not specific to the farm site.
6.3: Total feed input for all culture operations on the lake or reservoir shall not exceed the BAP maximum allowable daily feed input.	Maximum feed limits are applied at the waterbody level, but are not specific to the waterbody. They are based on the general HRT of the waterbody. Frequency of water quality monitoring is not specified in the BAP standard (may not cover peak events)

The total for Factor 2.2a is 2 out of 5

Factor 2.2b assesses the enforcement of the above measures.

Relevant Content of Standards	How we applied it
The enforcement mechanism is considered to be the Standard holder who will not issue a certification if the requirements are not met.	
The enforcement organization (Standard holder) is considered to be identifiable, contactable and appropriate to the scale of the industry.	
Enforcement is not applicable at the area-based scale, as certification is specific to the farm site.	
Standard does not specify that the entire production cycle must be recorded, therefore this cannot be enforced.	

Factor 2.2b score is 4 out of 5

The Factor 2.2 score for the effectiveness of the management is 3.2 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 19 of the criteria document shows how this score is calculated, producing a final C2 score of 4 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 BAP Tilapia

Habitat parameters	Value	Score	
F3.1 Habitat conversion and function		7	
F3.2a Content of habitat regulations	1		
F3.2b Enforcement of habitat regulations	1		
F3.2 Regulatory or management effectiveness score		0.4	
C3 Habitat Final Score		4.80	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 pages 25-26 of the assessment criteria.

Relevant Content of Standards	How we applied it
<p>1.1: Current documents shall be available to prove legal land and water use by the applicant.</p> <p>Pg. 10 guidance: Natural waterbodies can already be eutrophic when certification is sought. Sites at which water quality in the water body containing cages or net pens does not comply with BAP effluent guidelines shall not be eligible for certification</p>	<p>No illegal siting can occur</p> <p>Standards do not have any measures relating to habitat impacts of cage farms in protected or high value freshwater environments. While floating cages have minimal habitat impacts, benthic impacts may be severe and the standards only require them to be monitored without limiting their impacts, however these benthic impacts are typically rapidly reversible and impact to the environment is considered “moderate.”</p>

The final score for Factor 3.1 is 7 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.

Relevant Content of Standards	How we applied it
Not addressed by initiative	Management system is not considered to be based on ecological principles. The BAP Finfish and Crustacean Standard includes specific standards relating to habitat are applicable to land-based systems and marine net pens, but are not applicable to net pens and cages in freshwater lakes/reservoirs.

The final score for Factor 3.2a is 1 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
Management system does not include requirements for managing habitat impacts from siting of net pens in freshwater lakes or reservoirs. No management measures to enforce.	

The final score for Factor 3.2b is 1 out of 5

The final score for 3.2 combines 3.2a and 3.2b to give a management effectiveness score for cumulative habitat impacts of 0.4 out of 10.

The final score for Criterion 3 combines factors 3.1 and 3.2 (see criteria document for calculation) to give a score of 4.80 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 BAP Tilapia

Chemical Use parameters	Score	
C4 Chemical Use Score	4	
C4 Chemical Use Final Score	4	YELLOW
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 pages 32-33 of the assessment criteria.

Relevant Content of Standards	How we applied it
<p>15.2: If used, drug treatments shall be based on recommendations and authorizations overseen by a fish health specialist only to treat diagnosed diseases in accordance with instructions on product labels and national regulations.</p> <p>15.6: 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>20.2: The facility shall avoid releasing methyl testosterone-treated water directly into the environment, for example by retaining for a minimum of 48 hours.</p> <p>20.3 Any antibiotic usage shall not exceed 3 treatments per on-growing cycle, where a treatment comprises a single course of antibiotics given to address a specific disease issue over one or more days.</p>	<p>Chemicals Critical to Human Health are prohibited.</p> <p>Limit of 3 antibiotic treatments per production cycle.</p>

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20.4: Antimicrobials that are critically important for human medicine* shall not be used.	
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The final score for Criterion 4 is 0 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 BAP Tilapia

Feed parameters	Value	Score	
F5.1a Feed Fish Efficiency Ratio (FFER)	0.7	8.25	
F5.1b Source fishery sustainability score		-8	
F5.1: Wild Fish Use		7.13	
F5.2a Protein IN	54.01		
F5.2b Protein OUT	16.62		
F5.2: Net Protein Gain or Loss (%)	-69.23	3	
F5.3: Feed Footprint (hectares)	3.10	8	
C5 Feed Final Score		6.32	YELLOW
Critical?	NO		

Justification of Ranking

Assumptions

- If un-specified in the standards, assume the average of recent Seafood Watch assessment data for the same species for FCR, fishmeal and oil levels, byproduct use, protein content of feed.
- 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.

- For all species, assume 100% of by-products from harvested fish are utilized unless otherwise specified in the standards.

Explanatory score tables and calculations can be found on pages 36-44 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 Feed Fish Efficiency 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 37 of the assessment criteria.

Factor 5.1a Feed Fish Efficiency Ratio (FFER)

Relevant Content of Standards	How we applied it
Fishmeal inclusion level Not addressed by initiative	Used 4.15% average from Honduras, Indonesia, Mexico and Peru SFW assessments
Fishmeal from by-products Not addressed by initiative	Used 66.25% average from Honduras, Indonesia, Mexico and Peru SFW assessments
Fish oil inclusion level Not addressed by initiative	Used 1.13% average from Honduras, Indonesia, Mexico and Peru SFW assessments
Fish oil from by-products Not addressed by initiative	Used 50% average from Honduras, Indonesia, Mexico and Peru SFW assessments
FCR Not addressed by initiative	Used 1.79 average from Honduras, Indonesia, Mexico and Peru SFW assessments
9.5: The fish in:fish out ratio shall not exceed the following values: <i>Litopenaeus vannamei</i> – 1.2, <i>Penaeus monodon</i> – 1.7, tilapia – 0.7 , <i>Pangasius</i> – 0.5	FFER value of 0.7

SFW F5.1a FFER score is 8.25 out of 10.

The GAA standards dictate a maximum allowable fish in: fish out ratio for tilapia of 0.7. As average country level values are notably lower, the value of 0.7 was used in this assessment to illustrate a realistic worst-case scenario accepted under the GAA standards. This results in a score of 8.25 out of 10 for Factor 5.1a.

Note: GAA BAP uses a different calculation for FIFO than the Seafood Watch Aquaculture Standard. The equation used by GAA BAP produces a lower final FIFO value than the SFW calculation. Therefore, a farm producing tilapia at the GAA BAP FIFO limit of 0.7 would have a higher value using the Seafood Watch FFER calculation. However based on average industry values well below the limit of 0.7, this is not considered to be an issue at this time.

Factor 5.1b Fishery source sustainability

Relevant Content of Standards	How we applied it
<p>9.6: The applicant shall obtain feed from a BAP-certified feed mill or a feed mill that declares and documents compliance with standards 3.1 and 3.3 of the BAP feed mill standards.</p> <p>(Note: the referenced BAP Feed Mill Standards are FM 3.1: The applicant shall obtain declarations from suppliers on the species and fishery origins of each batch of fishmeal and fish oil. FM3.3: The applicant shall develop and implement a clear, written plan of action defining policies for responsibly sourcing fishmeal and fish oil.)</p>	<p>Species and origin of fishmeal and fish oil in feeds known, however there are no requirements for sustainability if feed not sourced from a BAP certified feed mill.</p> <p>There is a requirement that the farm has a plan defining policies for sustainable feed sourcing, but no requirements for the substance of that plan.</p> <p>BAP Feed Mill standard requires MSC, IFFO RS, or FIP compliance, however use of the BAP Feed Mill standard is not required, and there are no sustainability requirements in FM 3.1 or FM 3.3 aside from a policy.</p> <p>Source of wild fish in fishmeal and fish oil known, but sustainability can be unknown.</p>

The source sustainability score (F5.1b) is -8 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 7.13 out of 10 for BAP tilapia.

Factor 5.2. Net Protein Gain or Loss

Explanatory tables and calculations can be found on page 39-43 of the assessment criteria.

Relevant Content of Standards	How we applied it
<p>Protein content of feed Not addressed by initiative</p>	<p>32% average from Honduras, Indonesia, Mexico and Peru SFW assessments</p>
<p>Percentage of feed protein from non-edible sources Not addressed by initiative</p>	<p>5.71% based on average inclusion levels listed above</p>
<p>Percentage of feed protein from edible sources Not addressed by initiative</p>	<p>94.29% based on average inclusion levels listed above</p>
<p>FCR Not addressed by initiative</p>	<p>Used 1.79 average from Honduras, Indonesia, Mexico and Peru SFW assessments</p>

Protein content of harvested tilapia Not addressed by initiative	Used 14% from Boyd et al (2007)
Edible yield of harvested tilapia Not addressed by initiative	Used 37% from FAO ²
Percentage of non-edible byproducts from harvested tilapia utilized Not addressed by initiative	Used 100% across all standards unless otherwise specified in standard

Edible protein input in feeds is 54.01 kg protein/100 kg harvested farmed tilapia
Utilized protein output in harvested tilapia is 24.26 kg protein/100 kg harvested farmed tilapia
Net edible protein loss is 55.08% which equates to a score of 4 out of 10 (for the 50-60% category)

Factor 5.3. Feed Footprint

Relevant Content of Standards	How we applied it
Inclusion of aquatic ingredients Not addressed by initiative	5.28%
Inclusion level of crop ingredients Not addressed by initiative	94.72% (assumed all non-aquatic ingredients are crop)
Inclusion level of land animal ingredients Not addressed by initiative	0%

Inclusion levels are translated to footprint areas using scoring calculations explained on pages 43-44 of the criteria document.

Final feed footprint is 3.10 hectares per ton which equates to a score of 8 out of 10.

The final feed criterion (C5) score is a combination of the three feed factors with a double weighting on FFER. The final score is 6.57 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.*
- *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 BAP Tilapia

² Yield and nutritional value of the commercially more important fish species. Accessed 17 February 2016 from <http://www.fao.org/DOCREP/003/T0219E/T0219E05.htm>

Escape parameters	Value	Score	
F6.1 Escape Risk		2	
F6.1a Recapture	0		
F6.2 Invasiveness		4	
C6 Escape Final Score		3	RED
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

Relevant Content of Standards	How we applied it
<p>11.1: 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>11.3: During harvesting and stock transfer operations, effective secondary containment measures shall be applied to control the escape of animals.</p> <p>11.5: 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. Jump nets that extend above the water line should surround the perimeters of net cages.</p> <p>11.7: The applicant shall demonstrate that the farm meets the BAP procedural, performance, documentation and reporting requirements for fish containment required by the Fish Containment Plan outlined in the implementation requirements.</p> <p>18.7: Complete and accurate records regarding the harvest date, harvest quantity, movement document number (if applicable) and processing plant(s) or purchaser(s) shall be</p>	<p>Net pens/cages in freshwater lakes and reservoirs are considered a Moderate-high risk system. Best Aquaculture Practices for design, construction, and management of escape prevention are required by the BAP Standard, however trickle losses and escape events are still possible.</p> <p>Secondary containment systems are required, but only where tilapia are non-native.</p>

<p>maintained. If product lots are destined to more than one plant or purchaser, each lot shall be separately identified.</p> <p>20.5 In watersheds where Tilapia species are not indigenous and not established**, tilapia farms shall have at least two independent containment systems to prevent escapes. Additionally, they shall only stock monosex juveniles (minimum 99% phenotypically monosex).</p>	
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The initial escape risk score is 2 out of 10

Recaptures

Relevant Content of Standards	How we applied it
Not addressed by initiative	No adjustment for recapture of farmed tilapia

The recapture score can improve the escape risk score. The final escape risk score remains 2 out of 10 for cages.

Factor 6.2 Invasiveness

See criteria document pages 51-53 for explanation of the factors and scoring questions for native and non-native species

Relevant Content of Standards	How we applied it
<p>10.5: Where the species farmed is not native, not feral or not already farmed, further documents shall be provided to demonstrate that regulatory approval for farming is based on the 2005 ICES Code of Practice on Introductions and Transfers of Marine Organisms or, for freshwater species, the Codes of Practice and Manual of Procedures for Consideration of Introduction and Transfers of Marine and Freshwater Organisms, FAO 1988.</p> <p>20.5 In watersheds where Tilapia species are not indigenous and not established**, tilapia farms shall have at least two independent containment systems to prevent escapes. Additionally, they shall only stock monosex juveniles (minimum 99% phenotypically monosex).</p>	<p>Non-native, highly invasive species, assumed not ecologically established in the wild with possibility of establishment (99% monosex unlikely to establish, but still possible).</p> <p>Mozambique tilapia are included on the IUCN list of top 100 most invasive alien species.</p>

Final invasiveness score is 4 out of 10.

The final escapes score combines the escape risk score with the invasiveness score (explanatory score matrix can be found on page 53 of the assessment criteria) and is 3 out of 10 for the ongoing moderate risk of escape and establishment of an invasive species.

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 BAP Tilapia

Risk-based assessment

Pathogen and parasite parameters	Score	
C7 Biosecurity	4	
C7 Disease; pathogen and parasite Final Score	4	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 pages 56-57 of the assessment criteria

Relevant Content of Standards	How we applied it
No relevant standards for pathogen or parasite control	Scored as 4 out of 10 based on the fact that there are some biosecurity measures required by the BAP Standard, but the production system is still open to introduction and discharge of pathogens and parasites.

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

Criterion 8X: 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*

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. A score of zero means there is no impact.

Criterion 8X Summary of scores for BAP Tilapia

Source of stock parameters	Score	
C8X % of production from wild juveniles or wild-caught broodstock	0	
C8 Source of stock Final Score	0	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 59 of the assessment criteria

Relevant Content of Standards	How we applied it
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.	Assumed 0% reliance on wild broodstock or wild juveniles for growout.
10.4: Wild juveniles shall not be stocked, other than as incidental introductions when extensive ponds are first filled.	

The final Source of Stock score is 0 out of -10

Criterion 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” criterion 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.

Criterion 9X summary of scores for BAP Tilapia

Wildlife and predator mortality parameters	Score	
C9X Wildlife and predator mortality Final Score	-2	GREEN
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.

C9X Wildlife and predator score. Explanatory tables can be found on page 61 of the assessment criteria.

Relevant Content of Standards	How we applied it
<p>12.1: The facility shall use humane methods of predator deterrents and actively favor non-lethal methods. Where applicable, government permits for predator control shall be made available for review. 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>12.2: The facility shall record, and report where required, the species and numbers of all avian, mammalian and reptilian mortalities.</p> <p>12.3: Cages: The applicant shall have a written Wildlife Interaction Plan consistent with the implementation requirements listed above and that complies with the procedural, performance and reporting requirements therein.</p>	<p>Score -2 out of -10 for effective management and prevention of wildlife mortalities resulting in only exceptional cases of mortalities.</p> <p>No mortalities of endangered or highly endangered species allowed unless there is a threat to human life.</p>

Final score for 9X is -2 out of -10

Criterion 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.

Criterion 10X Summary of scores for BAP Tilapia

Escape of unintentionally introduced species parameters	Score	
C10Xa International or trans-waterbody live animal shipments (%)	0	
C10Xb Biosecurity of source/destination	n/a	
C6 Escape of unintentionally introduced species Final Score	0	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 63 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>10.5: Where the species farmed is not native, not feral or not already farmed, further documents shall be provided to demonstrate that regulatory approval for farming is based on the 2005 ICES Code of Practice on Introductions and Transfers of Marine Organisms or, for freshwater species, the Codes of Practice and Manual of Procedures for Consideration of Introduction and Transfers of Marine and Freshwater Organisms, FAO 1988.</p>	<p>Assumed zero reliance on shipments as 100% is unrealistic, and it was not possible to set a consistent alternative arbitrary percentage across all standards. Score is 0 out of -10</p>

Factor 10Xb Biosecurity of source/destination

Not relevant with zero shipment assumption

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.

Criterion	Score (0-10)	Rank	Critical?
C1 Data	9.09	GREEN	
C2 Effluent	4.00	YELLOW	NO
C3 Habitat	4.80	YELLOW	NO
C4 Chemicals	4.00	YELLOW	NO
C5 Feed	6.32	YELLOW	NO
C6 Escapes	3.00	RED	NO
C7 Disease	4.00	YELLOW	NO
C8X Source	0.00	GREEN	NO
C9X Wildlife mortalities	-2.00	GREEN	NO

C10X Introduced species escape	0.00	GREEN
Total	33.21	
Final score	4.74	

Final Score	4.74
Initial rank	YELLOW
Red criteria	1
Final rank	YELLOW
Critical Criteria?	NO

FINAL RANK
YELLOW

Guiding Principles

Seafood Watch® defines “sustainable seafood” as seafood from sources, whether fished or farmed, that can maintain or increase production without jeopardizing the structure and function of affected ecosystems.

Sustainable aquaculture farms and collective industries, by design, management and/or regulation, address the impacts of individual farms and the cumulative impacts of multiple farms at the local or regional scale by:

1. Having robust and up-to-date information on production practices and their impacts publicly available;

Poor data quality or availability limits the ability to understand and assess the environmental impacts of aquaculture production and subsequently for seafood purchasers to make informed choices. Robust and up-to-date information on production practices and their impacts should be publically available.

2. Not allowing effluent discharges to exceed, or contribute to exceeding, the carrying capacity of receiving waters at the local or regional level;

Aquaculture farms 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.

3. Being located at sites, scales and intensities that maintain the functionality of ecologically valuable habitats;

The siting of aquaculture farms does not result in the loss of critical ecosystem services at the local, regional, or ecosystem level.

4. Limiting the type, frequency of use, total use, or discharge of chemicals to levels representing a low risk of impact to non-target organisms;

Aquaculture farms avoid the discharge of chemicals toxic to aquatic life or limit the type, frequency or total volume of use to ensure a low risk of impact to non-target organisms.

5. Sourcing sustainable feed ingredients and converting them efficiently with net edible nutrition gains;

Producing feeds and their constituent ingredients has complex global ecological impacts, and the efficiency of conversion can result in net food gains or dramatic net losses of nutrients. Aquaculture operations source only sustainable feed ingredients or those of low value for human consumption (e.g. by-products of other food production), and convert them efficiently and responsibly.

6. Preventing population-level impacts to wild species or other ecosystem-level impacts from farm escapes;

Aquaculture farms, by limiting escapes or the nature of escapees, prevent competition, reductions in genetic fitness, predation, habitat damage, spawning disruption, and other impacts on wild fish and ecosystems that may result from the escape of native, non-native and/or genetically distinct farmed species.

7. Preventing population-level impacts to wild species through the amplification and retransmission, or increased virulence of pathogens or parasites;

Aquaculture farms pose no substantial risk of deleterious effects to wild populations through the amplification and retransmission of pathogens or parasites, or the increased virulence of naturally occurring pathogens.

8. Using eggs, larvae, or juvenile fish produced from farm-raised broodstocks thereby avoiding the need for wild capture;

Aquaculture farms use eggs, larvae, or juvenile fish produced from farm-raised broodstocks thereby avoiding the need for wild capture, or where farm-raised broodstocks are not yet available, ensure that the harvest of wild broodstock does not have population-level impacts on affected species. Wild-caught juveniles may be used from passive inflow, or natural settlement.

9. Preventing population-level impacts to predators or other species of wildlife attracted to farm sites.

Aquaculture operations use non-lethal exclusion devices or deterrents, prevent accidental mortality of wildlife, and use lethal control only as a last resort, thereby ensuring any mortalities do not have population-level impacts on affected species.

10. Avoiding the potential for the accidental introduction of non-native species or pathogens during the shipment of live animals;

Aquaculture farms avoid the international or trans-waterbody movements of live animals, or ensure that either the source or destination of movements is biosecure in order to avoid the introduction of unintended pathogens, parasites and invasive species to the natural environment.

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

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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.

Data Category	Relevance (Y/N)	Data Quality	Score (0-10)
Industry or production statistics	Yes	10	10
Management	Yes	10	10
Effluent	Yes	10	10
Habitats	Yes	5	5
Chemical use	Yes	10	10
Feed	Yes	10	10
Escapes	Yes	7.5	7.5
Disease	Yes	10	10
Source of stock	Yes	10	10
Predators and wildlife	Yes	10	10
Animal movements	Yes	7.5	7.5
Energy use	Not applicable	n/a	n/a

Total		100
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C1 Data Final Score	9.09	GREEN
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Criterion 2: Effluents

Factor 2.1a - Biological waste production score

Protein content of feed (%)	32
eFCR	1.79
Fertilizer N input (kg N/ton fish)	0
Protein content of harvested fish (%)	14
N content factor (fixed)	0.16
N input per ton of fish produced (kg)	91.65
N in each ton of fish harvested (kg)	22.4
Waste N produced per ton of fish (kg)	69.25

Factor 2.1b - Production System discharge score

Basic production system score	0.8
Adjustment 1 (if applicable)	0
Adjustment 2 (if applicable)	0
Adjustment 3 (if applicable)	0
Discharge (Factor 2.1b) score	0.8

Factor 2.1 Score - Waste discharge score

Waste discharged per ton of production (kg N ton-1)	55.40
Waste discharge score (0-10)	4

Factor 2.2 – Management of farm-level and cumulative effluent impacts

2.2a Content of effluent management measure	2
2.2b Enforcement of effluent management measures	4
2.2 Effluent management effectiveness	3.2

C2 Effluent Final Score (0-10)	4.00	YELLOW
Critical?	NO	

Criterion 3: Habitat

Factor 3.1. Habitat conversion and function

F3.1 Score (0-10)	7
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Factor 3.2 – Management of farm-level and cumulative habitat impacts

3.2a Content of habitat management measure	1
3.2b Enforcement of habitat management measures	1
3.2 Habitat management effectiveness	0.4

C3 Habitat Final Score (0-10)	5	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

Feed parameters	Score
5.1a Fish In : Fish Out (FIFO)	
Fishmeal inclusion level (%)	4.15
Fishmeal from by-products (%)	66.25
% FM	1.400625
Fish oil inclusion level (%)	1.13
Fish oil from by-products (%)	50
% FO	0.565
Fishmeal yield (%)	22.5
Fish oil yield (%)	5
eFCR	1.79
FIFO fishmeal	0.11
FIFO fish oil	0.70
FIFO Score (0-10)	8.25
Critical?	NO
5.1b Susutainability of Source fisheries	
Sustainability score	-8
Calculated sustainability adjustment	-1.12

Critical?	NO
F5.1 Wild Fish Use Score (0-10)	7.13
Critical?	NO

5.2 Net protein Gain or Loss

Protein INPUTS	
Protein content of feed (%)	32
eFCR	1.79
Feed protein from fishmeal (%)	8.62
Feed protein from EDIBLE sources (%)	94.29
Feed protein from NON-EDIBLE sources (%)	5.71
Protein OUTPUTS	
Protein content of whole harvested fish (%)	14
Edible yield of harvested fish (%)	37
Use of non-edible by-products from harvested fish (%)	100
Total protein input kg/100kg fish	57.28
Edible protein IN kg/100kg fish	54.01
Utilized protein OUT kg/100kg fish	24.26
Net protein gain or loss (%)	-55.08
Critical?	NO
F5.2 Net protein Score (0-10)	4

5.3. Feed Footprint

5.3a Ocean Area appropriated per ton of seafood	
Inclusion level of aquatic feed ingredients (%)	5.28
eFCR	1.79
Carbon required for aquatic feed ingredients (ton C/ton fish)	69.7
Ocean productivity (C) for continental shelf areas (ton C/ha)	2.68
Ocean area appropriated (ha/ton fish)	2.46
5.3b Land area appropriated per ton of seafood	
Inclusion level of crop feed ingredients (%)	94.72
Inclusion level of land animal products (%)	0
Conversion ratio of crop ingredients to land animal products	2.88
eFCR	1.79
Average yield of major feed ingredient crops (t/ha)	2.64
Land area appropriated (ha per ton of fish)	0.64
Total area (Ocean + Land Area) (ha)	3.10
F5.3 Feed Footprint Score (0-10)	8

Feed Final Score

C5 Feed Final Score (0-10)	6.57	YELLOW
Critical?	NO	

Criterion 6: Escapes

6.1a System escape Risk (0-10)	2	
6.1a Adjustment for recaptures (0-10)	0	
6.1a Escape Risk Score (0-10)	2	
6.2. Invasiveness score (0-10)	0	
C6 Escapes Final Score (0-10)	0	RED
Critical?	YES	

Criterion 7: Diseases

Pathogen and parasite parameters	Score	
Disease Evidence-based assessment (0-10)		
Disease Risk-based assessment (0-10)	4.00	
Disease final score (0-10)	4.00	YELLOW
Critical?	NO	

Criterion 8X: Source of Stock

C8X Source of stock score (0-10)	0	
C8 Source of stock Final Score (0-10)	0	
Critical?	NO	GREEN

Criterion 9X: Wildlife and predator mortalities

C9X Wildlife and Predator Score (0-10)	-2	
C9X Wildlife and Predator Final Score (0-10)	-2	GREEN
Critical?	NO	

Criterion 10X: Escape of unintentionally introduced species

F10Xa live animal shipments score (0-10)	10.00	
F10Xb Biosecurity of source/destination score (0-10)	0.00	
C10X Escape of unintentionally introduced species Final Score (0-10)	0.00	GREEN

BAP Tilapia

Critical?	n/a
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