

# Monterey Bay Aquarium Seafood Watch®

Global Aquaculture Alliance  
Mussel Farms BAP Standards, Guidelines (Rev. 8/13)



Benchmarking equivalency results assessed against the Seafood  
Watch Aquaculture Criteria

15 November 2013

## Final Seafood Recommendation

Criterion	Score (0-10)	Rank	Critical?
C1 Data	8.13	GREEN	
C2 Effluent	10.00	GREEN	NO
C3 Habitat	6.42	YELLOW	NO
C4 Chemicals	8.00	GREEN	NO
C5 Feed	10.00	GREEN	NO
C6 Escapes	2.00	RED	NO
C7 Disease	4.00	YELLOW	NO
C8 Source	10.00	GREEN	
3.3X Wildlife mortalities	-4.00	YELLOW	NO
6.2X Introduced species escape	-4.00	YELLOW	
<b>Total</b>	<b>50.54</b>		
<b>Final score</b>	<b>6.32</b>		

Final Score	6.32
Initial rank	YELLOW
Red criteria	1
Interim 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.*

### Summary

The final numerical score for the Global Aquaculture Alliance Best Aquaculture Practices Mussel Farm standards is 6.32 out of 10, which is in the yellow range, and with only one red criterion the final ranking is yellow overall.

## **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” ranking.

The final result of the Global Aquaculture Alliance (GAA) Best Aquaculture Practices (BAP) for Mussel Farms 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 GAA Mussel certification as an assurance that certified products meet at least a yellow “Good Alternative” recommendation.

In general, the GAA Mussel standards:

- Cover a range of mussel species and production systems (e.g. suspended and on- or off-bottom culture) which have a variety of potential impacts.
- Score moderate to good on all criteria except escapes.
- Like all farm-level standards may not robustly address cumulative impacts of multiple neighboring, local or regional farms.
- Contain a large amount of important information in the explanatory text (i.e. “Reasons for Standard”, “Implementation”, and “Additional Information” sections) that is not included in the “Standards” section; the standards could be strengthened greatly by including the related requirements in the numbered standards themselves.

Specifically, the GAA Mussel standards:

- like all certification, require considerable data collection and combined with the farm-level certification process result in a good data score,
- Have maximum scores for effluent and feed due to the lack of external feed provided for filter-feeding bivalve shellfish aquaculture.
- Have standards to prevent benthic deposition impacts, but not for other (e.g. intertidal) habitat impacts or the cumulative impacts of multiple farms. Habitat impacts are a “moderate” concern.
- Do not mention chemical use, however chemical use in mussel farming is known to be minimal and is a “low” concern.
- Allow the culture of non-native species (or the culture of a species beyond its natural range), and do not robustly prevent ongoing impacts from the “escape” by highly fecund larval dispersal, resulting in a red “high concern” score for the escape criterion.

- Do not robustly prevent the introduction of pathogens or parasites, or prevent the amplification and dispersal of local pathogens and parasites from the farm site. This results in a “moderate” disease score.
- Do not prohibit lethal predator control.
- Require only hatchery or passive collection of seed, and do not allow the active collection and relocation of wild seed.

Overall the numerical score is 6.32 out of 10 and all but one of the criteria are yellow or green. The one red criterion (due to the potential to certify the culture (and associated impacts) of a mussel species beyond its natural range) means that the overall recommendation is a yellow “Good Alternative”.

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## **Introduction**

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

#### **Species**

The Global Aquaculture Alliance (GAA) Best Aquaculture Practices (BAP) Mussel Farms standards cover all commercial species of mussels. This assessment was conducted for the culture of a mussel species such as *Mytilus galloprovincialis* outside its native range as the realistic worst case scenario (see the “Benchmarking Principles” section below).

#### **Geographic coverage**

Global

#### **Production Methods**

Cultivation on the seabed or poles, and suspended cultures such as longlines or rafts.

## **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. Seafood Watch conducts benchmarking assessments on a variety of aquaculture standards and 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 to which the following scores relate 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**

Explanatory tables for C1 can be found on Pages 3-4 of the Seafood Watch Aquaculture assessment criteria.

<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	5	5
Chemical use	Yes	0	0
Feed	No	n/a	n/a
Escapes, animal movements	Yes	10	10
Disease	Yes	10	10
Source of stock	Yes	10	10
Other – (e.g. GHG emissions)	No	n/a	n/a
<b>Total</b>			<b>65</b>

<b>C1 Data Final Score</b>	<b>8.13</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.

Requirements for data collection in the GAA mussel standards are mostly good however there are a few areas where data requirements are lacking. For example, while a written Wildlife Interaction Plan is required, there are no specific requirements for ongoing documentation of wildlife mortalities. Additionally, while it is accepted that general industry practices for mussel

aquaculture do not utilize chemicals, the standards make no mention of chemical use whatsoever and therefore chemicals could potentially be used and undocumented: as such this category scores zero for Criterion 1 - Data.

Overall the farm-level audit and certification process typically requires significant monitoring and recording, and the GAA standards are specific in this regard.

Data Category	Relevant Content of Standards
Industry or production statistics	<p>5.8 The facility shall maintain accurate records of the species farmed and, where relevant, any significant stock characteristics</p> <p>11.1 The facility shall operate an effective record-keeping system that provides timely, organized, accurate entries, performed and overseen by a designated trained person or team responsible for collecting the data, ensuring it is complete and accurate, and that traceability requirements are met</p> <p>11.2 The facility shall keep complete and accurate records for each culture unit and production cycle, including the culture unit identification number, unit area and volume</p> <p>11.3 The facility shall maintain complete and accurate records of the sources of seed stocked, and stocking dates for each culture unit</p>
Effluent	6.2 Monitoring of sediment conditions shall be undertaken according to the requirements of the farm's operating permits
Locations/habitats	6.1 The applicant shall provide independent information (where this information exists and is available to the farm operator) that characterizes the general hydrographic and benthic characteristics of the area and identifies any sensitive or important habitats (specifically those subject to local or national management or legislative protection) that are present locally within the likely impact zone of the mussel farm
Predators and wildlife	7.1 Local rules notwithstanding, the applicant shall have a written Wildlife Interaction Plan consistent with the implementation requirements above and that complies with the procedural, performance, and reporting requirements therein
Chemical use	No standards relating to documentation of chemical use
Feed	Not relevant to mussel production
Escapes, animal movements	5.4 The applicant shall maintain up-to-date and accurate records of all mussel seed movements into and out of the farm
Disease	9.4 Observations by farm staff of abnormal mortality levels and disease indicators, and resulting actions concerning disease diagnosis and treatment shall be reported and recorded



	9.5 The applicant shall record data on disease outbreaks and actions taken so this information can be made available to auditors
Source of stock	11.2 The facility shall keep complete and accurate records for each culture unit and production cycle, including the culture unit identification number, unit area and volume

The overall score for Criterion 1 – Data is an average of the relevant scores; 8.13 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**

Explanatory tables for C2 can be found on Pages 8-12 of the Seafood Watch Aquaculture assessment criteria.

<b>C2 Effluent Final Score</b>	<b>10.00</b>	<b>GREEN</b>
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### **Justification of Ranking**

As mussel aquaculture does not utilize external feed inputs and is extractive, little to no effluent is released from the farm site, but the settlement of particulates bound in pseudofeces must be considered. Standards 6.1 through 6.4 address potential impacts of pseudofeces beyond the farm site or an allowable zone of effect (AZE). Impacts within the immediate area of the farm or AZE are assessed in Criterion 3 – Habitat. The final score of Criterion 2 (effluent) is 10 out of 10.

Relevant Content of Standards
6.1 The applicant shall provide independent information (where this information exists and is available to the farm operator) that characterizes the general hydrographic and benthic characteristics of the area and identifies any sensitive or important habitats (specifically those subject to local or national management or legislative protection) that are present within the likely impact zone of the mussel farm.

6.2 Monitoring of sediment conditions shall be undertaken according to the requirements of the farms operating permits.

6.3 Sediment sampling and analysis performed as part of any monitoring program shall be conducted according to methods generally accepted for such use in the region in which production is occurring.

6.4 In cases where significant adverse impacts are identified by the sediment-monitoring program, the applicant shall adopt corrective actions.

## **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**

Habitat parameters	Value	Score	
F3.1 Habitat conversion and function		7.00	
F3.2a Content of habitat regulations	3.50		
F3.2b Enforcement of habitat regulations	3.75		
F3.2 Regulatory or management effectiveness score		5.25	
<b>C3 Habitat Final Score</b>		<b>6.42</b>	<b>YELLOW</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 can be found on Page 14 of the Seafood Watch Aquaculture assessment Criteria.

Relevant Content of Standards	How we applied it
4.1 For established farms, the applicant shall provide evidence of responsible practices in setting stocking densities appropriate to local conditions for a period of at least three years prior to application or for as long as the cultivation site has been in operation	Interpreted to indicate that ecosystem functionality must be maintained
4.2 The applicant shall produce a management plan that describes the corrective or collaborative actions to be taken when production carrying capacity at the farm or	Interpreted to indicate that ecosystem functionality must be maintained

ecosystem level is exceeded	
6.2 Monitoring of sediment conditions shall be undertaken according to the requirements of the farms operating permits.	Not relevant as the requirements for a farm to obtain permits are not stipulated
6.3 Sediment sampling and analysis performed as part of any monitoring program shall be conducted according to methods generally accepted for such use in the region in which production is occurring.	Monitoring is important however the standards do not set limits on benthic impacts
6.4 In cases where significant adverse impacts are identified by the sediment-monitoring program, the applicant shall adopt corrective actions.	Interpreted to indicate that ecosystem functionality must be maintained

The production methods utilized by the global mussel aquaculture industry and covered in the scope of these standards (i.e. on-bottom culture, poles, and suspended) are recognized to have little direct habitat impact, yet the settlement of pseudofeces and mussel drop offs can have a significant impact on benthic habitats within the farm area. The impacts are considered to be rapidly reversible and are not considered to lead to long-term loss of ecosystem services. While there are some general requirements in the GAA standards to avoid habitat impacts and maintain ecosystem functionality, as shown above these standards do not set specific conditions or limits. As such, the lowest score for maintaining ecosystem functionality is allocated; i.e. 7 out of 10.

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

Factor 3.2a assesses the content of the management measures to manage site-specific and cumulative habitat impacts. Explanatory tables can be found on Page 16 of the Seafood Watch Aquaculture assessment criteria.

Relevant Content of Standards	How we applied it
6.1 The applicant shall provide independent information (where this information exists and is available to the farm operator) that characterizes the general hydrographic and benthic characteristics of the area and identifies any sensitive or important habitats (especially those subject to local or national management or legislative protection) that are present locally within the likely impact zone of the mussel farm	Score of 0.25 in F3.2a Question 1 because if this information doesn't exist, there is no requirement in the standards for an Environmental Impact Assessment.
4.2 The applicant shall produce a management plan that describes the corrective or collaborative actions to be taken when production carrying capacity at the farm or ecosystem level is exceeded.	Score of 1 in F3.2a Question 2 because the standards address cumulative impacts and the maintenance of ecosystem functionality.
4.2 The applicant shall produce a management plan that	Score of 1 in F3.2a Question 3

describes the corrective or collaborative actions to be taken when production carrying capacity at the farm or ecosystem level is exceeded.	because standards prevent further cumulative loss of ecosystem services around certified farms
6.1 The applicant shall provide independent information (where this information exists and is available to the farm operator) that characterizes the general hydrographic and benthic characteristics of the area and identifies any sensitive or important habitats (especially those subject to local or national management or legislative protection) that are present locally within the likely impact zone of the mussel farm	Score of 0.25 for F3.2a Question 4 because high value habitats are only required to be identified if this information exists and are not explicitly required to be avoided
4.2 The applicant shall produce a management plan that describes the corrective or collaborative actions to be taken when production carrying capacity at the farm or ecosystem level is exceeded	Score of 1 for F3.2a Question 5 because habitat restoration is required
6.4 In cases where significant adverse impacts are identified by the sediment-monitoring program, the applicant shall adopt corrective actions	

The total for Factor 3.2a is 3.5 (out of 5).

Factor 3.2b assesses the enforcement of the above measures.

Relevant Content of Standards	How we applied it
Farms shall comply with local and national laws and environmental regulations	Score of 0.5 for F3.2b Question 1 because the standards defer to unknown regional/ national regulations that may or may not be effective and robust
4.2 The applicant shall produce a management plan that describes the corrective or collaborative actions to be taken when production carrying capacity at the farm or ecosystem level is exceeded.  6.4 In cases where significant adverse impacts are identified by the sediment-monitoring program, the applicant shall adopt corrective actions	Score of 1 for F3.2b Question 2 because standards prevent cumulative loss of ecosystem services
4.2 The applicant shall produce a management plan that describes the corrective or collaborative actions to be taken when production carrying capacity at the farm or ecosystem level is exceeded.	Score of 1 in F3.2b Question 3 because standards prevent further cumulative loss of ecosystem services around certified farms
Transparency of the enforcement process	Score of 0.25 for F3.2b Question 4 as the

	transparency of the audit process and farm level information availability from certified farms is low and the standards do not have robust requirements for this transparency
Evidence that restrictions or control measures are being achieved	Score of 1 for F3.2b Question 5 based on audit and certification process

The total for Factor 3.2b is 3.75 (out of 5).

The combined score for Factor 3.2 is 5.25.

The final score for Criterion 3 – Habitat combines Factors F3.1 and F3.2 (see Page 16 of the Seafood Watch Aquaculture assessment document for calculation) to give a score of 6.42 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

Explanatory score tables for F3.3X can be found on Pages 17-18 of the Seafood Watch Aquaculture assessment criteria.

Wildlife and predator mortality parameters	Score	
<b>F3.3X Wildlife and predator mortality Final Score</b>	<b>-4.00</b>	<b>YELLOW</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.

Relevant Content of Standards	How we applied it
7.1 Local rules notwithstanding, the applicant shall have a written Wildlife Interaction Plan consistent with the implementation requirements above and that complies	Standards suggest but do not require non-lethal predator deterrents for all predators except

<p>with the procedural, performance and reporting requirements therein.</p> <p>7.2 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.</p> <p>7.3 No controls, other than non-lethal exclusion, shall be applied to species that are listed as endangered or critically endangered on the IUCN Red List or that are protected by local or national laws.</p>	<p>those listed as “endangered” or “critically endangered” on the IUCN Red List. Scored as -4 on the above assumption.</p>
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Final score for Factor 3.3X is -4 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**

Explanatory tables can be found on Page 20 of the Seafood Watch Aquaculture assessment criteria.

Chemical Use parameters	Score	
C4 Chemical Use Score	<b>8.00</b>	
<b>C4 Chemical Use Final Score</b>	<b>8.00</b>	<b>GREEN</b>
Critical?	NO	

### **Justification of Ranking**

Chemical use in mussel culture is generally considered to be minimal. While some chemical use is permitted in the GAA standards, it is typical industry practice to utilize these anti-fouling chemicals as dips rather than actively adding or discharging them into the water. Additionally, chemical use (e.g. antibiotics and pesticides) in mussel culture is of low concern due to infrequent use in typical industry practice. Score is 8 out of 10.

Relevant Content of Standards	How we applied it
[Page 12] Written procedures for farm staff based on current best practices for the use and disposal of non-medicinal chemicals for treatment of fouling (e.g. brine, lime, acetic acid, formic acid).	These chemicals are permitted according to the standards however it is expected that they would be used as dips rather than actively put into the water.



## **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**

Explanatory score tables and calculations can be found on Pages 21-26 of the Seafood Watch Aquaculture assessment criteria.

Feed parameters	Value	Score	
No supplemental feed added	0.00	10	GREEN

### **Justification of Ranking**

Shellfish aquaculture is extractive with the stock filtering natural plankton populations for nutrition. As external feed is not provided, a score of 10 out of 10 is assigned to this criterion.

## **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**

Explanatory score tables for C6 can be found on Pages 27-30 of the Seafood Watch Aquaculture assessment criteria.

Escape parameters	Value	Score	
F6.1 Escape Risk		0.00	
F6.1a Recapture and mortality (%)	0		
F6.1b Invasiveness		5	
<b>C6 Escape Final Score</b>		<b>2.00</b>	<b>RED</b>
Critical?	NO		

### Justification of Ranking

#### Factor 6.1a. Escape risk

An explanatory score table can be found on Page 28 of the Seafood Watch Aquaculture assessment criteria.

The “escape” risk for shellfish is primarily due to broadcast spawning of the stock for which there are no practical prevention measures. For the purposes of this assessment, the “escape risk” is considered to be high.

Relevant information	How we applied it
The “escape” of bivalve shellfish is different from many other forms of aquaculture due primarily to larval dispersal, but there are no standards relating to preventing or reducing the risk of escape	Scored 0 as an open system with high potential for larval dispersal

The initial escape score is 0 out of 10 for Factor 6.1a due to broadcast spawning.

#### Recaptures and mortality

Relevant Content of Standards	How we applied it
Not addressed by initiative. Likely to be high mortality of larval dispersal, yet very high initial potential “escape” numbers.	No score (zero)

The recaptures and mortality score can improve the escape risk score. The final escape risk score (Factor 6.1a) remains 0 out of 10.

#### Factor 6.1b. Invasiveness

See Page 29 of the Seafood Watch Aquaculture assessment criteria for an 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
5.10 The facility shall comply with all	The standards defer to both local government and

<p>government regulations regarding importation of native and non-native seedstock and/or broodstock (where applicable)</p> <p>5.11 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 the Introductions and Transfers of Marine Organisms.</p>	<p>international regulations but do not specifically prohibit the introduction and culture of non-native mussel species. Factor 6.1a PART B is scored 1 out of 5 for the culture of a non-native species which is partly established, and there is a potential to extend the species range or coverage (for example the culture of <i>M. galloprovincialis</i> beyond its native range)</p>
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Part B score is 1 out of 5.

Part C

Relevant Content of Standards	How we applied it
<p>There are no standards preventing the ecological impacts of “escaping” (i.e. broadcast spawning) of a non-native mussel species.</p>	<p>Scored 4 out of 5 for Factor 6.1b Part C because “escaping” non-native mussels will compete for food and habitat/substrate (see scores in Appendix 1)</p>

Part C score is 4 out of 5.

The invasiveness score (Factor 6.1b) is 5 out of 10.

The final score for Criterion 6 – Escapes combines the escape risk with the invasiveness score and is 2 out of 10 reflecting lack of standards to prevent the potential impact of farming a non-native broadcast spawning species without any robust controls or limitations.

## 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

Escape of unintentionally introduced species parameters	Score	
F6.2Xa International or trans-waterbody live animal shipments (%)	5.00	
F6.2Xb Biosecurity of source/destination	2.00	
<b>C6 Escape of unintentionally introduced species Final Score</b>	<b>-4.00</b>	<b>YELLOW</b>

### Justification of Ranking

#### Assumptions

- Assume 50% shipping of non-secure stock for shellfish or mussel standards (due to common movement of seed in shellfish production).

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

Explanatory score table can be found on Page 31 of the Seafood Watch Aquaculture assessment criteria.

Relevant Content of Standards	How we applied it
<p>5.2 The designated staff member shall ensure compliance with all legal requirements for shellfish movements and reporting of any notifiable alien invasive or pest species</p> <p>5.5 The applicant shall source mussel seed only from areas unlikely (based on available data) to contain alien invasive or other pest species that can infect cultivation areas.</p>	<p>The use of the word “unlikely” in 5.5 is not considered robust for the purposes of this assessment. The movement of spat or seed from a collection area to a culture site is common practice in mussel farming, and is permitted in the GAA standards. For the purposes of the benchmarking study, Seafood Watch assumed 50% movement for all benchmarked shellfish standards.</p>

F6.2Xa is scored as 5.

### Factor 6.2Xb Biosecurity of source/destination

Biosecurity score for the source and destination of any shellfish (seed/spat/juvenile etc) movements is 2 out of 10 for open locations with best management practices to prevent the introduction or loss of unintended transported organisms. Score 2 out of 10.

Relevant Content of Standards	How we applied it
<p>5.2 The designated staff member shall ensure compliance with all legal requirements for shellfish movements and reporting of any notifiable alien invasive or pest species</p> <p>5.5 The applicant shall source mussel seed only from areas unlikely (based on available data) to contain alien invasive or other pest species that can infect cultivation areas.</p>	<p>Neither the source (i.e. collection site) nor the destination (i.e. farming site) are biosecure (although they are considered to have best management practices in terms of minimizing the risk of transfer of non-native species) leading to a score of 2 out of 10 for 6.2Xb.</p>

F6.2Xa is scored as 2.

The final score for Factor 6.2X combines 6.2Xa and 6.2Xb giving a deduction of -4 out of -10 representing a moderate concern for the ongoing potential for the introduction of a non-native species during movements of mussels.

## **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**

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?	<b>NO</b>	

### **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 Seafood Watch Aquaculture assessment criteria.

Relevant Content of Standards	How we applied it
<p>9.1 The applicant shall designate a person or persons with relevant experience in mollusk health and biosecurity to liaise with local and/or national authorities regarding mollusk health management.</p> <p>9.2 The designated person or persons shall ensure that all existing employees are kept updated on any changes in mollusk health management and that new staff members undergo an induction appropriate to their activities and responsibilities within the farm.</p>	<p>Standards do not limit the introduction, transmission, and/or treatment of diseases</p>

<p>9.3 The applicant shall adequately train farm staff in applying these biosecurity, monitoring and health management procedures.</p> <p>9.4 Observations by farm staff of abnormal mortality levels and disease indicators, and resulting actions concerning disease diagnosis and treatment shall be reported and recorded.</p> <p>9.5 The applicant shall record data on disease outbreaks and actions taken so this information can be made available to auditors.</p>	
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While diseases are generally not common among cultured bivalve shellfish, the GAA Mussel Farms standards do not have specific requirements to limit the introduction, transmission, and/or treatment of diseases. As per the above assumption, it is recognized that shellfish production systems are open to the environment and subsequent introductions of local pathogens and parasites, resulting in a score of 4 out of 10 for Criterion 7 – Disease.

## **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, use minimal numbers, or source them from demonstrably sustainable fisheries.*

### **Criterion 8 Summary**

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

### **Justification of Ranking**

An explanatory score table can be found on Page 35 of the Seafood Watch Aquaculture assessment criteria.

Relevant Content of Standards	How we applied it
The collection of wild mussel seed or purchase of seed sources from wild stocks shall be carried out in a sustainable and environmentally-sensitive way. The translocation of seed mussels shall avoid the importation or spread of alien invasive or pest species (Page 6)	Score of 10 because while passive settlement is the most common industry practice, active harvest of wild seed is permitted, however the standards (in the Implementation Guidelines) generally require sustainable sourcing.

While the GAA standards allow active collection of mussel seed, this practice is a minor portion of global production with the majority of global mussel seed production being achieved through passive/ natural settlement. Reflecting this, the final score for Criterion 8 – Source of Stock 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.

Criterion	Score (0-10)	Rank	Critical?
C1 Data	8.13	GREEN	
C2 Effluent	10.00	GREEN	NO
C3 Habitat	6.42	YELLOW	NO
C4 Chemicals	8.00	GREEN	NO
C5 Feed	10.00	GREEN	NO
C6 Escapes	2.00	RED	NO
C7 Disease	4.00	YELLOW	NO
C8 Source	10.00	GREEN	
3.3X Wildlife mortalities	-4.00	YELLOW	NO
6.2X Introduced species escape	-4.00	YELLOW	
<b>Total</b>	<b>50.54</b>		
<b>Final score</b>	<b>6.32</b>		

Final Score	6.32
Initial rank	YELLOW
Red criteria	1
Interim rank	YELLOW
Critical Criteria?	NO

FINAL RANK
<b>YELLOW</b>



## **About Seafood Watch®**

Monterey Bay Aquarium's Seafood Watch® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch® defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch® makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from [www.seafoodwatch.org](http://www.seafoodwatch.org). The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Report. Each report synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices", "Good Alternatives" or "Avoid". The detailed evaluation methodology is available upon request. In producing the Seafood Reports, Seafood Watch® seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch® Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch®'s sustainability recommendations and the underlying Seafood Reports will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch® program at Monterey Bay Aquarium by calling 1-877-229-9990.

### **Disclaimer**

Seafood Watch® strives to have all Seafood Reports reviewed for accuracy and completeness by external scientists with expertise in ecology, fisheries science and aquaculture. Scientific review, however, does not constitute an endorsement of the Seafood Watch® program or its recommendations on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

Seafood Watch® and Seafood Reports are made possible through a grant from the David and Lucile Packard Foundation.

## Guiding Principles

Seafood Watch™ defines sustainable seafood as originating from sources, whether fished<sup>2</sup> 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.

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<sup>2</sup> “Fish” is used throughout this document to refer to finfish, shellfish and other invertebrates.

- 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.

## 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	5	5
Chemical use	Yes	0	0
Feed	No	Not relevant	n/a
Escapes, animal movements	Yes	10	10
Disease	Yes	10	10
Source of stock	Yes	10	10
Other – (e.g. GHG emissions)	No	Not relevant	n/a
<b>Total</b>			<b>65</b>

<b>C1 Data Final Score</b>	8.125	<b>GREEN</b>
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### Criterion 2: Effluents

Effluent Rapid Assessment

<b>C2 Effluent Final Score</b>	10.00	<b>GREEN</b>
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### Criterion 3: Habitat

#### 3.1. Habitat conversion and function

F3.1 Score	7
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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?	Partly	0.25
2 - Is the industry's total size and concentration based on its cumulative impacts and the maintenance of ecosystem function?	Yes	1
3 - Is the industry's ongoing and future expansion appropriate locations, and thereby preventing the future loss of ecosystem services?	Yes	1
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)	Partly	0.25
5 - Do control measures include requirements for the restoration of important or critical habitats or ecosystem services?	Yes	1
		3.5

**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?	Moderately	0.5
2 - Does the farm siting or permitting process function according to the zoning or other ecosystem-based management plans articulated in the control measures?	Yes	1
3 - Does the farm siting or permitting process take account of other farms and their cumulative impacts?	Yes	1
4 - Is the enforcement process transparent - e.g. public availability of farm locations and sizes, EIA reports, zoning plans, etc?	Partly	0.25
5 - Is there evidence that the restrictions or limits defined in the control measures are being achieved?	Yes	1
		3.75

<b>F3.2 Score (2.2a*2.2b/2.5)</b>	<b>5.25</b>
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<b>C3 Habitat Final Score</b>	<b>6.42</b>	<b>YELLOW</b>
	Critical?	NO

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

Wildlife and predator mortality parameters	Score	
<b>F3.3X Wildlife and Predator Final Score</b>	<b>-4.00</b>	<b>YELLOW</b>
Critical?	NO	

**Criterion 4: Evidence or Risk of Chemical Use**

Chemical Use parameters		Score
C4 Chemical Use Score		8.00
<b>C4 Chemical Use Final Score</b>		<b>8.00</b>
Critical?		NO

## Criterion 5: Feed

Feed parameters	Value	Score
No supplemental feed added	0.00	10

## Criterion 6: Escapes

### 6.1a. Escape Risk

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

### 6.1b. Invasiveness

#### Part B – Non-Native species

Score	1
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#### Part C – Native and Non-native species

Question	Score
Do escapees compete with wild native populations for food or habitat?	To some extent
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?	No
Do escapees modify habitats to the detriment of other species (e.g. by feeding, foraging, settlement or other)?	To some extent
Do escapees have some other impact on other native species or habitats?	No
	4

<b>F 6.1b Score</b>	5
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<b>Final C6 Score</b>	2.00	RED
	Critical?	NO

## Exceptional Factor 6.2X: Escape of unintentionally introduced species

<b>Escape of unintentionally introduced species parameters</b>	<b>Score</b>	
F6.2Xa International or trans-waterbody live animal shipments (%)	5.00	
F6.2Xb Biosecurity of source/destination	2.00	
<b>F6.2X Escape of unintentionally introduced species Final Score</b>	<b>-4.00</b>	<b>YELLOW</b>

## Criterion 7: Diseases

<b>Pathogen and parasite parameters</b>	<b>Score</b>	
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

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