



## Aquaculture Evaluation

**Species:** *Insert Species*

**Region:** *Insert Region*

**Analyst:** *Insert Analyst*

**Date:** *Insert Date*

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

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

- uses less wild caught fish (in the form of fish meal and fish oil) than it produces in the form of edible marine fish protein, and thus provides net protein gains for society;
- does not pose a substantial risk of deleterious effects on wild fish stocks through the escape of farmed fish<sup>1</sup>;
- does not pose a substantial risk of deleterious effects on wild fish stocks through the amplification, retransmission or introduction of disease or parasites;
- employs methods to treat and reduce the discharge of organic waste and other potential contaminants so that the resulting discharge does not adversely affect the surrounding ecosystem; and
- implements and enforces all local, national and international laws and customs and utilizes a precautionary approach (which favors conservation of the environment in the face of irreversible environmental risks) for daily operations and industry expansion.

Seafood Watch has developed a set of five sustainability **criteria**, corresponding to these guiding principles, to evaluate aquaculture operations for the purpose of developing a seafood recommendation for consumers and businesses. These criteria are:

1. Use of marine resources
2. Risk of escapes to wild stocks
3. Risk of disease and parasite transfer to wild stocks
4. Risk of pollution and habitat effects
5. Effectiveness of the management regime

Each criterion includes:

- Primary factors to evaluate and rank
- Secondary factors to evaluate and rank
- Evaluation guidelines<sup>2</sup> to synthesize these factors
- A resulting **rank** for that criterion

Once a rank has been assigned to each criterion, an **overall seafood recommendation** for the type of aquaculture in question is developed based on additional evaluation guidelines. The ranks for each criterion, and the resulting overall seafood recommendation, are summarized in a table.

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<sup>1</sup> “Fish” is used throughout this document to refer to finfish, shellfish and other farmed invertebrates.

<sup>2</sup> Evaluation Guidelines throughout this document reflect common combinations of primary and secondary factors that result in a given level of conservation concern. Not all possible combinations are shown – other combinations should be matched as closely as possible to the existing guidelines.

Criteria ranks and the overall recommendation are color-coded to correspond to the categories on the Seafood Watch pocket guide:

**Best Choices/Green:** Consumers are strongly encouraged to purchase seafood in this category. The aquaculture source is sustainable as defined by Seafood Watch.

**Good Alternatives/Yellow:** Consumers are encouraged to purchase seafood in this category, as they are better choices than seafood from the Avoid category. However, there are some concerns with how this species is farmed and thus it does not demonstrate all of the qualities of sustainable aquaculture as defined by Seafood Watch.

**Avoid/Red:** Consumers are encouraged to avoid seafood from this category, at least for now. Species in this category do not demonstrate enough qualities to be defined as sustainable by Seafood Watch.

## CRITERION 1: USE OF MARINE RESOURCES

*Guiding Principle:* To conserve ocean resources and provide net protein gains for society, aquaculture operations should use less wild-caught fish (in the form of fish meal and fish oil) than they produce in the form of edible marine fish protein.

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### *Feed Use Components to Evaluate*

A) Yield Rate: Amount of wild-caught fish (excluding fishery by-products) used to create fish meal and fish oil (ton/ton):

- Wild Fish: Fish Meal; Enter ratio = \_\_\_\_ [i.e. value = 4.5:1 from Tyedmers (2000)<sup>3</sup>]
- Wild Fish: Fish Oil; Enter ratio: \_\_\_\_ [i.e. value = 8.3:1 from Tyedmers (2000)]

B) Inclusion rate of fish meal, fish oil, and other marine resources in feed (%):

- Fish Meal; Enter % = \_\_\_\_
- Fish Oil; Enter % = \_\_\_\_

C) Efficiency of Feed Use: Known or estimated average economic Feed Conversion Ratio (FCR = dry feed:wet fish) in grow-out operations:

- Enter FCR here = \_\_\_\_

### *Wild Input:Farmed Output Ratio (WI:FO)*

Calculate and enter the larger of two resultant values:

- Meal:  $[\text{Yield Rate}]_{\text{meal}} \times [\text{Inclusion rate}]_{\text{meal}} \times [\text{FCR}] = \underline{\hspace{2cm}}$
- Oil:  $[\text{Yield Rate}]_{\text{oil}} \times [\text{Inclusion rate}]_{\text{oil}} \times [\text{FCR}] = \underline{\hspace{2cm}}$
- WI:FO = \_\_\_\_

### *Primary Factor (WI:FO)*

Estimated wild fish used to produce farmed fish (ton/ton, from above):

- Low Use of Marine Resources (WI:FO = 0 - 1.1) OR supplemental feed not used 
- Moderate Use of Marine Resources (WI:FO = 1.1 - 2.0) 
- Extensive Use of Marine Resources (WI:FO > 2.0) 

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<sup>3</sup> Tyedmers (2000): Salmon and sustainability: The biophysical cost of producing salmon through the commercial salmon fishery and the intensive salmon culture industry. PhD Thesis. The University of British Columbia. 272 pages.

**Secondary Factors**

Stock status of the reduction fishery used for feed for the farmed species:

- At or above  $B_{MSY}$  (> 100%) 
- Moderately below  $B_{MSY}$  (50 - 100%) OR Unknown 
- Substantially below  $B_{MSY}$  (e.g. < 50%) OR Overfished OR  
Overfishing is occurring OR fishery is unregulated 
- Not applicable because supplemental feed not used 

Source of stock for the farmed species:

- Stock from closed life cycle hatchery OR wild caught and intensity of  
collection clearly does not result in depletion of brood stock, wild  
juveniles or associated non-target organisms 
- Wild caught and collection has the potential to impact brood stock, wild  
juveniles or associated non-target organisms 
- Wild caught and intensity of collection clearly results in depletion of  
brood stock, wild juveniles, or associated non-target organisms 

***Evaluation Guidelines***

Use of marine resources is “**Low**” when WI:FO is between 0.0 and 1.1.

Use of marine resources is “**Moderate**” when WI:FO is between 1.1 and 2.0.

Use of marine resources is “**Extensive**” when:

1. WI:FO is greater than 2.0
2. Source of stock for the farmed species is ranked red
3. Stock status of the reduction fishery is ranked red

Use of marine resources is deemed to be a **Critical Conservation Concern** and a species is ranked **Avoid**, regardless of other criteria, if:

1. WI:FO is greater than 2.0 AND the source of seed stock is ranked red.
2. WI:FO is greater than 2.0 AND the stock status of the reduction fishery is ranked red

**Conservation Concern: Use of Marine Resources**

Low (Low Use of Marine Resources)



Moderate (Moderate Use of Marine Resources)



High (Extensive Use of Marine Resources)



Critical Use of Marine Resources



**CRITERION 2: RISK OF ESCAPED FISH TO WILD STOCKS**

*Guiding Principle:* Sustainable aquaculture operations pose no substantial risk of deleterious effects to wild fish stocks through the escape of farmed fish.

***Primary Factors to evaluate***

- Evidence that farmed fish regularly escape to the surrounding environment
- Rarely if system is open OR never because system is closed 
  - Infrequently if system is open OR Unknown 
  - Regularly and often in open systems 
- Status of escaping farmed fish to the surrounding environment
- Native and genetically and ecologically similar to wild stocks OR survival and/or reproductive capability of escaping farmed species is known to be naturally zero or is zero because of sterility, polyploidy or similar technologies 
  - Non-native but historically widely established OR Unknown 
  - Non-native (including genetically modified organisms) and not yet fully established OR native and genetically or ecologically distinct from wild stocks 

***Secondary Factors to evaluate***

- Where escaping fish is non-native – Evidence of the establishment of self-sustaining feral stocks
- Studies show no evidence of establishment to date 
  - Establishment is probable on theoretical grounds OR Unknown 
  - Empirical evidence of establishment 
- Where escaping fish is native – Evidence of genetic introgression through successful crossbreeding
- Studies show no evidence of introgression to date 
  - Introgression is likely on theoretical grounds OR Unknown 
  - Empirical evidence of introgression 
- Evidence of spawning disruption of wild fish
- Studies show no evidence of spawning disruption to date 
  - Spawning disruption is likely on theoretical grounds OR Unknown 
  - Empirical evidence of spawning disruption 

Evidence of competition with wild fish for limiting resources or habitats

- Studies show no evidence of competition to date
- Competition is likely on theoretical grounds OR Unknown
- Empirical evidence of competition



Stock status of affected wild fish

- At or above ( $> 100\%$ )  $B_{MSY}$  OR no affected wild fish
- Moderately below ( $50 - 100\%$ )  $B_{MSY}$  OR Unknown
- Substantially below  $B_{MSY}$  ( $< 50\%$ ) OR Overfished OR “endangered”, “threatened” or “protected” under state, federal or international law



**Evaluation Guidelines**

A “**Minor Risk**” occurs when a species:

- 1) Never escapes because system is closed
- 2) Rarely escapes AND is native and genetically/ecologically similar.
- 3) Infrequently escapes AND survival is known to be nil.

A “**Moderate Risk**” occurs when the species:

- 1) Infrequently escapes AND is non-native and not yet fully established AND there is no evidence to date of negative interactions.
- 2) Regularly escapes AND native and genetically and ecologically similar to wild stocks or survival is known to be nil.
- 3) Is non-native but historically widely established.

A “**Severe Risk**” occurs when:

- 1) The two primary factors rank red AND one or more additional factor ranks red.

Risk of escapes is deemed to be a **Critical Conservation Concern** and a species is ranked **Avoid**, regardless of other criteria, when:

- 1) Escapes rank a “severe risk” AND the status of the affected wild fish also ranks red.

<b>Conservation Concern: Risk of Escaped Fish to Wild Stocks</b>	
Low (Minor Risk)	
Moderate (Moderate Risk)	
High (Severe Risk)	
Critical Risk	

**CRITERION 3: RISK OF DISEASE AND PARASITE TRANSFER TO WILD STOCKS**

*Guiding Principle:* Sustainable aquaculture operations pose little risk of deleterious effects to wild fish stocks through the amplification, retransmission or introduction of disease or parasites.

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***Primary Factors to evaluate***

Risk of amplification and retransmission of disease or parasites to wild stocks

- Studies show no evidence of amplification or retransmission to date 
- Likely risk of amplification or transmission on theoretical grounds OR Unknown 
- Empirical evidence of amplification or retransmission 

Risk of species introductions or translocations of novel disease/parasites to wild stocks

- Studies show no evidence of introductions or translocations to date 
- Likely risk of introductions or translocations on theoretical grounds OR Unknown 
- Empirical evidence of introductions or translocations 

***Secondary Factors to evaluate***

Bio-safety risks inherent in operations

- Low risk: Closed systems with controls on effluent release 
- Moderate risk: Infrequently discharged ponds or raceways OR Unknown 
- High risk: Frequent water exchange OR open systems with water exchange to outside environment (e.g. nets, pens or cages) 

Stock status of potentially affected wild fish

- At or above (> 100%) B<sub>MSY</sub> OR no affected wild fish 
- Moderately below (50 – 100%) B<sub>MSY</sub> OR Unknown 
- Substantially below B<sub>MSY</sub> (< 50%) OR Overfished OR “endangered”, “threatened” or “protected” under state, federal or international law 

**Evaluation Guidelines**

Risk of disease transfer is deemed “**Minor**” if:

- 1) Neither primary factor ranks red AND both secondary factors rank green.
- 2) Both primary factors rank green AND neither secondary factor ranks red

Risk of disease transfer is deemed to be “**Moderate**” if the ranks of the primary and secondary factors “average” to yellow.

Risk of disease transfer is deemed to be “**Severe**” if:

- 1) Either primary factor ranks red AND bio-safety risks are low or moderate.
- 2) Both primary factors rank yellow AND bio-safety risks are high AND stock status of the wild fish does not rank green.

Risk of disease transfer is deemed to be a **Critical Conservation Concern** and a species is ranked **Avoid** regardless of other criteria, if either primary factor ranks red AND stock status of the wild fish also ranks red.

<b>Conservation Concern: Risk of Disease Transfer to Wild Stocks</b>	
Low (Minor Risk)	
Moderate (Moderate Risk)	
High (Severe Risk)	
Critical Risk	

**CRITERION 4: RISK OF POLLUTION AND HABITAT EFFECTS**

*Guiding Principle:* Sustainable aquaculture operations employ methods to treat and reduce the discharge of organic effluent and other potential contaminants so that the resulting discharge and other habitat impacts do not adversely affect the integrity and function of the surrounding ecosystem.

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**Primary Factors to evaluate**

**PART A: Effluent Effects**

Effluent water treatment

- Effluent water substantially treated before discharge (e.g. recirculating system, settling ponds, or reconstructed wetlands) OR polyculture and integrated aquaculture used to recycle nutrients in open systems OR treatment not necessary because supplemental feed is not used 
- Effluent water partially treated before discharge (e.g. infrequently flushed ponds) 
- Effluent water not treated before discharge (e.g. open nets, pens or cages) 

Evidence of substantial local (within 2 x the diameter of the site) effluent effects (including altered benthic communities, presence of signature species, modified redox potential, etc)

- Studies show no evidence of negative effects to date 
- Likely risk of negative effects on theoretical grounds OR Unknown 
- Empirical evidence of local effluent effects 

Evidence of regional effluent effects (including harmful algal blooms, altered nutrient budgets, etc)

- Studies show no evidence of negative effects to date 
- Likely risk of negative effects on theoretical grounds OR Unknown 
- Empirical evidence of regional effluent effects 

Extent of local or regional effluent effects

- Effects are in compliance with set standards 
- Effects infrequently exceed set standards 
- Effects regularly exceed set standards 

**Part B: Habitat Effects**

Potential to impact habitats: Location

- Operations in areas of low ecological sensitivity (e.g. land that is less susceptible to degradation, such as formerly used agriculture land or land previously developed) 
- Operations in areas of moderate sensitivity (e.g. coastal and near-shore waters, rocky intertidal or subtidal zones, river or stream shorelines, offshore waters) 
- Operations in areas of high ecological sensitivity (e.g. coastal wetlands, mangroves) 

Potential to impact habitats: Extent of Operations

- Low density of fish/site or sites/area relative to flushing rate and carrying capacity in open systems OR closed systems 
- Moderate densities of fish/site or sites/area relative to flushing rate and carrying capacity for open systems 
- High density of fish/site or sites/area relative to flushing rate and carrying capacity for open systems 

***Evaluation Guidelines***

Risk of pollution/habitat effects is “**Low**” if three or more factors rank green and none of the other factors are red.

Risk of pollution/habitat effects is “**Moderate**” if factors “average” to yellow.

Risk of pollution/habitat effects is “**High**” if three or more factors rank red.

No combination of ranks can result in a **Critical Conservation Concern** for Pollution and Habitat Effects.

<b>Conservation Concern: Risk of Pollution and Habitat Effects</b>	
Low (Low Risk)	
Moderate (Moderate Risk)	
High (High Risk)	

**CRITERION 5: EFFECTIVENESS OF THE MANAGEMENT REGIME**

*Guiding Principle:* The management regime of sustainable aquaculture operations respects all local, national and international laws and utilizes a precautionary approach, which favors the conservation of the environment, for daily operations and industry expansion.

**Primary Factors to evaluate**

Demonstrated application of existing federal, state and local laws to current aquaculture operations

- Yes, federal, state and local laws are applied 
- Yes but concerns exist about effectiveness of laws or their application 
- Laws not applied OR laws applied but clearly not effective 

Use of licensing to control the location (siting), number, size and stocking density of farms

- Yes and deemed effective 
- Yes but concerns exist about effectiveness 
- No licensing OR licensing used but clearly not effective 

Existence and effectiveness of “better management practices” for aquaculture operations, especially to reduce escaped fish

- Exist and deemed effective 
- Exist but effectiveness is under debate OR Unknown 
- Do not exist OR exist but clearly not effective 

Existence and effectiveness of measures to prevent disease and to treat those outbreaks that do occur (e.g. vaccine program, pest management practices, fallowing of pens, retaining diseased water, etc.)

- Exist and deemed effective 
- Exist but effectiveness is under debate OR Unknown 
- Do not exist OR exist but clearly not effective 

Existence of regulations for therapeutants, including their release into the environment, such as antibiotics, biocides, and herbicides

- Exist and deemed effective OR no therapeutants used 
- Exist but effectiveness is under debate, or Unknown 
- Not regulated OR poorly regulated and/or enforced 

Use and effect of predator controls (e.g. for birds and marine mammals) in farming operations

- Predator controls are not used OR predator deterrents are used but are benign 
- Predator controls used with limited mortality or displacement effects 
- Predator controls used with high mortality or displacement effects 

Existence and effectiveness of policies and incentives, utilizing a precautionary approach (including ecosystem studies of potential cumulative impacts) against irreversible risks, to guide expansion of the aquaculture industry

- Exist and are deemed effective 
- Exist but effectiveness is under debate 
- Do not exist OR exist but are clearly ineffective 

***Evaluation Guidelines***

Management is “**Highly Effective**” if four or more factors rank green and none of the other factors rank red.

Management is “**Moderately Effective**” if the factors “average” to yellow.

Management is deemed to be “**Ineffective**” if three or more factors rank red.

No combination of factors can result in a **Critical Conservation Concern** for Effectiveness of Management.

<b>Conservation Concern: Effectiveness of the Management Regime</b>	
Low (Highly Effective)	
Moderate (Moderately Effective)	
High (Ineffective)	

**Overall Seafood Recommendation**

*Overall Guiding Principle:* Sustainable farm-raised seafood is grown and harvested in ways can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

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**Evaluation Guidelines**

A species receives a recommendation of “**Best Choice**” if:

- 1) It has three or more green criteria and the remaining criteria are not red.

A species receives a recommendation of “**Good Alternative**” if:

- 1) Criteria “average” to yellow
- 2) There are four green criteria and one red criteria

A species receives a recommendation of “**Avoid**” if:

- 1) It has a total of two or more red criteria
- 2) It has one or more Critical Conservation Concerns.

**Summary of Criteria Ranks**

Sustainability Criteria	Conservation Concern			
	Low	Moderate	High	Critical
Use of Marine Resources				
Risk of Escapes to Wild Stocks				
Risk of Disease/Parasite Transfer to Wild Stocks				
Risk of Pollution and Habitat Effects				
Effectiveness of Management				

**Overall Seafood Recommendation**

**Best Choice** 

**Good Alternative** 

**Avoid** 