GLOBAL AQUACULTURE PERFORMANCE INDEX

HOW GREEN IS YOUR ECO-LABEL?

Comparing the Environmental Benefits of Marine Aquaculture Standards

University of Victoria, Seafood Ecology Research Group

December 2011

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We thank the Pew Environment Group for supporting the research and writing of this report.

FOREWORD

Close to half of the world's seafood is now grown on fish farms. The recent and rapid expansion of fish farms to meet the growing demand for seafood has posed serious threats to the environment. New industry projections suggest that aquaculture production will need to double by 2021 in order to meet global demand. The challenge for policy makers and other stakeholders is how to balance further growth in this industry with strong environmental protection.

Consumers concerned about the environmental, social, and health implications of farmed seafood have begun to demand more and better information about these products. Eco-labels have emerged as an efficient way to assure consumers of the sustainability of farmed seafood, while recognizing their demand to steer the aquaculture industry in a more sustainable direction. But are consumers really getting what they pay for? Are eco-labeled fish actually greener than conventionally produced farmed fish? And are the myriad standards and eco-labels for farmed fish really driving change in the aquaculture industry?

Over the past two years, a team of researchers at the University of Victoria and I have developed a methodology to help answer these questions. In 2010, we released the Global Aquaculture Performance Index (GAPI), a tool that distills the best available data on the impacts of fish farming into a sound yet simple score of environmental performance. Although this is an admittedly coarse look at the marine aquaculture industry, the 2010 GAPI methodology was the first quantitative tool to measure and compare the impacts of marine aquaculture across different species and countries. Based on the Environmental Performance Index (EPI), a joint effort created by Yale and Columbia universities, the 2010 GAPI does not tell us whether farmed fish production is "sustainable," but it does provide a clear measure of where conventional industry performance lies on the continuum between the worst performance and perfect, zero-impact performance.

Over the last year, we have used the 2010 GAPI methodology to measure the environmental performance of 20 major marine aquaculture standards. This report highlights the results of that analysis. This new assessment identifies leaders and laggards in the standard-setting arena by measuring which

standards achieve the strongest environmental performance and which add the most value in terms of requiring substantially better performance than conventional practice. It also takes one step further to assess whether the performance of leading aquaculture standards is good enough to warrant a "green" label.

This report is a first and important step in uncovering the true value of aquaculture eco-labels. It is a tool for all stakeholders — seafood buyers, fish farmers, standard setters, and policy makers — to better assess the environmental performance of individual standards and standard-setting initiatives. It is our hope that this report is a catalyst for more rigorous evaluation of aquaculture standards and prompts greater monitoring and data transparency by certification initiatives.

Dr. John Volpe

University of Victoria, British Columbia
Seafood Ecology Research Group

EXECUTIVE SUMMARY

Product standards and eco-labels have proliferated in the seafood market as a kind of shorthand — a seal of approval — buyers can rely on to make environmentally sustainable decisions. But what do these standards and eco-labels actually mean? Is fish produced according to a particular standard better than conventionally produced fish? And how do these different standards stack up?

This study — *How Green is Your Eco-label? A Comparison of the Environmental Benefits of Marine Aquaculture Standards* — uses a well-established methodology, refined by the 2010 Global Aquaculture Performance Index (GAPI), to determine numerical scores of environmental performance for 20 marine finfish aquaculture standards. While a number of previous assessments have offered important insight on the sustainability of standards, this is the first to quantitatively assess their ecological impact. GAPI does not delineate "good" versus "bad" performance. Instead, it is meant to be a tool to compare eco-labels and evaluate where they lie on the continuum of environmental performance. This study acts as a kind of *Michelin* guide for standards: distilling a large amount of disparate information into simple scores that highlight the strengths and weaknesses of different standards. The long-term objective is to help stakeholders — seafood buyers, fish farmers, standard setters, and policy makers — understand how standards as a whole are contributing to the ultimate goal of a more sustainable marine aquaculture industry.

20 Standards

Third party/Industry:
- AquaGAP
- A Code of Good Practice for Scottish Finfish Aquaculture (CoGP)
- Debio
- Federation of European Aquaculture Producers (FEAP)
- Friend of the Sea
- Global Aquaculture Alliance
- GLOBALG.A.P.
- Label Rouge
- Salmon Aquaculture Dialogue (Draft)
- SIGES (SalmonChile)

Organic:
- Australia Certified Organic
- BioGro
- BioSuisse
- Canadian Organic Standard (Draft)
- Naturland
- Organic Food Federation
- Soil Association
- U.S. National Organic Standard (Proposed)

Retailer:
- Marks & Spencer
- Whole Foods Market

Focus on Marine Finfish

Although marine finfish farming accounts for just 7 percent of global aquaculture production, its commercial value coupled with disproportionate environmental impacts and the controversy surrounding these impacts make it a focal point for standard-setting and certification. This study focuses on 11 marine finfish species, selected either because of commercial importance or because they are the focus of an assessed standard.

Evaluated Standards

The study evaluates voluntary standards that aim to reduce or eliminate the environmental impacts of marine finfish farming. It is limited to those standards for which there are publicly available criteria (including draft standards) and assesses performance as it relates to environmental impacts only. The standards fall into three basic categories: organic standards, retailer standards, and industry and other third-party standards.

The report is based on standards as they existed in August 2011 and does not incorporate changes after that date. Three of the standards assessed—the Salmon Aquaculture Dialogue, Canadian Organic Standard, and U.S. National Organic Standard—were in draft form at the time of this assessment. Final changes to these standards could affect their GAPI performance scores.

Impacts Considered

Each standard is evaluated according to its performance in 10 environmental impact categories. These categories have been selected based on a survey of the environmental impacts addressed in current aquaculture assessment initiatives. While there are no universal criteria for measuring performance in these areas, the formulas are designed to be scientifically sound and populated with publicly available data. For more information on how performance in each impact category is measured, see the 2010 GAPI report at www.gapi.ca.

11 Marine Finfish Species

Atlantic cod
Atlantic salmon
Barramundi
Chinook salmon
Cobia
Coho salmon
European seabass
Gilthead seabream
Grouper
Milkfish
Turbot

10 Impact Categories

ANTI: Antibiotics
BOD: Biochemical Oxygen Demand
CAP: Capture-Based Aquaculture
COP: Copper-Based Antifoulants
ECOE: Ecological Energy
ESC: Escapes
FEED: Sustainability of Feed
INDE: Industrial Energy
PARA: Parasiticides
PATH: Pathogens

For the formulas used in scoring impact categories, see www.gapi.ca.

Scoring Environmental Performance

The study yields two critical pieces of information:

Absolute Performance Score

How each standard scores on an overall zero to 100 scale, where zero is the worst performance of all standards assessed and 100 is perfect performance or zero-impact. The higher the score, the better the performance.

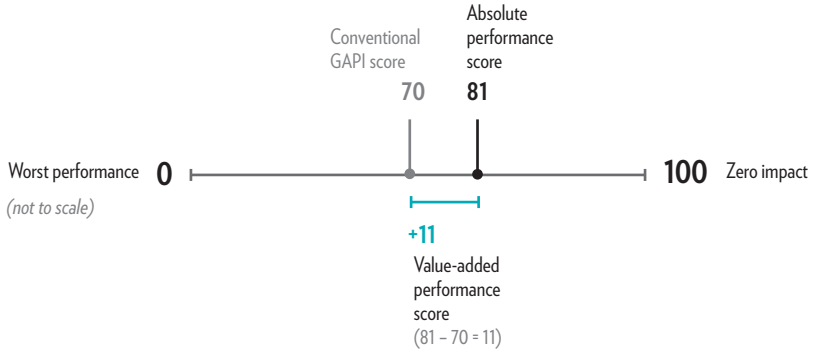
Value-Added Performance Score

How much better or worse a standard scores compared to average industry practice (as defined in the 2010 GAPI). The absolute performance score ranks standards based on which is "greener," but the value-added score determines which standards are driving the most change in their industry or region.

Within the report, absolute and value-added scores for each standard are also broken down by impact category and species to provide a more nuanced view of performance.

This study assesses the performance of each standard as written, translating each standard into the GAPI scoring system. It does not assess the performance of a specific certified farm, but simply asks how poorly a farm could perform and still meet the written standards relevant to each impact category.

Figure I: Environmental Performance Scores
A detailed explanation is online at www.gapi.ca.



RESULTS

Absolute Performance: Who Is the Greenest of Them All?

Figure II lists the absolute performance scores for all assessed standards.

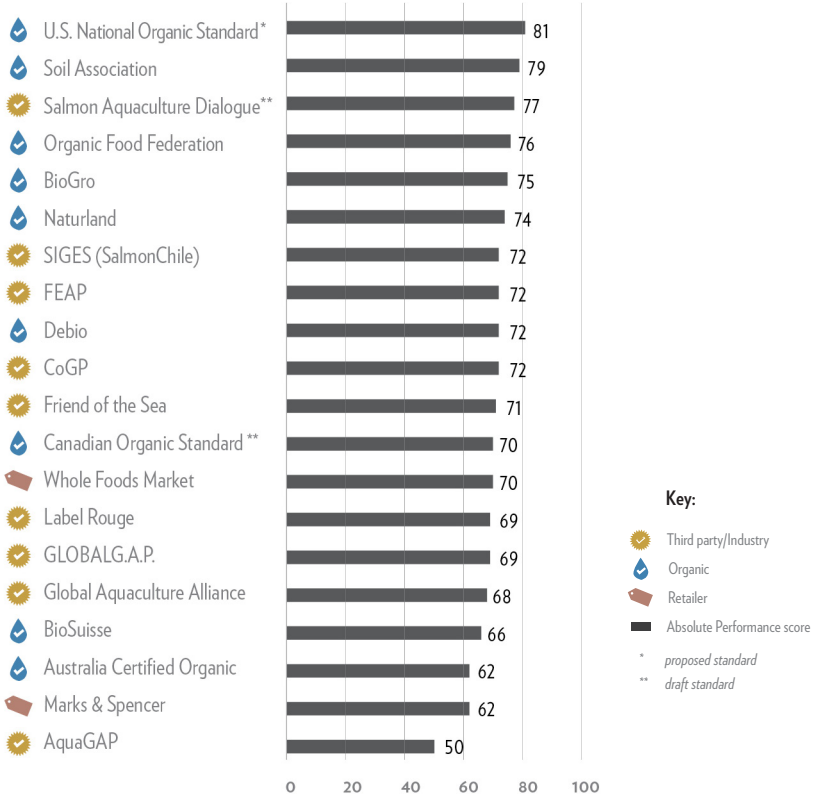
Organics Lead the Pack

In terms of absolute performance, four of the five top-performing standards are organic standards. Organic standards for marine aquaculture are generally meant to align with broader organic food production standards that place strong restrictions on waste management and the use and discharge of chemicals. The organic standards that score well receive relatively high scores in these categories.

Salmon-Specific Standards Have an Advantage

While Atlantic salmon continues to receive much of the attention regarding the negative environmental impacts of aquaculture, the 2010 GAPI demonstrated that the per-unit environmental impact of conventional salmon farming is lower than most marine finfish species in production. Those standards that focus solely on Atlantic salmon — such as Soil Association and Salmon Aquaculture Dialogue — have the advantage of a stronger starting position than those focused on less-developed industries, such as barramundi or gilthead seabream.

Figure II: Absolute Performance Scores *(for all species evaluated)*



Value-Added Performance: Who Is Driving the Most Change?

Figure III lists the value-added performance scores for all assessed standards.

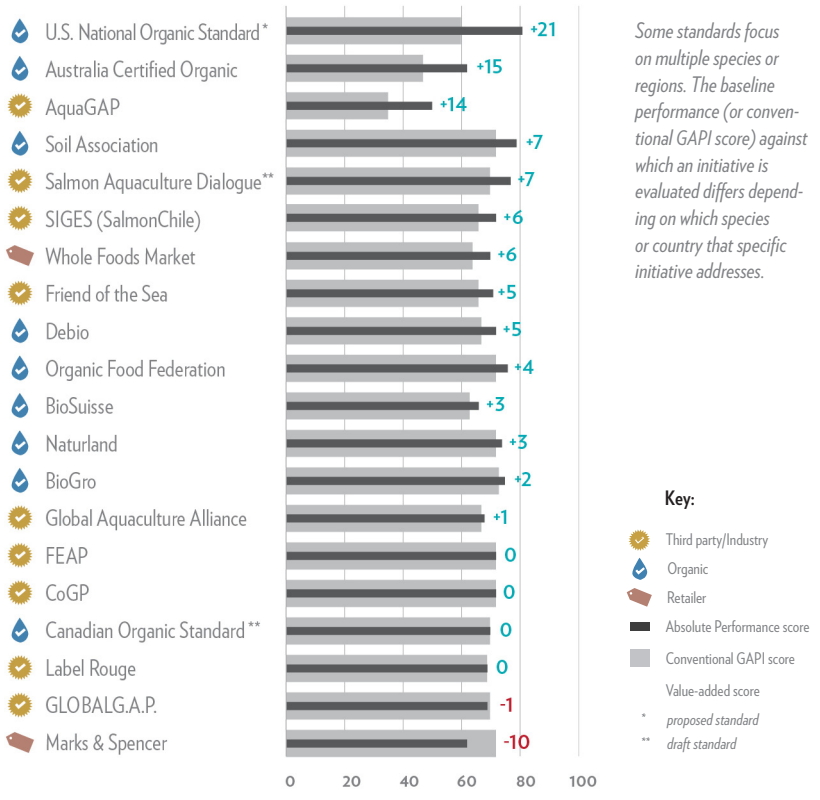
Some Flip-Flopping in Performance

Value-added performance and absolute performance provide two different pictures. A standard may score poorly on the absolute performance scale while being one of the highest-ranking standards for value-added performance, and vice versa. For example, the two barramundi-specific standards — AquaGAP and Australia Certified Organic — are at the bottom of the barrel for absolute performance. However, both have high value-added scores since their performance is substantially better than average barramundi production, demonstrating a potential to drive improvement within that sector.

Organics Lead the Pack Again

Three of the five top value-added performance scores are for organic standards. Since organic principles have been shaped and applied across many different types of food systems, these standards seem to be less influenced by concerns regarding feasibility and industry adoption than multi-stakeholder aquaculture standards are. Thus, organic standards have the potential to be set well above average industry practice, even if those standards can only be achieved by a small (or perhaps zero) percent of the industry at the time of adoption.

Figure III: Value-Added Scores *(for all species evaluated)*



Some standards focus on multiple species or regions. The baseline performance (or conventional GAPI score) against which an initiative is evaluated differs depending on which species or country that specific initiative addresses.

Distance to Green

The absolute and value-added performance scores are useful for comparing the environmental performance of existing standards. But are these scores good enough?

Instead of establishing yet another benchmark for what "green" is, this study relies on two well-established seafood guides—the Monterey Bay Aquarium's Seafood Watch guide (MBA) and the Blue Ocean Institute's seafood guide (BOI). To the extent seafood buyers feel comfortable with the seafood guides, this section provides a look at how well standards perform relative to these rankings.

These leading buyers' guides are translated into the GAPI scoring system in the same way the 20 standards are translated. This allows the standards to be expressed in the red-yellow-green language of buyers' guides, showing where each standard ranks along the color spectrum and the magnitude of improvement needed to move to the next color.

This red-yellow-green grouping is not meant to reflect the internal categorization regime by the MBA or BOI. It only reflects the interpretation of their criteria within our framework.

Accurate translation from the red-yellow-green scoring system to GAPI requires an abundance of high-quality data to ensure accuracy. Since Atlantic salmon is the only species assessed by nearly all initiatives, it provides a level playing field to directly compare relative performance by each initiative in the red-yellow-green context. The scores and rankings in this part of the analysis have changed to reflect performance as it relates to Atlantic salmon standards only.

Figure IV: Distance to Green: MBA rating results *(Absolute Performance Scores for Atlantic salmon)*

No standard achieves a green rating. Only one standard – the proposed U.S. National Organic Standard – comes close to a green ranking. Most standards fall in the yellow category and two in the red category.

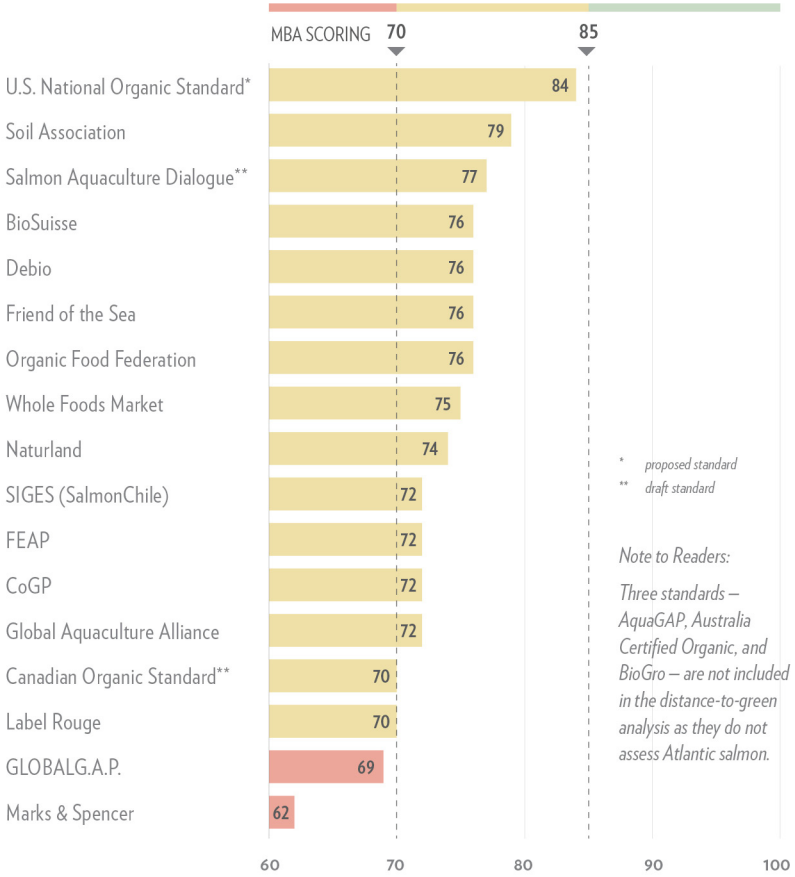
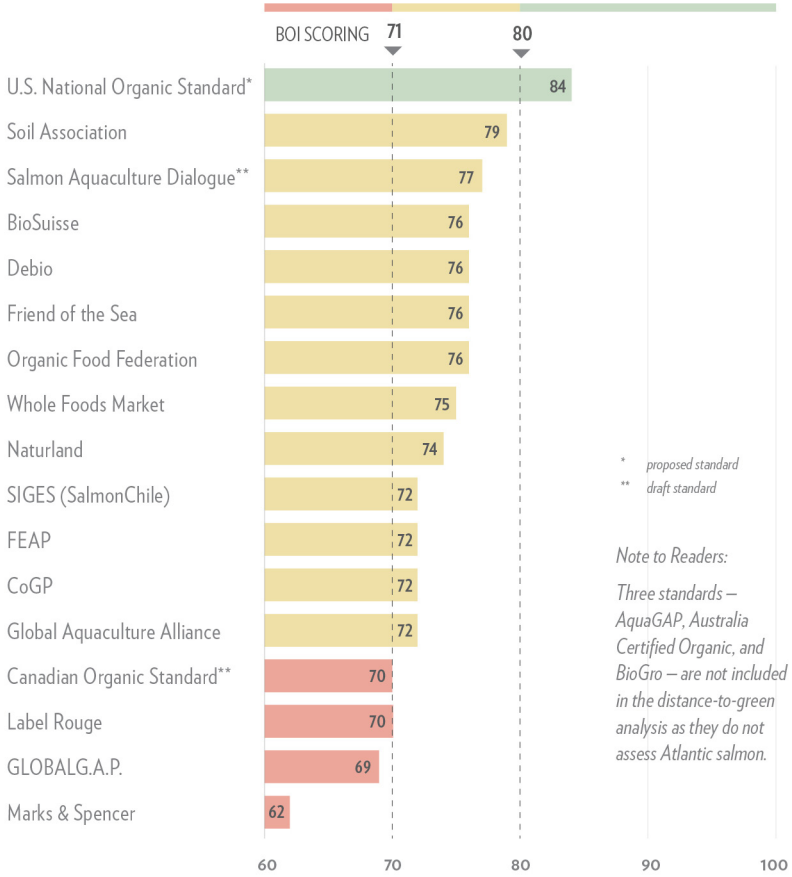


Figure V: Distance to Green: BOI rating results *(Absolute Performance Scores for Atlantic salmon)*

The proposed U.S. National Organic Standard is also the only standard to achieve BOI's green rating. Similar to the MBA results, 12 of 17 standards fall into BOI's yellow category and four into its red category.



WHAT THE STUDY SHOWS

A Lack of Strong and Measurable Performance-Based Standards

While many eco-labels have won consumer confidence, an alarming number of the standards ignore major environmental impacts or fail to set measurable limits. Given that standard-setting initiatives and certification bodies do not yet share monitoring data, measurable, performance-based standards are the only assurance consumers have that these products are better. In the absence of quantitative standards, there is no evidence that these certified products are actually environmentally-preferable. Those standard-setting initiatives that establish largely quantitative, performance-based standards — such as the proposed U.S. National Organic Standard, draft Salmon Aquaculture Dialogue standard, and Whole Foods Market standard — are leaders in this regard.

A Questionable Return on Investment

A substantial investment of financial and human capital has gone into establishing production standards for marine aquaculture that are likely to achieve only modest environmental benefit. While the best-performing standard — the proposed U.S. National Organic Standard — could lead to 33 percent improvement over conventional performance if adopted, most standards offer no more than 10 percent improvement over status quo. In fact, a third of the standards assessed perform at or even below average industry performance. Of all the Atlantic salmon standards assessed, only one meets the green threshold of a seafood guide.

The Challenges of Scale

Earlier GAPI research identified that most of the best-performing marine finfish farming sectors (e.g., Atlantic salmon in Norway) have the largest cumulative ecosystem impacts. As these sectors have expanded, they have benefited from economies of scale and become more efficient with much of their resource use. In turn, the increasing efficiency of these farms — and the associated profitability — has stimulated additional growth, until the level of production often exceeds the local carrying capacity.

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Strong farm-level standards alone are not sufficient to constrain the ecological footprint of the entire industry, and may in some cases amplify the problem by stimulating net growth rather than compelling existing producers to decrease their total ecological impacts. The environment cannot recognize incremental improvements per unit of production—it can only reflect the cumulative impacts. It is of no ecological consequence if a particular cumulative impact is generated by 100 efficient farms, or just one inefficient farm.

Another limitation to voluntary standards is the trade-off between the strength of standards and their rate of adoption. For any standard, the overall environmental improvement generated is essentially a function of the value added of the standard multiplied by the size of the industry and the standard's adoption rate. As marine finfish production increases, the combination of very strong standards with very high adoption rates is unlikely to be feasible.

These observations beg the question: how can aquaculture production continue in a way that contributes to global food supplies while protecting the marine environment? Part of the answer lies in applying strong standards to individual operations, and encouraging public policy that incentivizes increased adoption of these standards by the market. Governments of major aquaculture-producing countries must also make farm-level environmental impact data publicly available so that standards can be set at levels that actually drive improvement.

But even the best eco-labels are not a cure-all, especially when cumulative impacts are considered. As an effective complement to voluntary standards and eco-labels, regulatory and legislative processes must address the cumulative impacts of the industry, scaling production to the carrying capacity of marine ecosystems.

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OVERVIEW

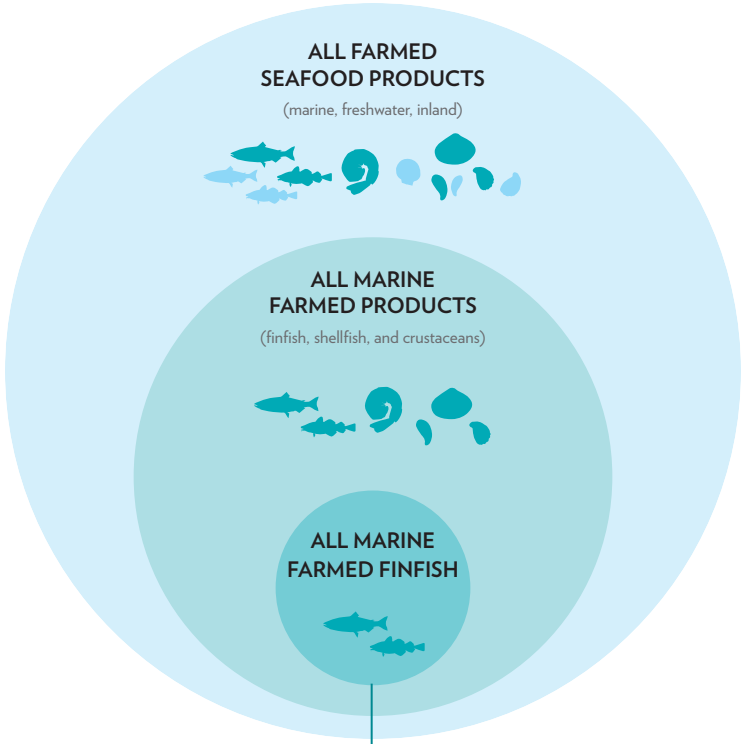
When it comes to seafood, lack of information on where products come from and how they are produced has long made it tough for buyers to determine the best environmental choices. Product standards and eco-labels have proliferated in the market as a kind of shorthand — a seal of approval — buyers can rely on when making purchasing decisions. But what do these standards and eco-labels actually mean? Is a fish produced according to a particular standard better than conventionally produced fish? And how do these different standards stack up?

A New Way of Comparing Aquaculture Standards

In the last several years, as standard-setting efforts for aquaculture have ramped up, a number of assessments were released to help grapple with the question of which standards and certification initiatives were the most rigorous. These assessments, including the World Wildlife Fund's *Benchmarking Study: Certification Programmes for Aquaculture* (2007) and the Environmental Law Institute's *Gold Standard for Sustainable Aquaculture Ecolabel Design* (2008), offer important insight into the strengths and weaknesses of existing aquaculture standards.

Recently there has been a shift in the way the environmental sustainability of food production is assessed. Instead of relying on more theoretical, qualitative assessments, decision makers are placing greater emphasis on quantitative measures of environmental performance. Similarly, standard-setting initiatives are now focused on developing standards that set measurable thresholds for environmental performance, rather than standards that simply recommend better production practices. The hope is that this focus on in-the-water performance allows fish farmers room to be flexible and innovative while it assures that standards are more closely aligned with the ultimate goal: reduced environmental impact.

This study — *How Green Is Your Eco-label? Comparing the Environmental Benefits of Marine Aquaculture Standards* — represents a new wave of analysis of aquaculture standards. It uses a well-established methodology, refined by the 2010 Global Aquaculture Performance Index (GAPI), to determine numerical scores of environmental performance for 20 marine finfish aquaculture standards. It acts as a kind of *Michelin* guide for standards—distilling a large amount of disparate information into simple scores that highlight the strengths and weaknesses of different standards. As the *Michelin* guide



SPECIES ASSESSED BY INITIATIVES IN THIS STUDY

- Atlantic salmon
- Atlantic cod
- Barramundi
- Chinook salmon
- Cobia
- Coho salmon
- European seabass
- Gilthead seabream
- Grouper
- Milkfish
- Turbot

does for restaurants, GAPI allows users to view an overall performance score or delve deeper into specific evaluation categories. GAPI does not delineate "good" versus "bad" performance. Instead, it is meant to be a tool to compare eco-labels and evaluate where they lie on the continuum of environmental performance.

By definition, this report is a snapshot in time to aid in the assessment of a moving target. It is based on standards as they existed in August 2011 and does not incorporate changes after that date. Three of the standards assessed—Salmon Aquaculture Dialogue, Canadian Organic Standard, and U.S. National Organic Standard—were in draft form at the time of this assessment. Final changes to these standards could affect their GAPI performance scores.

The practical, short-term objective is to evaluate existing and proposed standards and see how they stack up against one another; draw attention to existing shortcomings; and provide insight to improve these shortcomings. The longer-term objective is to help aquaculture stakeholders understand how standards as a whole are contributing to the ultimate goal of a more sustainable marine aquaculture industry.

More background on GAPI is available at www.gapi.ca.

Focus on Marine Finfish

Although marine finfish farming (e.g., salmon farming) accounts for just 7 percent of global aquaculture production, its disproportionate environmental impact and the controversy surrounding the farming of marine finfish makes it a focal point for standard-setting and certification efforts; marine finfish is also a concern for seafood buyers given the large commercial value of salmon in particular. As a result, this study focuses solely on marine finfish aquaculture standards. The 2010 GAPI assessed the environmental performance of the top 20 marine finfish species in production; these species currently comprise 94 percent of all marine finfish production. This benchmarking study focuses on 11 of the 20 species assessed by the 2010 GAPI; the species were selected because they are commercially important, or because they are already included within the 20 assessed aquaculture standards.

What Does the Study Tell Us?

The GAPI approach is not new. It is based on a well-established methodology — the Environmental Performance Index (EPI) — created by a team of researchers at Yale and Columbia universities to calculate numerical scores that reflect the environmental performance of countries across a range of environmental impacts. The results of their work are released every two years at the World Economic Forum Annual Meeting in Davos, Switzerland. With input from EPI researchers and other scientific experts, the GAPI project translated EPI into a tool specifically designed to evaluate the performance of marine finfish aquaculture across different countries and species. The 2010 GAPI scores provided a measure of average industry practice — or what is referred to as "conventional" performance in this report — across marine finfish species and producing countries.

In this phase of work, GAPI is used to measure the environmental performance of different aquaculture standards. Each standard is evaluated across 10 major impact areas such as disease transmission, sustainability of feed, and energy use (see pages 20-21 for further details).

Standard-setting and certification initiatives do not currently publish consistent farm-level environmental monitoring data. In the absence of these data, each standard is assessed as written. This study does not assess the performance of a specific certified farm, but simply asks: how poorly could a farm perform and still meet the written standard?

The study yields two critical pieces of information:

Absolute Performance Score

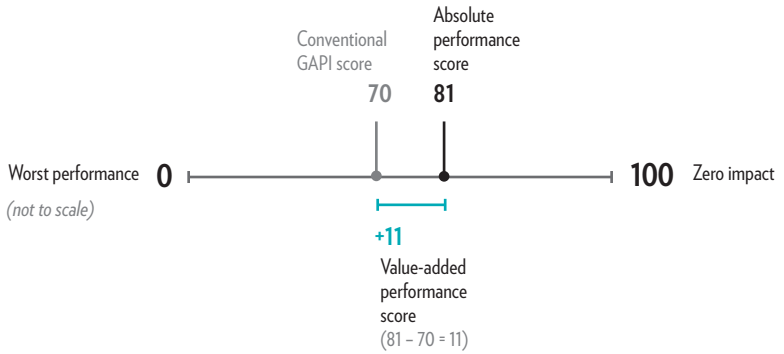
How each standard scores on an overall zero to 100 scale, where zero is the worst performance on record and 100 is perfect performance or zero-impact. The higher the score, the better the performance.

Value-Added Performance Score

How much better or worse the standard scores compared to conventional industry practice (as defined in the 2010 GAPI). The absolute performance score ranks standards based on which is "greener," but the value-added score determines which standards are driving the most change in their industry or region.

Figure 1: Understand Scoring

A detailed explanation of the GAPI scoring methodology is available online at www.gapi.ca.



Distance to Green

The study takes a step further by using well-known red-yellow-green seafood guides as a benchmark for strong environmental performance. To the extent seafood buyers feel comfortable with the seafood guides, this section provides a look at how well standards perform relative to these rankings.

What Impacts Are Considered?

As in the 2010 GAPI study, each standard is evaluated across 10 environmental impact areas. These have been selected based on a survey of the ecological impacts addressed in current aquaculture assessment initiatives, including voluntary standards and seafood guides. While there are no universal criteria for creating these impact categories, the formulas are designed to be scientifically sound and populated with publicly available data.

The study uses a common statistical tool—principal component analysis (PCA)—to determine the appropriate weighting for each impact category. PCA does not assign weights based on the ecological importance of each indicator, given the inherent challenges and biases involved with that approach, but instead "looks" at the set of data to determine which of the impact areas drive most of the variation in performance between the standards. In other words, it aims to highlight those impact categories where differences, or improvements, in performance have been demonstrated. If performance in a certain impact category varies significantly, PCA assigns a larger weight. If performance in a category hardly changes from one standard to the next, this suggests it is not a good indicator for distinguishing better performers from worse performers; thus, PCA gives it a lower weight.

For more information on each impact area and its formulation, see www.gapi.ca.

Figure 2: Impact Category Weighting

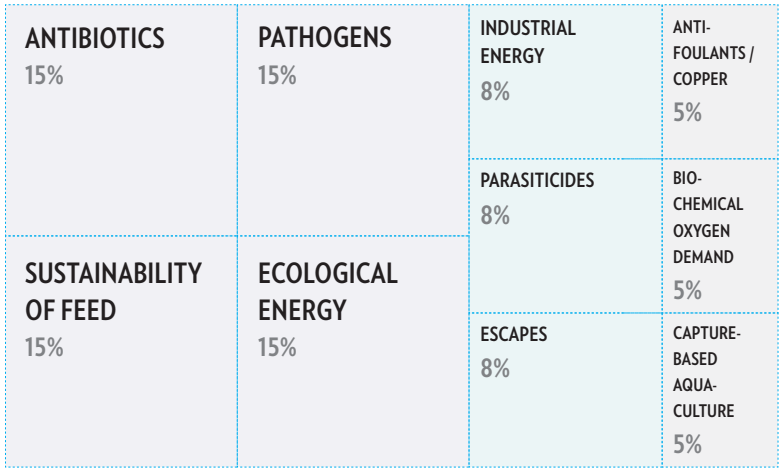


Figure 3: Impact Categories

GAPI Indicator and Abbreviation		Description
Antibiotics	ANTI	Amount of antibiotics used, weighted by a measure of human and animal health risk
Biochemical Oxygen Demand	BOD	A measure of organic pollutant impacts, particularly the oxygen-depletion effect of organic wastes (uneaten feed and feces)
Capture-Based Aquaculture	CAP	The extent to which a system relies on the capture of wild fish for production, taking into account the sustainability of these wild fish inputs
Copper-Based Antifoulants	COP	Estimated proportion of production using copper-based antifoulants
Ecological Energy	ECOE	Amount of energy, or net primary productivity (NPP), that farmed fish divert from the marine ecosystem through consumption of wild fish ingredients of feed
Escapes	ESC	Number of escaped fish, weighted by an estimate of the per capita risk associated with escapes
Sustainability of Feed	FEED	Amount, efficiency, and sustainability of wild fish ingredients of feed
Industrial Energy	INDE	Energy consumed in the acquisition and processing of feed ingredients, which serves as a proxy for the total industrial energy used in production
Parasiticides	PARA	Amount of parasiticides used, weighted by measures of environmental toxicity and persistence
Pathogens	PATH	Number of on-farm mortalities, weighted by an estimate of wild species in the ecosystem that are susceptible to farm-derived pathogens

How Are Standards Translated into Scores?

Each standard is translated into a GAPI score by using a simple, systematic approach (see Figure 4):

1. **Review the standard as written.**
2. **Determine which species and countries will be assessed.**
   - For existing standards: The assessment includes all species and countries currently evaluated or certified by the standard that are also assessed in the 2010 GAPI study (i.e., major marine finfish species and producing countries).
   - For proposed standards or those in draft form: The scope of inclusion was informed by materials gleaned from the standards themselves. For example, while the draft Canadian Organic Standard may eventually be applied to any aquaculture product imported to Canada, the guiding documents of this standard suggest that standards are currently being developed specific to Canadian products. Atlantic salmon is the only Canadian product that meets GAPI's minimum production limit for inclusion and is therefore the only species assessed under this standard.
3. **For each standard, determine which of its individual standards are relevant to the 10 environmental impact categories assessed.**
   - If a measurable standard exists, then input that value ("No antibiotic use" = "100").
   - Use the conventional performance score (2010 GAPI score) if:

     No relevant standard exists for that particular impact category, or a standard exists but cannot be quantified ("Reduce escapes").

     For example, Label Rouge and the Federation of European Aquaculture Producers (FEAP) received the conventional performance score in several standards because they did not use or make available measurable performance-based standards. Without measurable standards, there is no assurance that farms certified under these standards are required to perform better than conventional production.
   - If a measurable standard exists but that standard does not sufficiently translate into the relevant GAPI indicator, assume conventional industry practice.

     For example, the Salmon Aquaculture Dialogue (SAD) has quantitative standards for the waste discharges, but it was impossible to translate those standards into the relevant GAPI impact area (biochemical oxygen demand, or BOD). Within the Results section and Appendix, the report highlights those cases where the translation of measurable standards into GAPI is not possible.

To ensure that the analysis was as transparent and accurate as possible, all standard-setting initiatives were contacted twice during the translation process—first in the early stages of the study, to ensure that the research team had all available and up-to-date information describing the program's criteria; and a second time, to invite feedback on how their criteria were translated and standardized in the GAPI framework.

Getting to a Single Score

After all of the individual standards have been translated into numerical GAPI values, these 10 values are combined into a single score for the overall standard. In those cases where a standard is intended to certify more than one marine finfish species or production within multiple countries, individual scores for each country-species are calculated (e.g., Atlantic salmon-Norway) and weighted to reflect the total production volume in each country. The individual country-species scores are then combined to obtain a single score for the entire standard. Similarly, many standards are meant to apply to production in several countries, not just production in one country. In those cases, the study evaluates production in all major producing regions assessed by the 2010 GAPI to provide a global assessment of that standard and highlight any regional inconsistencies that may exist.

What Standards Are Evaluated?

This study set out to evaluate all existing and proposed voluntary standards that aim to reduce or eliminate the environmental impacts of marine finfish farming (see Figure 5). These voluntary standards fall into three basic categories: organic standards, retailer standards, and industry and other third-party standards. While some standards consider impacts such as social issues, human health, and animal welfare, this study assesses a standard's performance as it relates to environmental impacts only. In addition, this study only assesses those standards with criteria that are publicly available. In several cases, a standard exists in name only with no criteria available for review. While the study is intended to evaluate all major marine finfish aquaculture standards, it is acknowledged that other standards may have appeared during the study period.

Figure 4: Methodology at a Glance

Survey existing aquaculture standards and select those suitable for assessment.

Identify countries and species to be assessed.

Bin individual standards into relevant GAPI impact categories.

Calculate absolute performance scores from 0 to 100 within each category. Weight the scores and add them to produce an **absolute performance score** for the country-species pair.

Subtract the conventional performance score from the absolute performance score to determine the "value-added" score for each impact category. Add these individual weighted, value-added scores to produce a **value-added performance score** for the country-species pair.

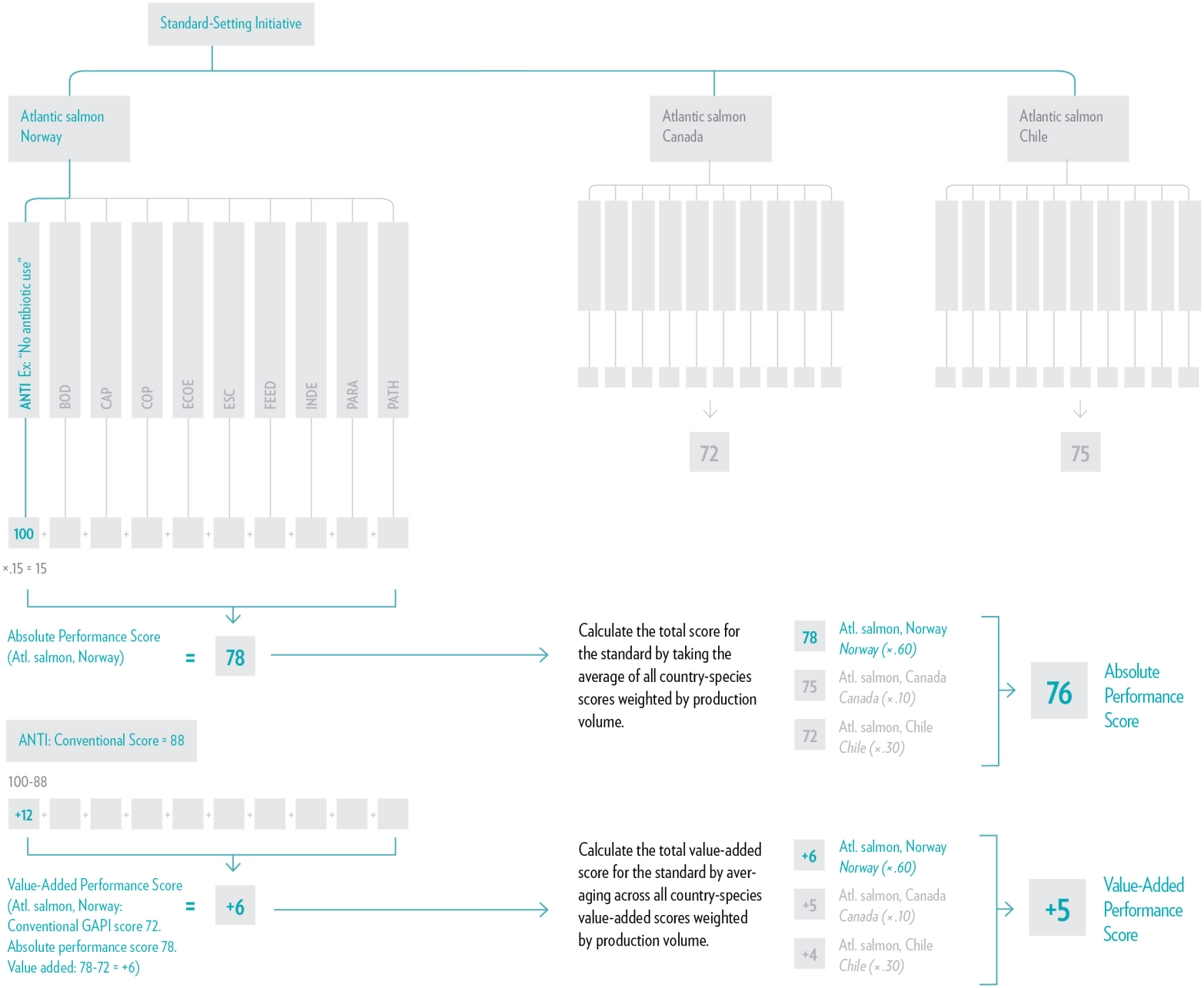


Figure 5: The Standards at a Glance

Key: Third party/Industry · Organic · Retailer

STANDARD	TYPE	SPECIES ASSESSED BY GAPI	OTHER IMPACTS NOT ASSESSED BY GAPI	SPECIFIC STANDARD ASSESSED
AquaGAP Third-party certification program for aquaculture globally		Barramundi (Indonesia, Malaysia) Grouper (Indonesia)	Social, animal welfare, traceability, wild-life control, land and freshwater impacts	*AquaGAP Standard For Good Aquaculture Practices* Version 3.0 (13.10.2010) *http://www.aquagap.net/Docs/AquaGAP%20Standard%20V3.pdf*
Australia Certified Organic Leading organic certifier in Australia		Barramundi (Australia)	Social, animal welfare, traceability, wild-life control, land and freshwater impacts	Australia Certified Organic Standard (ACOS) updated May 2010 *http://www.bfa.com.au/IndustryResources/BFAPublications/AustralianOrganicStandard.aspx*
BioGro Leading organic certification program in New Zealand		Chinook (New Zealand)	Social, animal welfare, traceability, land and freshwater impacts	BioGro Organic Standards, Module 6 Aquaculture Production Standards *http://www.biogro.co.nz/*
BioSuisse Certification program led by association of Swiss organic farmers		Atlantic cod (Iceland, Norway) Atlantic salmon (U.K.) European seabass (Greece, Italy, Spain, Turkey) Gilthead seabream (Greece, Israel, Italy, Spain, Turkey)	Social, animal welfare, land and freshwater impacts	BioSuisse Checklist 2010 Aquaculture Net cage farming *http://www.bio-suisse.ch/en/library/import/standards.php*
Canadian Organic Standard (Draft) National organic standard for aquaculture		Atlantic salmon (Canada)	Social, animal welfare, traceability, wild-life control, land and freshwater impacts	Canadian General Standards Board Organic Aquaculture Standards *http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb/programme-program/norms-standards/internet/bio-org/aqua-eng.html*
A Code of Good Practice for Scottish Finfish Aquaculture (CoGP) Scottish production standard for marine finfish		Atlantic salmon (U.K.)	Social, animal welfare, traceability, wild-life control, land and freshwater impacts	A Code of Good Practice for Scottish Finfish Aquaculture *http://www.thecodeofgoodpractice.co.uk/*
Debio Certification program for all organic products in Norway		Atlantic cod (Norway) Atlantic salmon (Norway)	Social, animal welfare, traceability, wild-life control, land and freshwater impacts	Debio Standards for Organic Aquaculture June 2009 *http://debio.no/*
Federation of European Aquaculture Producers (FEAP) Code of best practices supported by National Aquaculture Associations of European countries		Atlantic salmon (Norway, U.K.)	Social, animal welfare, wildlife control, land and freshwater impacts	FEAP Code of Conduct for European Aquaculture *http://www.feap.info/feap/code/default_en.asp*
Friend of the Sea Nonprofit organization and certification program for fisheries and aquaculture globally		Atlantic cod (Iceland, Norway) Atlantic salmon (Norway) Turbot (Spain)	Social, animal welfare, land and freshwater impacts	"FOS Certification Criteria Checklist for Aquaculture Products-Marine Aquaculture (updated 01/04/2010)." FOS farm audits for Villa Organic and Lovund Laks *http://www.friendofthesea.org/download.asp*
Global Aquaculture Alliance (GAA) Aquaculture industry trade association and certification program for aquaculture globally		Atlantic salmon (Canada, Chile, Norway, U.K.) Chinook (Chile, New Zealand) Coho (Chile, Japan)	Social, animal welfare, traceability, wild-life control, land and freshwater impacts	Aquaculture Facility Certification: Salmon Farms, Best Aquaculture Practices-Certification Standards, Guidelines. 2011 *http://www.gaalliance.org/bap/standards.php*
GlobalG.A.P. Private sector body that sets standards for agricultural products globally		Atlantic salmon (Canada, Chile, Norway, U.K.)	Social, animal welfare, traceability, wild-life control, land and freshwater impacts	GlobalGAP-Control Points and Compliance Criteria Integrated Farm Assurance-Aquaculture base (SN)-Salmonids species-Version 3.0-3_Mar10 *http://www.globalgap.org/cms/front_content.php?idcat=202*

Key: Third party/Industry · Organic · Retailer

Label Rouge Certification program of the French Ministry of Agriculture that also certifies foreign products	Atlantic salmon (Canada, Chile, Norway, U.K.) Turbot (France)	N/A	None available *http://www.labelrouge.fr/*
Marks & Spencer Leading U.K. retailer	Atlantic salmon (U.K.)	Social, animal welfare, wildlife control, land and freshwater impacts	Code of Practice for Salmon Select Farms-Saltwater-January 2006 *http://help.marksandspencer.com/faqs/products-services/salmon_lochmuir*
Naturland Organic farming association based in Germany but active globally	Atlantic salmon (Norway, U.K.)	Social, animal welfare, traceability, wild-life control, land and freshwater impacts	Naturland Standards for Organic Aquaculture-2009 (from personal contact) *http://www.naturland.de/standards.html#c1855*
Organic Food Federation U.K.-based organic certification program	Atlantic salmon (U.K.)	Social, animal welfare, wildlife control, land and freshwater impacts	Organic Food Federation Book 6-Aquaculture Standards-Salmonids *http://www.orgfoodfed.com/Downloads/1101%20Salmonids%20(approved%20by%20Defra).pdf*
Salmon Aquaculture Dialogue (Draft) Multi-stakeholder standard-setting initiative for farmed Atlantic salmon, coordinated by World Wildlife Fund.	Atlantic salmon (Canada, Chile, Norway, U.K.)	Social, traceability, wildlife control, land and freshwater impacts	Salmon Aquaculture Dialogues-Second draft standards for responsible salmon aquaculture (5/16/2011) *http://www.worldwildlife.org/what/globalmarkets/aquaculture/dialogues-salmon.html*
SIGES (SalmonChile) Set of regulations and standards for the Chilean salmon industry	Atlantic salmon (Chile)	Social, traceability, wildlife control, land and freshwater impacts	Intesal-SalmonChile-Manual of Regulations and Best Practices SIGES Salmon Chile-Version 2.0 (Chilean Salmon industry association-Salmon Technological Institute) *http://www.salmonchile.cl/frontend/index.asp*
Soil Association U.K.-based organic certification program	Atlantic salmon (U.K.)	Social, animal welfare, traceability, wild-life control, land and freshwater impacts	Soil Association Organic Standards January 2009 *http://www.soilassociation.org/*
U.S. National Organic Standard (Proposed) Proposed U.S. organic standard for marine finfish aquaculture	Atlantic cod (Iceland, Norway) Atlantic salmon (Canada, Chile, Norway, U.K.) Cobia (China, Taiwan)	Social, animal welfare, traceability, wild-life control, land and freshwater impacts	"National Organic Standard Board (NOSB) Final Recommendation-Proposed Organic Aquaculture Standards: Net Pens and Related Management Issues (19/11/08)," "National Organic Standard Board (NOSB) Final Recommendation- Proposed Organic Aquaculture Standards: Fish Feed and Related Management Issues (19/11/08)," & "Interim Final Report of the Aquaculture Working Group Winter 2006" *http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5074509&acct*
Whole Foods Market Largest retailer of organic and natural foods globally, with stores in the U.S. and U.K.	Atlantic cod (Iceland, Norway) Atlantic salmon (Canada, Chile, Norway, U.K.) European seabass (Greece, Italy, Spain, Turkey) Gilthead seabream (Greece, Israel, Italy, Spain, Turkey)	Social, animal welfare, wildlife control, land and freshwater impacts	Whole Foods Market Seafood Quality Standards Farm Standards for Salmon July 1, 2008 Version 2.0 *http://www.wholefoodsmarket.com/products/aquaculture.php*

RESULTS

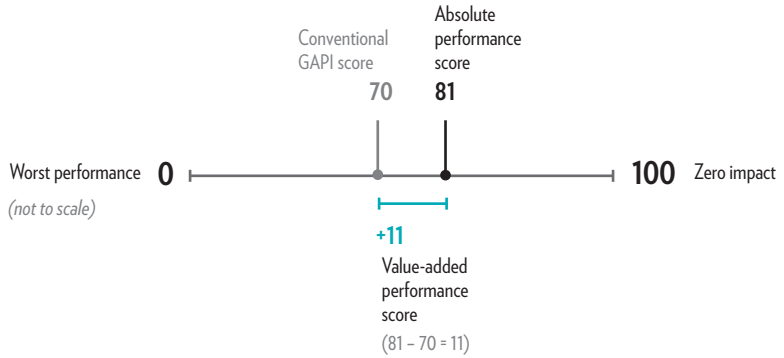
The GAPI approach looks at the performance of marine finfish aquaculture standards from multiple angles. Like the *Michelin* restaurant guide, the results can be read at different levels depending on user interest. If users simply want to know which standard is the strongest as written, they should focus on the scores for **absolute performance**. But if the concern is who is driving the most improvement or adding the most value in a particular impact category (such as escapes or disease), **value-added performance** scores are most relevant.

Within this section, performance scores are also broken down by species and by impact area to provide users with a more nuanced understanding of each standard's environmental performance. The Appendix also provides more detail on the translation of each standard into GAPI and related assumptions regarding standards.

Once again, results are broken down into two main scores:

Absolute Performance Score
How each standard scores on an overall zero to 100 scale, where zero is the worst performance on record and 100 is perfect performance or zero-impact. The higher the score, the better the performance.

Value-Added Performance Score
How much better or worse the standard scores compared to conventional industry practice (as defined in the 2010 GAPI). The overall performance score ranks standards based on which is "greener," but the value-added score determines which standards are driving the most change in their industry or region.



Absolute Performance: Who Is the Greenest of Them All?

Figure 6 provides a measure of the absolute environmental performance of each of the 20 marine finfish standards assessed by GAPI. These scores evaluate the strength of each standard, where 100 is perfect performance and 0 represents the worst performance of all the standards assessed. They not only provide a measure of how strong each standard is, but they also rank standards according to their overall environmental performance.

Organics Lead the Pack

Four of the five top-performing standards in terms of absolute performance are organic standards—the proposed U.S. National Organic Standard (#1), Soil Association (#2), Organic Food Federation (#4), and BioGro (#5).

Why do organic standards do so well? Organic standards for marine aquaculture are generally meant to align with broader organic food production standards that place strong restrictions on waste management and the use and discharge of chemicals. For example, the proposed U.S. National Organic Standard prohibits the use of antibiotics and copper-based antifoulants, while other standards limit the use or discharge of these substances, at best. The proposed U.S. National Organic Standard also requires that a minimum of 50 percent of nutrient wastes be recycled. While the Soil Association organic standard for Atlantic salmon does not establish criteria for several impact categories, it does set firm limits on the area of overlap between fish farms and prohibits the use of certain parasiticides.

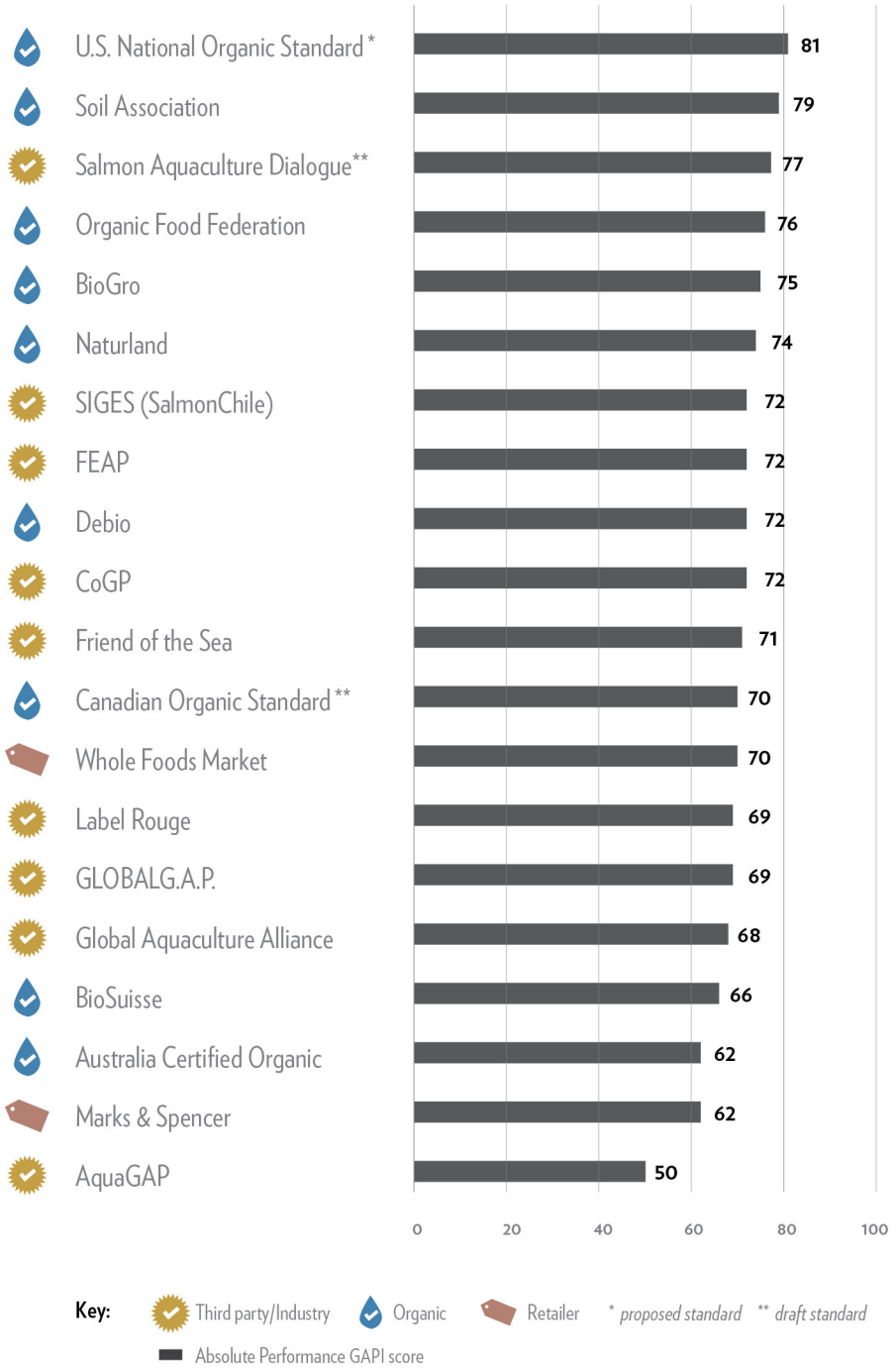
Some of the poorer-performing organic standards—the draft Canadian Organic Standard (#12) and BioSuisse (#17)—either did not set standards in key impact areas or did not set measurable limits for these impacts.

Salmon-Specific Standards Have an Advantage

Atlantic salmon has been a natural launching point for many aquaculture standard-setting initiatives. It dominates the marine finfish aquaculture industry and comprises a healthy 35 percent of global aquaculture production by value. While it continues to receive much of the scrutiny regarding the negative environmental and social impacts of aquaculture, the salmon industry has made efforts in recent years to reduce some of its core

Figure 6: How Standards Performed Overall

For all species evaluated.



environmental impacts. As GAPI 2010 demonstrated, the per-unit environmental impact of conventional salmon farming is lower than most marine finfish species in production. Those standards that focus solely on Atlantic salmon have the advantage of a stronger starting position than those standards that are geared toward less-developed industries such as barramundi or gilthead seabream. Thus it makes sense that some of the better-performing standards in terms of absolute scores are Atlantic salmon-focused, such as Soil Association and draft Salmon Aquaculture Dialogue standard.

Delving Deeper: Absolute Performance by Species and Impact Categories

The overall absolute performance score for a standard tells users how strong a particular standard is. To determine what is driving this performance, it is necessary to delve deeper into its absolute performance scores in each impact category or species, if the standard addresses more than one species. It can be that a standard's score is being driven by performance in only a couple of key impact areas such as escapes or antibiotic use. Similarly, a standard-setting initiative may have a strong standard for one species but not another. Figure 7 provides a breakdown of the unweighted, absolute performance scores for all 20 standards.

The Importance of Measurable Performance-Based Standards

While many eco-labels have won consumer confidence, an alarming number of the standards do not address several major impact categories. Label Rouge, for instance, does not — at least publicly — offer standards for any of the 10 environmental impact areas assessed by GAPI. In many cases, standards make mention of certain impacts but do not establish measurable thresholds. For instance, Friend of the Sea has standards related to antibiotic use, water quality, capture-based aquaculture, fish meal and oil use, escapes, and energy use, but none of these puts a measurable limit on the related impacts. For antibiotic use, for example, Friend of the Sea's standard is simply: "drugs and other chemicals are only used when clearly justified to treat specific problems." In other cases, a standard intends to set a future threshold but does not establish an immediate threshold.

In all of these cases, without measurable standards, there is no evidence to support claims that a farm certified to these specific standards is required to perform better than conventional producers. Without clear thresholds for performance in a particular impact category, the study assumes that farms perform no better than conventional industry performance (average GAPI score). The standard-setting initiatives that do establish largely quantitative, performance-based standards — such as the proposed U.S. National Organic Standard, the draft Salmon Aquaculture Dialogue standard, and Whole Foods Market standard — are leaders in this regard.

An alternate conclusion is that the 10 GAPI indicators simply do not reflect the impact areas of concern to stakeholders. However, to determine which impact areas would be assessed by GAPI, the project examined existing aquaculture assessments (e.g., seafood guides) and standard-setting efforts and pinpointed those environmental impacts most commonly addressed across all of the standards. The 10 impact categories assessed by GAPI — such as escapes, disease, and waste discharges — were those that appeared consistently among the standards and were deemed important enough to include within GAPI.

Figure 7: Unweighted Absolute Performance Scores by Indicator

STANDARD	SPECIES	ANTI	BOD	CAP	COP	ECOE	ESC	FEED	INDE	PARA	PATH
AquaGAP	Barramundi	63	97	100	100	39	35	44	40	41	57
	Grouper	0	99	100	100	39	32	0	0	84	3
Australia Certified Organic	Barramundi	100	62	99	28	70	35	99	0	100	24
BioGro	Chinook salmon	100	100	100	28	70	38	69	43	100	100
BioSuisse	Atlantic cod	97	76	100	100	64	0	68	58	67	75
	Atlantic salmon	95	61	100	100	66	42	75	60	53	86
	European seabass	48	79	100	100	60	55	73	43	80	75
	Gilthead seabream	30	74	100	100	68	19	76	50	70	53
Canadian Organic Standard (Draft)	Atlantic salmon	86	66	100	28	74	39	79	57	99	72
Code of Good Practice Scottish Salmon Farmers Association	Atlantic salmon	96	61	100	49	66	40	75	60	53	86
Debio	Atlantic cod	98	59	100	100	64	0	68	58	45	63
	Atlantic salmon	99	50	100	100	65	40	75	51	96	78
Federation of European Aquaculture Producers	Atlantic salmon	98	56	100	38	69	40	75	62	69	82
Friend of the Sea	Atlantic cod	98	76	100	100	64	0	69	59	73	75
	Atlantic salmon	99	50	100	100	72	39	65	64	84	78
	Turbot	23	79	100	100	68	61	74	44	65	77
Global Aquaculture Alliance	Atlantic salmon	88	65	100	35	72	57	76	61	78	76
	Chinook salmon	84	99	100	35	73	59	65	49	82	77
	Coho salmon	40	79	100	35	70	0	69	60	72	64
GLOBALG.A.P.	Atlantic salmon	88	65	100	33	72	39	67	61	78	76
Label Rouge	Atlantic salmon	90	66	100	28	74	39	75	57	99	72
	Turbot	52	100	100	51	68	61	81	44	67	73
Marks & Spencer	Atlantic salmon	51	61	100	28	66	40	75	60	31	86
Naturland	Atlantic salmon	99	50	100	100	58	40	75	56	84	78
Organic Food Federation	Atlantic salmon	96	99	100	100	66	40	66	60	75	86
Salmon Aquaculture Dialogue (Draft)	Atlantic salmon	94	65	100	35	72	84	96	61	78	73
SIGES (SalmonChile)	Atlantic salmon	68	81	100	100	75	38	75	62	77	67
Soil Association	Atlantic salmon	96	100	100	100	66	40	83	60	53	86
U.S. National Organic Standard (Proposed)	Atlantic cod	100	93	100	100	78	31	70	66	100	100
	Atlantic salmon	100	68	100	100	77	31	86	57	100	100
	Cobia	100	51	100	100	47	31	61	35	100	100
Whole Foods Market	Atlantic cod	100	92	100	28	70	0	62	58	100	87
	Atlantic salmon	100	66	100	49	72	39	86	62	99	72
	European seabass	100	58	100	28	60	47	79	50	81	75
	Gilthead seabream	100	49	100	28	67	5	82	60	57	56

Absolute scores range from 0 (worst) to 100 (zero-impact). Scores are based on how the written standard performs within 10 key impact categories. A standard is assigned the conventional score if it doesn't set a measurable threshold for a particular impact or if the standard could not be translated appropriately.

Legend:

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Value-Added Performance: Who Is Driving the Most Improvement?

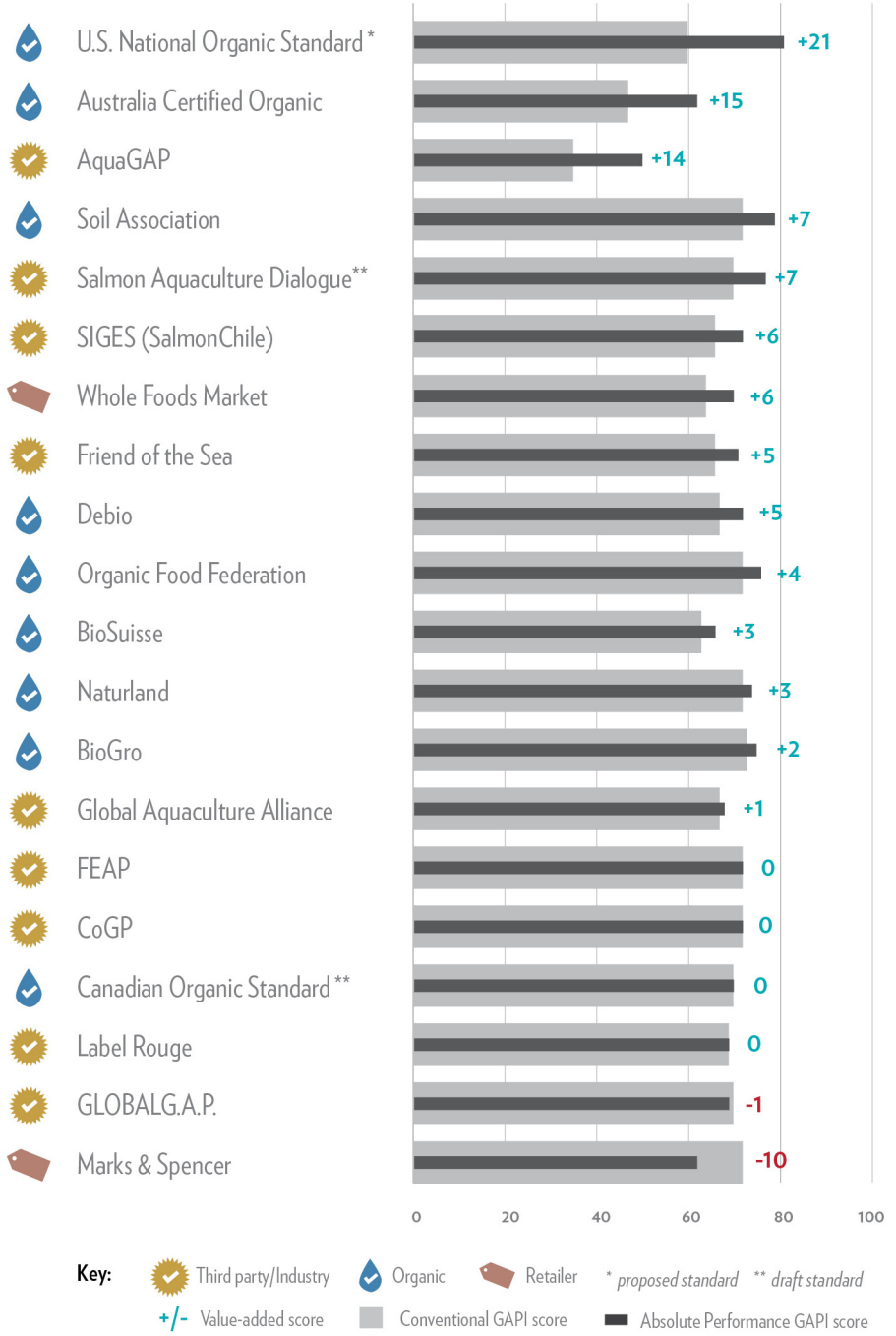
Value-added scores reflect the ability of a standard to drive improvement within the marine aquaculture industry. A high value-added score results when the initiative sets a bar well above conventional industry practice. A standard with a significant value-added score can be a catalyst for improvement.

On the other end of the spectrum, a standard receives a negative value-added score if it sets standards that are lower than conventional industry practice. It is unlikely that any standard aims to set performance below conventional practice. However, the lack of quality data on current performance makes setting a standard for "better" performance a challenge. While this is the goal of most standards, given the lack of data on the current environmental performance of the aquaculture industry, standards have in several cases been set below that of conventional practice. It is important to note that a negative value-added score does not mean that every farm certified under that standard will perform worse than average, but it does mean that a farm could do so and still be certified under that particular standard.

In the interpretation of value-added scores, context is important. A high value-added score can be a red flag indicating that, on average, conventional aquaculture production for that species scores poorly (receiving a low GAPI score), which makes it easier for an industry to add value. It can also be a sign that a particular standard is adding value, even where an industry already scores relatively well (received a high GAPI score). Achieving a high value-added score for an already well-performing industry is arguably more challenging than achieving the same value-added score for a new industry where practices are relatively poor. The graphics in this section provide context for the value-added scores by illustrating both the conventional GAPI score and the absolute performance score for that standard.

Figure 8: Value-Added Scores

For all species evaluated. Some standards focus on multiples species or regions. The baseline performance (or conventional GAPI score) against which an initiative is evaluated differs depending on which species or country that specific initiative addresses.



Organics Lead the Pack Once Again

Three of the five top value-added scores are for organic standards. The proposed U.S. National Organic Standard ranks first again with 21 value-added points, which translates into a 33 percent improvement over conventional performance. The Australia Certified Organic standard is a close second with 15 points value-added (32 percent improvement over the conventional performance score). Soil Association secures one of the top ranks again with seven value-added points, or 10 percent improvement over conventional Atlantic salmon performance in the U.K.

Why do organic standards tend to achieve some of the higher value-added scores? Since organic principles have been shaped and applied across many different types of food systems, these standards seem to be less influenced by concerns regarding feasibility and industry adoption than by multi-stakeholder aquaculture standards. Thus organic standards have the potential to be set well above conventional industry practice, even if those standards can only be achieved by a small (or perhaps zero) percent of the industry at the time of adoption.

Other, non-organic standard-setting initiatives aim to certify a relatively substantial portion of current fish production. For instance, the industry-driven Global Aquaculture Alliance aims to certify around 80 percent of current salmon production. The World Wildlife Fund-coordinated Salmon Aquaculture Dialogue has a clearly stated dual objective of minimizing or eliminating environmental impact while allowing the industry to remain economically viable. Similarly, retailer standards tend to focus on improving environmental performance and quality, while ensuring there is enough certified product to fill demand.

Some Flip-Flopping in Performance

Value-added and absolute performance scores can provide very different pictures. A standard may score poorly on the absolute performance scale but can be one of the highest-ranking standards for value-added performance, and vice versa. For example, the two barramundi-specific standards — AquaGAP and Australia Certified Organic—are at the bottom of the barrel for absolute performance scores (50 and 62, respectively). However, their performance is actually substantially better than conventional production for barramundi (with value-added scores of 14 and 15 points, respectively). Thus AquaGAP rises to third place and Australia Certified Organic to second place when value added is considered.

A Questionable Return on Investment

Standard setters and engaged stakeholders have dedicated significant time and financial resources to the development of many aquaculture standards evaluated in this study. In many cases, standards have taken multiple years to develop, with extensive input from a variety of stakeholders and scientific experts.

But, what is the ecological return on all of this investment by the standard-setting community? Based on this GAPI analysis of standards as written, the two best-performing standards lead to over 30 percent improvement compared to conventional industry performance. Putting aside the question of whether these standards improve performance to a level that would be deemed "green" or "sustainable," it would be difficult to argue that a 30 percent improvement is not substantial.

A majority of the standards, however, achieve value-added scores of seven and under. Depending on the species and countries assessed, this translated into a 10 percent or less improvement over conventional performance scores. Of most concern is that approximately one-third of the standards scored at or even below conventional industry performance. Both GlobalG.A.P. and Marks & Spencer received negative value-added points, indicating standards set below average industry performance.

Delving Deeper: Value-Added Performance by Species and Impact Categories

The overall value-added score for a particular standard does not tell the whole story. To discern where a particular standard is driving improvement or where it is falling short compared to conventional industry practice, it is necessary to delve deeper into the value-added scores for different species and impact categories. Figure 9 provides a breakdown of the unweighted, value-added performance scores for all 20 standards.

Performance Is Not Always Consistent Across Species

While some standards are focused on one particular species, several standards are intended to certify all marine finfish species, or at least several commercially important species. A single standard for multiple species may have substantially different results in terms of the ability of that standard to drive improvement. For example, the Global Aquaculture Alliance's escapes standard for all salmon species (Chinook, coho, and Atlantic) limits escapes to 5,000 fish or less per production cycle. While this is a relatively strong

Figure 9: Value-Added Performance Scores by Indicator Before Weighting

STANDARD	SPECIES	ANTI	BOD	CAP	COP	ECOE	ESC	FEED	INDE	PARA	PATH
AquaGAP	Barramundi	2	17	0	72	0	0	0	0	75	0
	Grouper	0	14	0	72	0	0	0	0	78	0
Australia Certified Organic	Barramundi	42	0	-1	0	0	0	34	0	70	0
BioGro	Chinook salmon	0	0	0	68	0	0	16	0	0	0
BioSuisse	Atlantic cod	-1	0	0	72	0	0	0	0	0	0
	Atlantic salmon	-1	0	0	51	0	2	0	0	0	0
	European seabass	-15	0	0	62	0	-1	0	0	0	0
	Gilthead seabream	-21	0	0	60	0	-1	0	0	0	0
Canadian Organic Standard (Draft)	Atlantic salmon	-1	0	0	0	0	0	0	0	0	0
Code of Good Practice Scottish Salmon Farmers Association	Atlantic salmon	0	0	0	0	0	0	0	0	0	0
Debio	Atlantic cod	0	0	0	72	0	0	0	0	0	0
	Atlantic salmon	0	0	0	72	-10	0	0	-12	11	0
Federation of European Aquaculture Producers	Atlantic salmon	0	0	0	0	0	0	0	0	0	0
Friend of the Sea	Atlantic cod	0	0	0	72	0	0	1	0	6	0
	Atlantic salmon	0	0	0	72	0	0	-10	0	0	0
	Turbot	0	0	0	49	0	0	-9	0	0	0
Global Aquaculture Alliance	Atlantic salmon	0	0	0	2	0	17	1	0	0	0
	Chinook salmon	0	0	0	4	0	30	1	0	0	0
	Coho salmon	0	0	0	0	0	56	-11	0	0	0
GLOBALG.A.P.	Atlantic salmon	0	0	0	0	0	0	-1	0	0	0
Label Rouge	Atlantic salmon	0	0	0	0	0	0	0	0	0	0
	Turbot	0	0	0	0	0	0	0	0	0	0
Marks & Spencer	Atlantic salmon	-45	0	0	0	0	0	0	0	-22	0
Naturland	Atlantic salmon	0	0	0	62	-13	0	0	-7	0	0
Organic Food Federation	Atlantic salmon	0	0	0	51	0	0	-9	0	22	0
Salmon Aquaculture Dialogue (Draft)	Atlantic salmon	6	0	0	2	0	45	21	0	0	-3
SIGES (SalmonChile)	Atlantic salmon	0	0	0	72	0	0	0	0	0	0
Soil Association	Atlantic salmon	0	39	0	51	0	0	9	0	0	0
U.S. National Organic Standard (Proposed)	Atlantic cod	2	1	0	72	9	11	7	5	33	18
	Atlantic salmon	12	2	0	67	7	1	9	2	22	28
	Cobia	70	6	0	72	46	-11	10	30	80	40
Whole Foods Market	Atlantic cod	2	0	0	0	0	0	6	0	6	0
	Atlantic salmon	12	0	0	16	-7	0	12	2	0	0
	European seabass	37	0	0	0	2	0	7	1	0	0
	Gilthead seabream	50	0	0	0	-1	0	4	1	0	0

Legend:

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

improvement above average industry practice for coho (56 points value-added) and Chinook (30 points value-added), it represents only modest improvement (17 points value-added) for Atlantic salmon.

Performance Can Vary Drastically Across Impact Categories

While some standards are consistently strong or consistently poor performers, the performance of most standards fluctuates across different impact categories. For instance, BioSuisse's copper standard performs relatively well in terms of its value-added score, but its antibiotic standard is weaker than conventional practice (hence the negative value-added score in this impact area). These fluctuations can be a reflection of a standard-setting initiative's focus on one or two impact areas. It is sometimes a reflection that strong performance is easier to achieve (i.e., solutions more readily available) in certain impact areas such as copper use. Other areas, such as controlling the transmission of pathogens, are often more challenging to address and scores trend accordingly.

The Tricky Puzzle of Pathogens

Very few standards address pathogens in a meaningful way. Of the 20 standards assessed, only two standards — the proposed U.S. National Organic Standard and the draft Salmon Aquaculture Dialogue — set a measurable performance-based standard related to the minimization or elimination of disease and parasite transmission to wild fish.

The proposed U.S. Organic Standard sets the strongest standard for pathogen transmission by far, stating "whether or not diseased fish are treated, they may not be sold as organic" and "producers must implement measures to prevent transmission of diseases and parasites between cultured and wild aquatic animals." While the draft Salmon Aquaculture Dialogue standard sets a measurable standard for sea lice loads on farms and for farmed fish mortalities, it receives a negative value-added score for the "pathogens" category. This is because its on-farm mortalities cap of 20 percent (of total production) is higher than average on-farm mortalities, which GAPI considers a proxy for disease and parasite transmission to wild fish. While this may be viewed as an unfair penalty, it is important for standard-setting initiatives to be aware of those areas where standards may have inadvertently been set lower than status quo practice.

Of all environmental impacts associated with the farming of marine finfish in net pens, pathogen transfer is arguably the most challenging to address. Diseases and parasites exist in virtually all food animal production systems. In a majority of marine finfish production, farmed fish share an environment with wild fish that serves as host for many pathogens, and the transfer of these diseases and parasites is a virtual certainty. While fish farmers rely on a variety of methods to control for these pathogens on farmed fish, there is a major trade-off between pathogen control and the release of toxic chemicals into the marine environment.

Some of the standards that aim to minimize pathogen transfer — such as the draft Salmon Aquaculture Dialogue standard — currently allow the use and discharge of toxic parasiticides and antibiotics. Other standards with stronger limits on chemical use—such as the organic BioGro and Australian Certified Organic standards — have no measurable standards for pathogen transmission. The only standard that seems to hold a firm line on both pathogens and chemical use is the proposed U.S. National Organic Standard. The big question, however, is whether any marine finfish producer will be able to meet this standard when it takes effect.

DISTANCE TO GREEN

When Is Performance Good Enough?

This study provides a close look at how marine finfish aquaculture standards perform when compared to each other and to zero-impact performance. But, assuming no food production system is perfect, how does one decide if these scores are good enough?

Instead of establishing its own benchmark for what is "green," the study relies on two well-established and well-known seafood guides — the Monterey Bay Aquarium's Seafood Watch guide (MBA) and the Blue Ocean Institute's seafood guide (BOI). The guides use a red-yellow-green system to inform buyers which fish are preferred and which should be avoided. By including the seafood guides in this way, a standard's performance can be viewed in the "green means go, red means no" color-coding language understood by the marketplace.

To the extent seafood buyers feel comfortable with the seafood guides, this section provides a look at how well standards perform relative to these rankings. Further, the stoplight system for both guides aligns soundly with GAPI scores (e.g., green categories equate to high GAPI scores, red categories equate to low GAPI scores), which makes the guides solid benchmarks for assessing a standard's performance.

This red-yellow-green grouping is not meant to reflect the internal categorization regime by the MBA or BOI. It only reflects the interpretation of their criteria within our framework.

A Focus on Atlantic Salmon

While the standard-setting initiatives assessed focus on different species or production regions, nearly all are intended to certify Atlantic salmon. Of the 20 marine finfish standards assessed, 17 address Atlantic salmon production either specifically or generically, through a broader set of marine finfish standards. Given its ubiquitous coverage, Atlantic salmon is an obvious species on which to focus in order to distinguish more thoroughly relative performances among standards.

Accurate translation from GAPI scores to a red-yellow-green scoring system also requires an abundance of high-quality data to ensure accuracy. The abundance and accuracy of Atlantic salmon data far outweigh those of any other species (only five standards considered Atlantic cod, the next most commonly assessed species). Since Atlantic salmon is the only species

assessed by nearly all standards, it provides a level playing field to directly compare relative performance of each initiative in the red-yellow-green context.

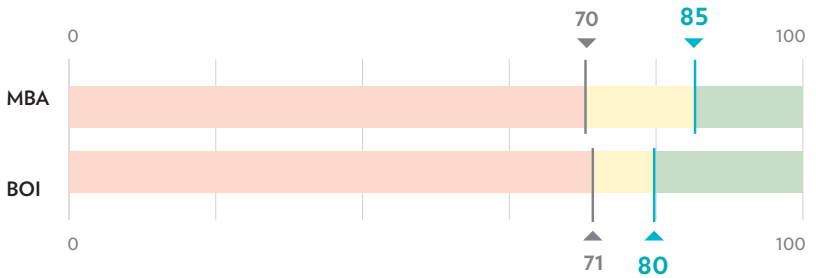
The absolute performance scores highlighted thus far in the report are in many cases a weighted average of each standard's performance across a number of different species. When the study is refocused on performance in Atlantic salmon alone, the scores and rankings change to reflect only the Atlantic salmon scores for each standard. As a result, scores and rankings presented in this section vary somewhat from the overall absolute performance scores presented in the first part of this report.

How Were Seafood Guides Translated into GAPI?

To calibrate seafood guides in the GAPI scoring system, each seafood guide is treated as if it were a country-species pair (e.g., Chile-Atlantic salmon). Like standards, each guide has specific requirements or thresholds for environmental performance.

For each guide these thresholds are translated into a GAPI score. For those species, for which the guides make no regional differentiation (e.g., Atlantic salmon globally), all producing countries that met the decision rule for inclusion in GAPI are included in the analysis. If regions were specified by a guide, the analysis is restricted to only those specified countries that also met the GAPI inclusion rule (i.e., major producing countries only).

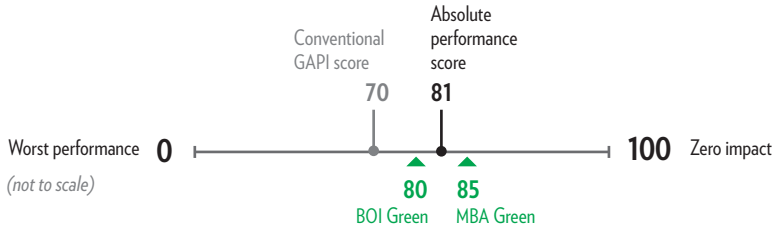
Figure 10: Seafood Guides Calibrated into GAPI Scores



How the standards compare. Comparison of the red-yellow breakpoint and yellow-green breakpoint for MBA and BOI (for Atlantic salmon). MBA sets a slightly higher benchmark for a "green" rating than BOI.

While MBA and BOI rating scales are largely consistent in terms of GAPI scoring, the minimum score required to be green is slightly higher in the MBA system.

Figure 11: Comparing Performance Scores to Seafood Guides



How Close to Green Are Salmon Standards?

On the MBA Scale:

None of the standards were able to achieve a green ranking although the proposed U.S. National Organic Standard came within two points in absolute score (see Figure 12). The large majority of the standards (15 out of 17 salmon standards) fall into MBA's yellow category. MBA defines the yellow category as products that "did not evaluate well against one or more of the criteria, but are better choices than seafood on the Avoid list." The result of most concern: two of the salmon standards — GlobalG.A.P., and Marks & Spencer — are in MBA's red or "avoid" category. According to MBA, "these seafood products evaluated very poorly against one, or poorly against many of our sustainability criteria, and are thus deemed to not be sustainable."

On the BOI Scale:

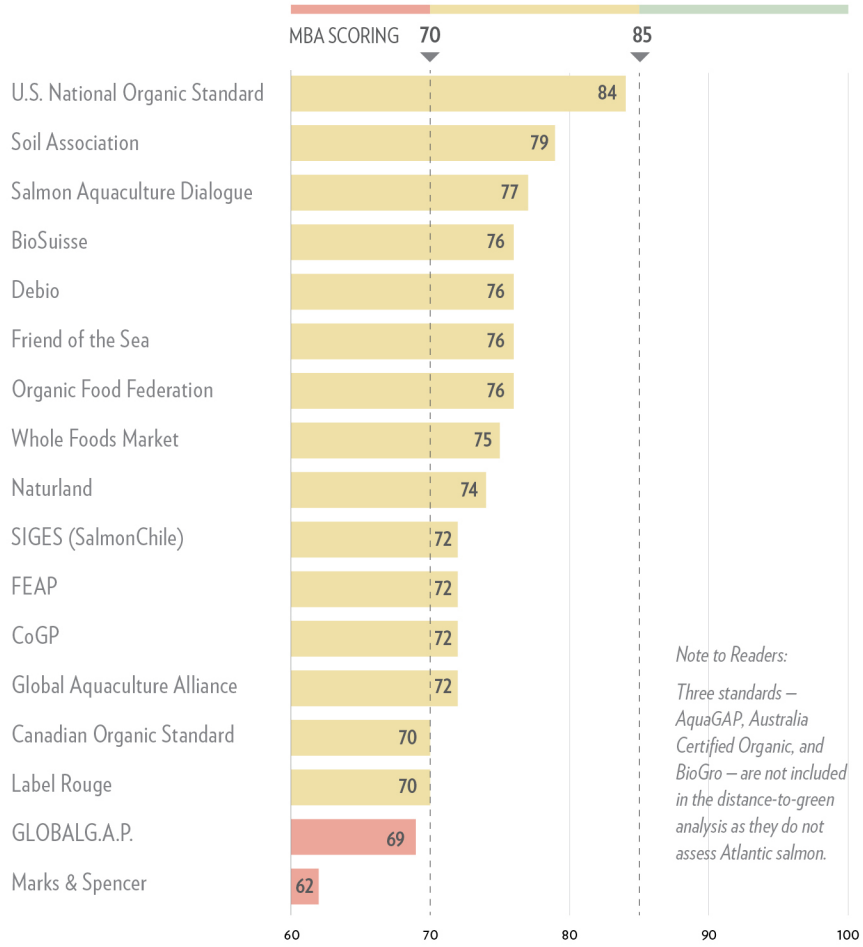
The standards did not perform much better when placed on BOI's scale (see Figure 13). Only one standard — the proposed U.S. National Organic Standard — achieved BOI's green rating (i.e., a score of 85 and above). Similar to the MBA-focused analysis, 12 of 17 standards fall in BOI's yellow category and four in the red category. According to BOI, farming methods of red ranked species "have serious environmental impacts."

What does this all mean? As one of the top seafood items consumed in the U.S., salmon — particularly farmed Atlantic salmon — is top of mind for businesses that buy and sell seafood. Identifying better or more sustainable farmed salmon has been a particular challenge for concerned seafood buyers. While this study highlights some of the "better" choices in farmed Atlantic salmon, it suggests that options are slim to none for those buyers who are committed to sourcing "green" seafood only.

Figure 12: How Standards Performed for Atlantic Salmon According to MBA

Seafood Watch (MBA)

MBA has a red-yellow breakpoint of 70 and a yellow-green breakpoint of 85.

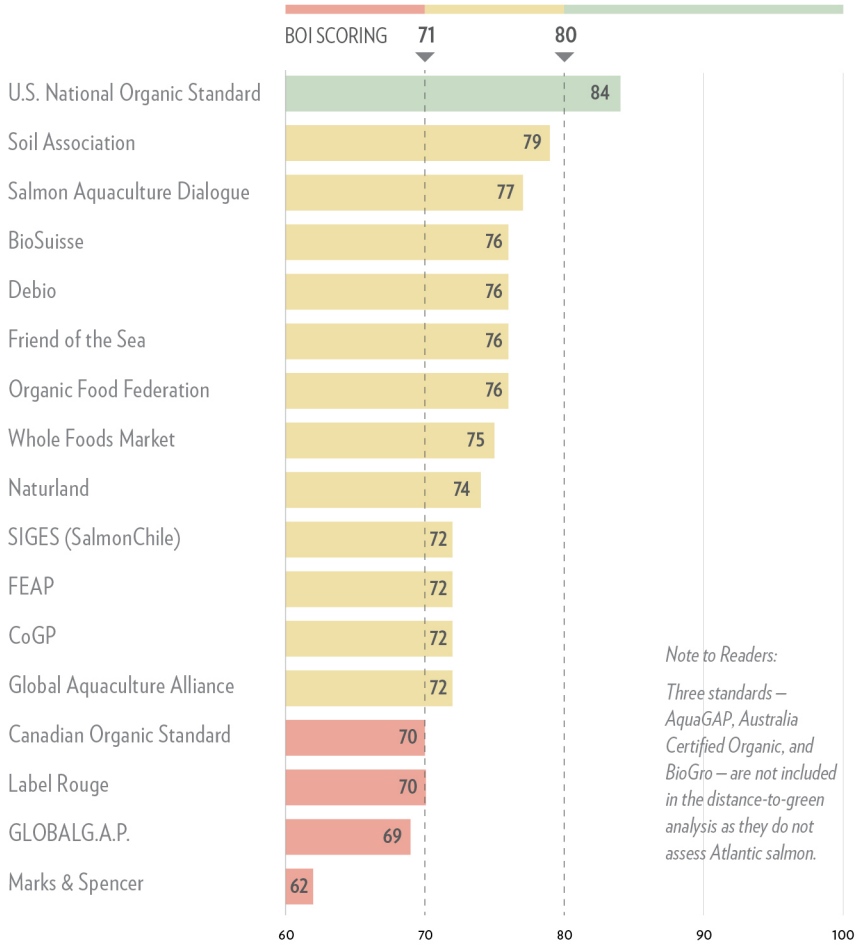


ABSOLUTE PERFORMANCE SCORES IN GAPI

Figure 13: How Standards Performed for Atlantic Salmon According to BOI

Blue Ocean Institute (BOI)

BOI has a red-yellow breakpoint of 71 and a yellow-green breakpoint of 80. BOI sets a lower benchmark for green than MBA.



ABSOLUTE PERFORMANCE SCORES IN GAPI

FINAL THOUGHTS

The Challenges of Scale

Even the best standards are not a cure-all. Standards help set performance bars for individual farms and industry sectors, but they rarely provide guidance on what size an industry should be.

As an industry grows, its cumulative effects grow as well. Consider the global transportation sector. China alone is adding over 15 million cars to the road each year. Even if most of these new cars are hybrids, overall emissions in the transportation sector will grow dramatically.

Earlier GAPI research identified that most of the best-performing marine finfish farming sectors (e.g., Atlantic salmon in Norway) also have the largest cumulative ecosystem impacts. As industries grow, they often become more efficient; these increases in efficiency, rather than decreasing overall impacts, lower costs and allow for greater production and therefore greater cumulative impacts. The problem of cumulative effects is an important limitation to the standards-based approach: strong farm-level standards alone are not sufficient to constrain the ecological footprint of the entire industry, and may in some cases amplify the problem by stimulating net growth rather than compelling existing producers to decrease their total ecological impacts.

The double-edged nature of efficiency and the issue of scale are important considerations that need to be incorporated into any environmental performance assessment. After all, the environment cannot recognize incremental improvements per unit of production—it can only reflect the cumulative impacts. It is of no ecological consequence if a particular cumulative impact is generated by 100 efficient farms, or just one inefficient farm.

A second limitation to voluntary standards is the trade-off between the strength of standards and their rate of adoption. Because of the cost of compliance, looser voluntary standards will tend to have higher adoption rates than will more stringent ones. In the U.S., for example, organic agriculture represents less than 1 percent of total agricultural production across all commodities. A "super-green" aquaculture standard may be achievable, but it is unlikely to obtain widespread traction among producers. By contrast, a more modest industry standard may be widely adopted but offer little added value. For any standard, the overall environmental improvement generated is essentially a function of the value added by the standard multiplied by

the size of the industry and the standard's adoption rate. As farmed marine finfish production increases, the combination of very strong standards with very high adoption rates is unlikely to be feasible.

These observations beg the question: how can aquaculture production continue in a way that contributes to global food supplies while protecting the marine environment? Clearly, part of the answer lies in applying appropriate standards to individual operations, and market tools like eco-labels help encourage this trend. Public policy needs to provide incentives for increased adoption of eco-label standards by producers and large buyers. Further, governments of major aquaculture-producing countries must make farm-level environmental impact data publicly available so that standards can be set at levels that actually drive improvement.

A substantial investment of financial and human capital has gone into establishing production standards for marine aquaculture. Alone they appear to achieve only modest gains in actual environmental performance, especially when cumulative impacts are considered. An effective complement to these investments would involve working through the regulatory and legislative processes to help set overall limits on cumulative impacts, scaled to the carrying capacity of marine ecosystems.

APPENDIX

Decision Rules for Translating Standards into GAPI

The following table demonstrates how each standard has been translated into GAPI. For each standard, it also identifies those impact areas for which relevant or measurable standards do not exist or where the metric used could not be adequately translated into GAPI. Where multiple standards addressed one impact category, as long as one of the standards established a measurable limit, the category was set to "Set a measurable standard" (unshaded). The color codes are as follows:

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

AquaGAP (Barramundi, Grouper)

Source: *AquaGAP Standard For Good Aquaculture Practices Version 3.0 (13.10.2010)*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *The following treatments are prohibited:* *• drugs and chemicals banned for use in food production such as chloramphenicol and nitrofuran antibiotics* *• drugs and chemicals banned in the country of import • Malachite Green, crystal violet, tributyltin compounds* *• antibiotics, to which there is plausible suspicion or evidence of build up of resistance*	Applied standard's criteria: Applied only those antibiotics permitted in the producing country. Remove any use of the following: chloramphenicol and nitrofuran.
Biochemical Oxygen Demand (BOD) ***DO**: Prior to certification: ≥ 4 (mg/L), Within first 3 yrs of cert: ≥ 5 (mg/L)* ***Total ammonia nitrogen**: Prior to certification < 5 (mg/L), Within first 3 yrs of cert < 3 (mg/L)* ***Soluble phosphorus**: Prior to certification: < 0.5 (mg/L), Within first 3 yrs of cert :< 0.3 (mg/L)* ***BOD**: Prior to certification: < 50 (mg/L), Within first 3 yrs of cert: < 30 (mg/L)*	Applied standard's criteria: *50mg/L*
Capture-Based Aquaculture (CAP) *The following is prohibited:* *• Use of genetically modified species* *• Use of wild-caught brood stock with the following exceptions:* *1. black tiger shrimp* *2. for the start-up of new hatchery/species* *3. a small percentage allowed to maintain genetic diversity* *• Use of wild-caught smolts/fry/PL •* *Use of non-native species with no history of safe production in the area*	Applied standard's criteria: Same as country regulations so same as average country data
Copper-Based Antifoulants (COP) *The use of copper-based antifoulants is prohibited.*	Applied standard's criteria: *Zero use of copper based antifoulants*
Ecological Energy (ECOE) *Feed conversion ratio (FCR) = (feed used) / (fish biomass increase). Within the first three years of certification, the FCR shall be reduced to below 2. After the first three years of certification, an FCR of 1 should be reached.*	Applied average country data: Standard only applies to future goals.
Escapes (ESC) *Where there is an existing industry with a non-native species, there shall be strict escape prevention measures in place and there shall be no evidence of any impact on the local ecosystem.*	Applied average country data: Standard does not set a limit.
Sustainability of Feed (FEED) *Only compound feed from an ISO 9001 certified feed mill, where feed specifications are available, shall be used...*	Applied average country data: Standard does not set a limit.
Within 3 years of first certification must comply with the following: At least 70 % of animal meal and oil shall originate from certified sustainable fisheries, from certified aquaculture...	Applied average country data: Standard only applies to future goals.
Feed conversion ratio (FCR) = (feed used) / (fish biomass increase). Within the first three years of certification, the FCR shall be reduced to below 2. After the first three years of certification, an FCR of 1 should be reached.	Applied average country data: Standard only applies to future goals.
The FFER (fish feed equivalency ratio) shall be calculated...The calculated values for FFER are currently used to monitor improvement over time during certification. Limit values will be set when more scientific data are available. In the meantime, all operators shall achieve an FFER of less than 1 within three years of certification.	Applied average country data: Standard does not set a limit.
There will be no acceptance of specifically harvested juvenile fish or 'trash fish ' for aquaculture feeds...	Applied standard's criteria: Same as industry operations so same as average country data
Industrial Energy (INDE) *...50% of the energy used at the hatchery and farm level should be sourced from renewable resources...*	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
Parasiticides (PARA) *The following treatments are prohibited:* *• drugs and chemicals banned for use in food production such as chloramphenicol and nitrofuran antibiotics* *• drugs and chemicals banned in the country of import* *• Malachite Green, crystal violet, tributyltin compounds*	Applied standard's criteria: Only use those parasiticides permitted in the producing country, remove any use of Malachite Green
Pathogens (PATH) No relevant criteria	Applied average country data. No standard

Australia Certified Organic (Barramundi)

Source: *Australian Organic Standards (AOS) May 2010*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *The use of prohibited allopathic veterinary treatments (such as drugs and antibiotics) or other treatments not listed or allowed under this Standard shall require prior written veterinary advice and shall lead to de-certification of stock, as listed in table 5a.*	Applied standard's criteria: *Zero use of antibiotics*
Biochemical Oxygen Demand (BOD) *Water leaving the operation shall be treated or managed in such a way as to prevent excessive nutrient build up either on or off site.*	Applied average country data. Standard does not set a limit.
Capture-Based Aquaculture (CAP) *...uncertified stock may be introduced to certified farm units to a maximum of 10% per annum...*	Applied standard's criteria: *10% wild fingerlings @ 20 g per fingerling*
Copper-Based Antifoulants (COP) No relevant criteria	Applied average country data. No standard
Ecological Energy (ECOE) *For ruminants, animal by products, including meat, offal, manures and feathermeal are prohibited as feedstuffs.*	Applied standard's criteria: Same as country regulations so same as average country data
Escapes (ESC) No relevant criteria	Applied average country data. No standard
Sustainability of Feed (FEED) *Where marine food sources are used, a minimum of 50% of the total diet shall be comprised from by products of wild fish or marine organisms caught for human consumption...The balance not derived from such sources shall be derived from wild marine sources independently certified as capable of sustainable harvesting by either ACO or an approved international certifier (e.g., through the Marine Stewardship Council).*	Applied standard's criteria: Mackerel in Australia is the only certified species so removed all other species.
There will be no acceptance of specifically harvested juvenile fish or "trash fish " for aquaculture feeds...	Applied standard's criteria: *Zero use of trash fish*
Industrial Energy (INDE) *For ruminants, animal by products, including meat, offal, manures and feathermeal are prohibited as feedstuffs.*	Applied standard's criteria: Same as country regulations so same as average country data
Parasiticides (PARA) *The use of prohibited allopathic veterinary treatments (such as drugs and antibiotics)... shall lead to de-certification of stock, as listed in table 5a.*	Applied standard's criteria: *Zero use of parasiticides*
Pathogens (PATH) No relevant criteria	Applied average country data. No standard

BioGro (Chinook salmon)

Source: *BioGro Organic Standards, Module 6 Aquaculture Production Standards*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *Prophylactic use of veterinary drugs is prohibited. Chemical allopathic veterinary drugs and antibiotics are prohibited for invertebrates.*	
If veterinary drugs are used, treated fish must be quarantined and must not be sold as BioGro certified.	Applied standard's criteria: Same as operating conditions in country so same as average country performance
Biochemical Oxygen Demand (BOD) *Organic aquaculture units located downstream of any conventional aquaculture units must be at an appropriate distance (as a guideline at least 5 km)...*	Calculated the area of overlap using the criteria of at least 5 km distance. This is the same as the average practice in the country.
Capture-Based Aquaculture (CAP) *...wild-harvested stock may be brought in subject to BioGro's written approval. Wild stock collection must comply with the Fisheries Acts and Regulations.*	Applied standard's criteria: *Low use of wild based on value seen in other salmon production systems*
Copper-Based Antifoulants (COP) *BioGro certified/approved forms of the following: copper in the forms of copper hydroxide, copper oxychloride, copper sulphate, cuprous oxide, and copper octanoate. Total applications of copper must not exceed 3 kg copper active ingredient per hectare per year*	Applied standard's criteria: *3 kg/ha/yr over total ha of production*
Ecological Energy (ECOE) *Ingredients of agricultural origin must ideally be certified organic. If such certified organic feed is not available in satisfactory quantity or quality then up to 15% of those ingredients may be non-organic subject to BioGro's annual written approval, for a limited period of time.*	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
Escapes (ESC) *Adequate measures must be taken to prevent escapes of cultivated fish and to prevent infiltration of predators that may kill or damage them. The poisoning of predators is not permitted.*	Applied average country data. Standard does not set a limit.
Sustainability of Feed (FEED) *If raw materials from wild-caught fish are used, this shall come from sustainable stocks that are within biological secure limits according to ICES. This means that the raw material shall come from fish stocks where the catch/harvest does not exceed the recommendations set by ICES for the actual year or/and are in accordance with the FAO Code of Conduct or certified by MSC.*	Applied standard's criteria: Removed any feed species that have a FAO score of 3 or above to reflect a sustainably managed fishery.
Industrial Energy (INDE) *Ingredients of agricultural origin must ideally be certified organic. If such certified organic feed is not available in satisfactory quantity or quality then up to 15% of those ingredients may be non-organic subject to BioGro's annual written approval, for a limited period of time.*	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
Parasiticides (PARA) *All synthetic fertilisers and pesticides are prohibited unless otherwise allowed in the BioGro Standards, refer Appendix B Permitted and Restricted Materials. The use of Malachite Green or formalin is not permitted as fungal treatment of eggs.*	Applied standard's criteria: *Zero use of parasiticides*
Pathogens (PATH) *If the behaviour of the fish becomes irregular, or if mortality rates exceed 0.5% per week, diagnostic tests must be made, water quality checked, and the results recorded.*	Applied average country data: Standard does not set a limit.

BioSuisse (Atlantic cod, Atlantic salmon, European seabass, Gilthead seabream)

Source: *BioSuisse Checklist 2010 Aquaculture Net Cage Farming* and *BioSuisse Standards for the Production, Processing and Marketing of Produce from Organic Farming*

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *If an animal has been treated with chemically synthesized allopathic veterinarian medicines or antibiotics more than three times within the calendar year (or more than one therapeutic treatment, if the productive life-cycle is less than one year), the animals concerned or products derived thereof must not be sold as organic...*	Applied standard's criteria: *Three doses per year to reflect criteria stating no more than three treatments per year*
Biochemical Oxygen Demand (BOD) No relevant criteria	Applied average country data: No standard
Capture-Based Aquaculture (CAP) *In principle, only native fish species adapted to regional conditions are to be raised. Derogations to this rule are subject to approval and special conditions.*	Applied average country data : Standard does not set a limit.
Fry from countries outside of Switzerland and its adjacent countries	
Copper-Based Antifoulants (COP) *The net must not be treated with chemically synthesized substances.*	Applied standard's criteria: *Zero use of copper-based antifoulants*
Ecological Energy (ECOE) No relevant criteria	Applied average country data: No standard
Escapes (ESC) *Sufficient protection of the facilities against escape and immigration*	Applied average country data: Standard does not set a limit.
Net cages: Only species native to the waters concerned may be kept in net cages.	Applied average country data: Standard does not set a limit.
Sustainability of Feed (FEED) No relevant criteria	Applied average country data: No standard

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Industrial Energy (INDE) No relevant criteria	Applied average country data: No standard
Parasiticides (PARA) No relevant criteria	Applied average country data: No standard
Pathogens (PATH) No relevant criteria	Applied average country data: No standard

Canadian Organic Standard (Draft) (Atlantic salmon)

Source: *Organic Aquaculture Standards-National Standard of Canada-2010-06-23-Draft*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *Use of synthetic veterinary drugs is limited to 2 courses of treatments per year and to one treatment when production cycle is less than 1 year.*	Applied standard's criteria: *Two doses per year to reflect criteria stating no more than two treatments per year*
If the use of the products in par. 6.5.12 a. and b. is unlikely to be effective in combating illness or injury, chemical allopathic drugs (not listed on the Permitted Substances Lists) may be administered under veterinary supervision. Some restrictions apply when aquaculture animals are treated (see par. 6.5.13, 6.5.14d and 6.5.15). In addition to the treatments allowed for combating illness or injury, anaesthetics may be administered no more than twice a year when handling individual fish (e,g., vaccination, weight counts, parasite counting, fin clipping, tagging, or surgery).	Applied average country data: Standard does not set a limit.
Biochemical Oxygen Demand (BOD) *Open water units shall be sited and managed, so that sediment build-up underneath the unit is minimized.*	Applied average country data: Standard does not set a limit.
For aquaculture in fishponds, tanks or raceways, effluent monitoring shall be carried out at regular intervals...	Applied average country data: Standard does not set a limit.
Capture-Based Aquaculture (CAP) *For breeding purposes or for improving genetic stock and when organic aquaculture animals are not available, wild-caught or non-organic aquaculture animals may be brought into a production unit and shall be kept under organic management.*	Applied average country data: Standard does not set a limit.
Copper-Based Antifoulants (COP) *6.1.8 Fouling organisms on production equipment shall be managed using environmentally sustainable methods.*	Applied average country data: Standard does not set a limit.
Ecological Energy (ECOE) No relevant criteria	Applied average country data: No standard
Escapes (ESC) *Aquaculture animals intended for organic production shall be taken from indigenous species or adapted to rearing conditions.*	Applied average country data: Standard does not set a limit.
Cultivation shall occur within a secure and well-managed production system where risk of escape has been reduced to a minimum. A contingency plan for all units shall describe how escapes can be limited and how escapees may be recaptured. Note: Any escape event must immediately be reported to the certification body as well as the appropriate government authorities.	
Sustainability of Feed (FEED) *All feed shall be derived by order of priority from organic feed, trimming of fish already caught for human consumption in sustainable fisheries (Code of Conduct for Responsible Fisheries – FAO 1995), other products and by-products of aquatic animals from sustainable fisheries.*	Applied average country data: Standard does not set a limit.
Industrial Energy (INDE) No relevant criteria	Applied average country data: No standard

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Canadian Organic Standard (Draft)

Parasiticides (PARA) *By way of derogation, when preventive measures fail (because of aquatic climatic conditions or other uncontrollable factors), and in the case where the operator uses direct treatment measures such as feeding, topical application or external application in a confined static bath, the use of synthetic parasiticides is permitted, provided that i. observation of the animal, as appropriate for the species, indicates the aquaculture animals are infected with parasites; ii the operator has received written instructions from a veterinarian indicating the product and method for parasite control that shall be used;*	Applied average country data: Standard does not set a limit.
....there shall be only one treatment for slaughter aquaculture animals under a year old and a maximum of two treatments for older slaughter aquaculture animals. Slaughter aquaculture animals that require further treatment will lose organic status...	Applied standard's criteria: *Two doses per year for adult grow-out production*
If the use of the products in par. 6.5.12 a. and b. is unlikely to be effective in combating illness or injury, chemical allopathic drugs (not listed on the Permitted Substances Lists) may be administered under veterinary supervision. Some restrictions apply when aquaculture animals are treated (see par. 6.5.13, 6.5.14d and 6.5.15). In addition to the treatments allowed for combating illness or injury, anaesthetics may be administered no more than twice a year when handling individual fish (e.g., vaccination, weight counts, parasite counting, fin clipping, tagging, or surgery).	Applied average country data: Standard does not set a limit.
Pathogens (PATH) *Disease, injury and functional impairment. Disease should be prevented or rapidly diagnosed and treated.*	Applied average country data: Standard does not set a limit.

Code of Good Practice for Scottish Finfish Aquaculture
(Atlantic salmon)

Source: *A Code of Good Practice for Scottish Finfish Aquaculture, Appendix F-Seabed monitoring and assessment*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *The use of authorised veterinary medicines and other treatments to protect fish welfare is a legitimate aspect of fish husbandry. Only those substances that are permitted under European and U.K. legislation must be used in fish destined for human consumption.*	Applied standard's criteria: Same as country regulations so same as average country data
Biochemical Oxygen Demand (BOD) No relevant criteria	Applied average country data: No standard
Capture-Based Aquaculture (CAP) No relevant criteria	Applied average country data: No standard
Copper-Based Antifoulants (COP) *Biofouling should not be allowed to build up on pen nets to a level that impairs water exchange.*	Applied average country data: Standard does not set a limit.
Ecological Energy (ECOE) *Farmers should obtain written assurances from their feed suppliers that the feeds supplied to them do not contain any material derived from terrestrial animals (inc. birds) or any material derived from recycled farmed fish. Approved technical products are permitted.*	Applied standard's criteria: Same as country regulations so same as average country data
Escapes (ESC) *All equipment and systems must be designed, installed and operated to minimize risk of compromising fish health and welfare and to prevent risk of fish escapes...*	Applied average country data: Standard does not set a limit.
Sustainability of Feed (FEED) *Farmers should obtain written assurances from their feed suppliers that the feeds supplied to them do not contain any material derived from terrestrial animals (inc. birds) or any material derived from recycled farmed fish. Approved technical products are permitted.*	Applied standard's criteria: Same as country regulations so same as average country data
Farmers should request a written declaration from the feed supplier that the fishmeal and fish oil used in the manufacture of their feed was obtained from fisheries: whose vessels are registered within a state that has publicly subscribed to the FAO's 'Code of Conduct for Responsible Fisheries'; and/or which has been recognised by the International Fish Meal and Fish Oil Organisation (IFFO), as publicised by the Fish Meal Information Network (FIN) and others, as having 'independent national or international management controls'.	
Industrial Energy (INDE) *Farmers should obtain written assurances from their feed suppliers that the feeds supplied to them do not contain any material derived from terrestrial animals (inc. birds) or any material derived from recycled farmed fish. Approved technical products are permitted.*	Applied standard's criteria: Same as country regulations so same as average country data
Parasiticides (PARA) *The use of authorised veterinary medicines and other treatments to protect fish welfare is a legitimate aspect of fish husbandry. Only those substances that are permitted under European and U.K. legislation must be used in fish destined for human consumption.*	Applied standard's criteria: Same as country regulations so same as average country data
Veterinary medicines should be used prudently and in accordance with the conditions set out in the data sheet. Prescription only medicines (POMS) must only be used under the instruction of a veterinary surgeon.	
Pathogens (PATH) *During the period February to June inclusive, coinciding with the appearance of wild juvenile salmonids in the sea, the criterion for treatment is an average of 0.5 adult female L.salmonis per fish. ii) During the period July to January inclusive, the criterion for treatment is an average of 1.0 adult female L.salmonis per fish.*	Applied standard's criteria: Same as country regulations so same as average country data

Debio (Atlantic cod, Atlantic salmon)

Source: *Debio Standards for Organic Aquaculture June 2009*

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *The use of drugs and other chemical compounds permitted by regulations is justified only for specific problems*	Applied standard's criteria: Same as country regulations so same as average country data
Biochemical Oxygen Demand (BOD) *As a minimum the oxygen content in the water shall be at least 7 mg oxygen per litre, and the water through flow shall be so great that harmful effects of carbon dioxide (CO_2) and ammoniac (NH_3) are avoided.*	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
Capture-Based Aquaculture (CAP) *When organic stock is not available, conventional sources may be used according to time-limits agreed upon in the description of the production unit.*	Applied average country data: Standard does not set a limit.
Copper-Based Antifoulants (COP) *...Antifouling with poisonous chemicals is prohibited. The Organisation either does not use anti-fouling paints or has an independent scientific study demonstrating their non-toxicity.*	Applied standard's criteria: *Zero use of antifoulants*
Ecological Energy (ECOE) *Ongrowing feed must contain at least 30% organic vegetable ingredients.*	Applied standard's criteria: *Plant proportion in feed set to 30%, Fish 70%*
Escapes (ESC) *The production shall focus on preventing escape, regarding technical equipment and internal control.*	Applied average country data: Standard does not set a limit.
Sustainability of Feed (FEED) *To secure overfishing of such stocks, we recommend that the quotas set by ICES are to be followed.*	Applied average country data: Same as country regulation so same as average country data
Industrial Energy (INDE) *Ongrowing feed must contain at least 30% organic vegetable ingredients.*	Applied standard's criteria: *Plant proportion in feed set to 30%, Fish 70%*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Parasiticides (PARA) *Allow use of anti-louse disease treatment (after use of wrasse, etc.)*	Applied standard's criteria: Removed any use of the pesticide emamectin benzoate and cypermethrin.
Pathogens (PATH) *...risk of infection and outbreak of disease is minimised...In the event of abnormal behaviour or mortality exceeding 0.5 per thousand daily, this shall be reported to the fish health control programme and to Debio.*	Applied average country data: Standard does not set a limit.

Federation of European Aquaculture Producers (FEAP) (Atlantic salmon)

Source: *FEAP Code of Conduct for European Aquaculture*

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *The use and application of therapeutic agents should observe the prescribed dosage and where appropriate, withdrawal times...*	Applied average country data: Standard does not set a limit.
Biochemical Oxygen Demand (BOD) No relevant criteria	Applied average country data: No standard
Capture-Based Aquaculture (CAP) No relevant criteria	Applied average country data: No standard
Copper-Based Antifoulants (COP) No relevant criteria	Applied average country data: No standard
Ecological Energy (ECOE) No relevant criteria	Applied average country data: No standard
Escapes (ESC) *Farmers will seek to minimise the potential risks that are presented by farmed fish escapes to wild fisheries.*	Applied average country data: Standard does not set a limit.
Sustainability of Feed (FEED) No relevant criteria	Applied standard's criteria: No standard
Industrial Energy (INDE) No relevant criteria	Applied average country data: No standard
Parasiticides (PARA) *The use and application of therapeutic agents should observe the prescribed dosage and where appropriate, withdrawal times...*	Applied average country data: Standard does not set a limit.
Pathogens (PATH) *Avoidance of spreading of diseases—farmers have the responsibility to minimise the risk of the spread of diseases beyond their farms into the ecosystem where wild fish and other farms may be affected.*	Applied average country data: Standard does not set a limit.

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Friend of the Sea (Atlantic cod, Atlantic salmon, Turbot)

Source: *FOS Certification Criteria Checklist for Aquaculture Products Marine Aquaculture (updated 01/04/2010)*

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *Drugs and other chemicals are only used when clearly justified to treat specific problems.*	Applied average country data: Standard does not set a limit.
Biochemical Oxygen Demand (BOD) *Water quality: must demonstrate it is not significantly deteriorated...*	Applied average country data: Standard does not set a limit.
Capture-Based Aquaculture (CAP) *Dependency on wild-caught broodstock is to be minimized...*	Applied average country data: Standard does not set a limit.
Copper-Based Antifoulants (COP) *No use of anti-fouling paints. The use of toxic and persistent chemicals must be prohibited (e.g., TBT's, Malachite Green, DDT).*	Applied standard's criteria: *Zero use of copper-based antifoulants*
Ecological Energy (ECOE) *Reduced use of fish meals and oil in favor of vegetable meals and oils.*	Applied average country data: Standard does not set a limit.
Escapes (ESC) *In order to limit the consequences of fish escape, the Organisation has put in place prevention measures...*	Applied average country data: Standard does not set a limit.
Sustainability of Feed (FEED) *The Organisation uses feeds certified by Friend of the Sea, when available on the market for the farmed species. As an alternative, feeds derive from residues of the processing of edible products (trimmings).*	Applied standard's criteria: Only species that fall within the approved FOS list were included.
Industrial Energy (INDE) *High-energy input farming systems are only allowed if alternative heat/energy sources are used...must maintain a record of energy consumption...*	Applied average country data: Standard does not set a limit.
Reduced use of fish meals and oil in favor of vegetable meals and oils.	Applied average country data: Standard does not set a limit.

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Parasiticides (PARA) *The use of toxic and persistent chemicals must be prohibited (e.g., TBT's, Malachite Green, DDT).*	Applied standard's criteria: Malachite Green was removed.
Pathogens (PATH) No relevant criteria	Applied average country data: No standard

Global Aquaculture Alliance
(Atlantic salmon, Chinook salmon, Coho salmon)

Source: *Aquaculture Facility Certification Salmon Farms Best Aquaculture Practices Certification Standards November 10, 2010*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *Antibiotics shall only be used in response to a confirmed disease outbreak to treat diagnosed bacterial disease (see also Standard 10.8) and shall not be used as growth promoters.*	Applied average country data: Standard does not set a limit.
Antibiotics or chemicals banned in the producing or importing country shall not be used in feeds or any treatment that could result in harmful residue in fish.	Applied standard's criteria: Same as country regulations so same as average country data
Biochemical Oxygen Demand (BOD) *4.1 The applicant shall provide documents that describe local standards for benthic impacts under salmon farms, which shall include the benthic indicator 'trigger level' above which the farm would not be in full compliance with the local standard, where this is clearly defined, or with its intent where it is not clearly defined.* *• Chart an allowable sediment impact zone that shall not exceed the total area of the farm plus a boundary zone of 40 m around it for contiguous (steel) cages and 25 m for circular cages that are set out individually. The footprint may be shifted in any direction to account for normally occurring uneven current patterns, as long as the total area remains the same.* *• Monitor the organic buildup on the seabed within this zone by the method deemed best for the type of sediment that exists there. The choice of method shall be justified by prior documentation of the type of sediments over which the farm is located.*	Applied average country data: Standard does not set a limit.
Capture-Based Aquaculture (CAP) No relevant criteria	No standard
Copper-Based Antifoulants (COP) *If any farm nets are treated with copper or other toxicant-based antifouling materials, cleaning procedures shall collect, treat and dispose of wash water in compliance with national regulations regarding collection, treatment and disposal of such toxic wastes.*	Applied standard's criteria and reduced copper use by 20% for on land net-cleaning.
The applicant shall have a written waste reduction plan and be able to demonstrate compliance with it, including annual reduction by at least 20% in the use of toxicant-based antifoulants per ton of fish produced.	Applied average country data: Standard only applies to future goals.
The use of toxicant-based antifoulants will no longer be allowed in BAP certified farms once the utility of alternatives is full established. This will be a priority consideration at the first review of these...	Applied average country data: Standard only applies to future goals.
Ecological Energy (ECOE) *Although a BAP standard for feed conversion has not been established, producers should strive to reduce their facilities' feed conversion ratios as low as practicable.*	Applied average country data: Standard does not set a limit.
Escapes (ESC) *• BAP certification shall be suspended if three or more escapes of more than 500 fish from individual cages are documented over two consecutive production cycles, or if such escapes cumulatively exceed 5,000* *BAP certification shall also be suspended if there is a single escape of more than 5,000 fish at any time, which shall be reported to GAA immediately to the regulator with GAA being notified accordingly.* *The applicant shall provide documents to show that the variance between the projected and actual harvest numbers of fish from the last year class harvested was less than +/- 3% after accounting for known losses.*	Applied standard's criteria: *Single event loss of 3,300 fish per year (assumed 18-month production cycle so 5,000 fish per production cycle)*

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Global Aquaculture Alliance

Sustainability of Feed (FEED) *...obtain documents from their feed suppliers that state all non-marine ingredients used at inclusion rates over 10% and all marine-derived ingredients used at inclusion rates over 1% are traceable to their sources.*	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
After June 1, 2015, at least 50% of the fishmeal and fish oil derived from reduction fisheries shall come from approved certified sources.	Applied average country data: Standard only applies to future goals.
(Future critical standard.) After June 1, 2015, at least 50% of the fishmeal or fish oil derived from fishery by-products such as trimmings and offal shall come from approved certified sources.	Applied average country data: Standard does not set a limit.
The facility shall calculate and record FCR for each year class. ***Equation 1:*** *Feed-conversion ratio (year class) =* *Total feed use (mt) ÷ total harvested fish weight – weight of smolts (mt).*	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
From 2011, BAP certified salmon producers shall obtain a FIFO ratio below 2.0, and by 2016 obtain a FIFO ratio below 1.5. ***Equation 2****: Fish in: fish out ratio = Feed fish inclusion factor of feed (from manufacturer) x Feed-conversion ratio. Where feed fish inclusion factor = {Level of fishmeal in diet (%) + Level of fish oil in diet (%)] ÷ [Yield of fishmeal from wild fish (%) + Yield of fish oil from wild fish (%)]. The transformation yields for industrial fish to fishmeal and fish oil should be 22.5% and 5.0%, respectively. Achieve a final fish in: fish out ratio of 2.5 or less for the most recent year class harvested.*	Applied standard's criteria: *Used the cut off value of 2.0 for Fish in: Fish out as the transfer coefficient value*
Industrial Energy (INDE) *Although a BAP standard for feed conversion has not been established, producers should strive to reduce their facilities' feed conversion ratios as low as practicable.*	Applied average country data: Standard does not set a limit.

Parasiticides (PARA) *If used, drug treatments shall be based on recommendations and authorizations overseen by the fish health professional...*	Applied average country data: Standard does not set a limit.
Antibiotics or chemicals banned in the producing or importing country shall not be used in feeds or any treatment that could result in harmful residue in fish.	Applied standard's criteria: Same as country regulations so same as average country data
Documentation shall be available that states all fish in the farm have been grown from smolts reared without the use of banned medicines such as Malachite Green or other substances prohibited in food animals.	Applied standard's criteria: *Removed Malachite Green from parasiticides*
Pathogens (PATH) *The applicant shall record data on disease outbreaks and actions taken so this information can be made available to the BAP database, when it is established.*	Applied average country data: No standard

GLOBALG.A.P. (Atlantic salmon)

Source: *GLOBALG.A.P. Control Points and Compliance Criteria Integrated Farm Assurance-Aquaculture module-Final Version 4.0 March 2011*

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *Medicines applied shall not contain one or more of the following compounds: Nitrofurans (or its derivates), Triarylmethane dyes (including, but not limited to Malachite Green, Crystal violet and Brilliant green), Stilbenes (including, but not limited to Stilbene, Dienestrol, Diethylstilbestrol, Hexoestrol), Chloramphenicol, Nitroimidazoles (including, but not limited to Dimetridazole, Ipronidazole, Metronidazole) or ß- agonists (including, but not limited to Clenbuterol).*	Applied standard's criteria: Any prohibited chemicals listed in standards were removed.
Biochemical Oxygen Demand (BOD) *The farm must have a risk based monitoring and control system for water quality in place...temperature, dissolved oxygen, carbon dioxide, dissolved nitrogen (saturation), pH, ammonia, nitrate, nitrite, suspended solids.*	Applied average country data: Standard does not set a limit.
Capture-Based Aquaculture (CAP) *No wild-captured seedlings fished stock is allowed...*	Applied standard's criteria: Same as country regulations so same as average country data
Copper-Based Antifoulants (COP) *Records must be kept for each net documenting age, condition, types and dates of treatments/handling, location, net inspection records, divers observations and records of corrective actions that have been taken according to results of monitoring operations.*	Applied average country data: Standard does not set a limit.
Ecological Energy (ECOE) No relevant criteria.	Applied average country data: No standard
Escapes (ESC) *...Net mesh size must be appropriate for the fish size to prevent escapes and risk of injuries to the fish...Prefer native species and utmost precaution must be in place to prevent escapes...*	Applied average country data: Standard does not set a limit.

- Set a measurable standard
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Sustainability of Feed (FEED) *At least 50% of the protein originating from marine wild fish must come from cut-off waste.*	Applied standard's criteria: *50% off cuts for feed species list*
For compound feed recognized through option iii), a letter stating the origin of fishmeal and fish oil must be present at the farm level, including country, species and confirmation no IUCN Redlist species are included in this raw material (refer to GLOBALG.A.P. Compound Feed Manufacturing - CFM Standard criteria, under section "Feed Ingredients Specifications and Risk Assessment")	Applied standard's criteria: Same as country regulations so same as average country data
The inclusion of animal protein in the HACCP study must address the legal requirements of the country of production and the country of destination.	Applied standard's criteria: Same as country regulations so same as average country data
Industrial Energy (INDE) *The Energy Policy for all farms must be in place and must demonstrate objectives to be implemented and steps taken to ensure and improve energy efficiency. Evidence is obtained by inspection that maintenance schedules are implemented to ensure fuel and energy efficiency.*	Applied average country data: Standard does not set a limit.
Parasiticides (PARA) *Medicines applied shall not contain one or more of the following compounds: Nitrofurans (or its derivates), Triarylmethane dyes (including, but not limited to Malachite Green, Crystal violet and Brilliant green), Stilbenes (including, but not limited to Stilbene, Dienestrol, Diethylstilbestrol, Hexoestrol), Chloramphenicol, Nitroimidazoles (including, but not limited to Dimetridazole, Ipronidazole, Metronidazole) or ß- agonists (including, but not limited to Clenbuterol).*	Applied standard's criteria: Any prohibited chemicals listed in standards were removed.
Pathogens (PATH) *...As a minimum the diseases stipulated as notifiable by the O.I.E. must be notified...*	No standard

Label Rouge (Atlantic salmon, Turbot)

Source: *GLOBALG.A.P Control Points and Compliance Criteria Integrated Farm Assurance-Aquaculture module-Final Version 4.0 March 2011*

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *No standards available online*	Applied average country data: No standard
Biochemical Oxygen Demand (BOD) *No standards available online*	Applied average country data: No standard
Capture-Based Aquaculture (CAP) *No standards available online*	Applied average country data: No standard
Copper-Based Antifoulants (COP) *No standards available online*	Applied average country data: No standard
Ecological Energy (ECOE) *No standards available online*	Applied average country data: No standard
Escapes (ESC) *No standards available online*	Applied average country data: No standard
Sustainability of Feed (FEED) *No standards available online*	Applied average country data: No standard
Industrial Energy (INDE) *No standards available online*	Applied average country data: No standard
Parasiticides (PARA) *No standards available online*	Applied average country data: No standard
Pathogens (PATH) *No standards available online*	Applied average country data: No standard

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
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- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Marks & Spencer (Atlantic salmon)

Source: *Code of Practice for Salmon Select Farms Saltwater January 2006*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *Only medicines licensed for use with Atlantic salmon by DEFRA may be used... medicines approved under cascade authority may be used.*	Applied standard's criteria: Same as country regulations, applied dosage amounts for listed substances
Biochemical Oxygen Demand (BOD) *Sites should have good levels of dissolved oxygen all year round...*	Applied average country data: Standard does not set a limit.
...The substrate immediately under cages must be monitored...	Applied average country data: Standard does not set a limit.
Capture-Based Aquaculture (CAP) No relevant criteria	Applied average country data: No standard
Copper-Based Antifoulants (COP) *Ideally, chemicals should not be used for net cleaning or anti-fouling...*	Applied average country data: Standard does not set a limit.
Ecological Energy (ECOE) No relevant criteria	Applied average country data: No standard
Escapes (ESC) *Each farm must have a documented escape prevention plan and provide details of regular maintenance of all nets and moorings...*	Applied average country data: Standard does not set a limit.
Sustainability of Feed (FEED) *Fish feed must only be sourced from approved feed companies...*	Applied average country data: Standard does not set a limit.
Industrial Energy (INDE) No relevant criteria	Applied average country data: No standard
Parasiticides (PARA) *Use of ivermectin is prohibited.*	Applied standard's criteria: Removed any use of ivermectin
Only medicines licensed for use with Atlantic salmon by DEFRA may be used... medicines approved under cascade authority may be used.	Applied standard's criteria: Same as country regulations, applied dosage amounts for listed substances
Pathogens (PATH) No relevant criteria.	Applied average country data: No standard

Naturland (Atlantic salmon)

Source: *Naturland Standards for Organic Aquaculture 2009 (sections II and III)*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *Use of conventional medicine is only permitted in vertebrates and after detailed diagnosis and remedial prescription by a veterinarian. In this case, at least twice the legally prescribed waiting period must be observed...*	Applied average country data: Standard does not set a limit.
Biochemical Oxygen Demand (BOD) *At least once a year the level of nutrient load in the discharge water shall be measured during the regular operative intensity. Measurement of BOD5-value or KMnO4 consumption*	Applied average country data: Standard does not set a limit.
Capture-Based Aquaculture (CAP) No relevant criteria	Applied average country data: No standard
Copper-Based Antifoulants (COP) *...Use of chemical "anti-fouling" agents is prohibited.*	Applied standard's criteria: *Zero use of antifoulants*
Ecological Energy (ECOE) *The animal components in feed shall, where acceptable..., be replaced by vegetable products...the proportion of animal components in the feed shall be lower than 100%.*	Applied standard's criteria: *99% to fish and 1% to plant*
Escapes (ESC) *...negative impact caused by effluents as well as by escape of animals shall be prevented by adopting suitable preventive measures.*	Applied average country data: Standard does not set a limit.
Sustainability of Feed (FEED) *All feed originating from wild marine fauna has to be harvested in compliance with internationally established sustainability standards (e.g., FAO Code of Conduct23, ICES24)...* *...The following sources are permitted: Fishmeal/-oil from fisheries certified independently as sustainable...Fishmeal/-oil from trimmings of fish processed for human consumption. Fishmeal/-oil from by-catches of captures for human consumption.*	Applied average country data: Standard does not set a limit.
The use of fishmeal/-oil...maximum 30% of total fishmeal/-oil, referring to total life-span of fish.	Applied standard's criteria: Same as country regulations so same as average country data
Industrial Energy (INDE) *The animal components in feed shall, where acceptable..., be replaced by vegetable products...the proportion of animal components in the feed shall be lower than 100%.*	Applied standard's criteria: *99% to fish and 1% to plant*
Parasiticides (PARA) *For controlling sea lice in marine net cages, stocking with wrasse as "cleaner fishes" is recommended.*	Applied average country data: Standard does not set a limit.
Pathogens (PATH) No relevant criteria	Applied average country data: No standard

Organic Food Federation (Atlantic salmon)

Source: *Organic Food Federation Book 6 Aquaculture Standards Salmonids*

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *Restricted: The use of antibiotics in clinical cases where no other remedy would be effective or after major trauma as a consequence of surgery or accident*	Applied average country data: Standard does not set a limit.
Biochemical Oxygen Demand (BOD) *Sea water - grade 1 quality sites with minimal threat of pollution. Dissolved oxygen – min 7 mg/l or 80% air-saturated value, 90% of the time. Salinity – min 40 psu (percentage salinity units) pH – between 7 and 9. Dissolved available inorganic nitrogen – max 168 ug/l (winter values). Dissolved available inorganic phosphorus – max 6.2 ug/l (winter values). Chlorophyll-a – max 10 ug/l. Current speed – moderate (mean flush rate 5+ cm/sec) to strong (mean flush rate 10+ cm/sec). At some stage of the tidal cycle the current speed should exceed 1 body length/sec.*	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
Capture-Based Aquaculture (CAP) No relevant criteria	Applied average country data: No standard
Copper-Based Antifoulants (COP) *Prohibited: Copper-based and other toxic anti-foulants.*	Applied standard's criteria: *Zero use of copper-based antifoulants*
Ecological Energy (ECOE) *Fishmeal or other processed ingredients derived from the same species or from farmed salmonids or terrestrial animals.*	Applied standard's criteria: Same as country regulations so same as average country data
Escapes (ESC) *The risk of escaped stocks from confined systems must be kept to an absolute minimum by appropriate strategies and comprehensive measures.*	Applied average country data: Standard does not set a limit.
Sustainability of Feed (FEED) *...The balance not derived from such by-product must be derived from wild marine resources independently certified as sustainable or approved by a recognised control authority (such as through the Marine Stewardship Council).*	Applied average country data: Standard does not set a limit.
High-energy diets (defined as more than 28% oil) aimed at enhancing fish production or fast tracking.	Applied standard's criteria: *28% fishoil*
Prohibited: Fishmeal from dedicated fishmeal harvesting and manufacturing operations that are not independently certified as sustainable...	Applied average country data: Standard does not set a limit.

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Industrial Energy (INDE) *Fishmeal or other processed ingredients derived from the same species or from farmed salmonids or terrestrial animals.*	Applied standard's criteria: Same as country regulations so same as average country data
Parasiticides (PARA) *Restricted: Treatment for tape worm, Formalin, Benzalkonium chloride (BZK)... Prohibited:...Malachite Green (for treatment of water and fish), Synthetic pesticides, including organophosphate, pyrethroid and ivermectin products...*	Applied standard's criteria: Removed any prohibited substances
Pathogens (PATH) *If illness does occur, treatment should be directed at complementing the animal's natural powers of recovery and correcting the imbalance that created the disorder...*	Applied average country data: Standard does not set a limit

Salmon Aquaculture Dialogue (Draft) (Atlantic salmon)

Source: *Salmon Aquaculture Dialogue-Second draft standards for responsible salmon aquaculture 05/16/2011*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *Zero allowance for use of therapeutic treatments that include antibiotics or chemicals that are banned in any of the primary salmon producing or importing countries*	Applied standard's criteria: Same as country regulations so same as average country data
For any use of antibiotics listed as highly important for human medicine by the World Health Organization (WHO), demonstration that a risk assessment was conducted by the veterinarian prior to prescription and application	Applied average country data: Standard does not set a limit.
Allowance for use of antibiotics listed as critically important for human medicine by the WHO - 'none'	Applied standard's criteria: No antibiotics listed as critically important by WHO. The antibiotics listed as critically important were pulled out of the total amount used.
Allowance for prophylactic use of antimicrobial treatments *'none*	Applied standard's criteria: Same as country regulations so same as average country data
Biochemical Oxygen Demand (BOD) *Redox potential or sulphide levels in sediment outside of the Allowable Zone of Effect (AZE - 30 m) Redox potential > 0 millivolts (mV) Sulphide ≤ 1,500 microMoles / l*	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
Maximum percentage of weekly samples from 2.2.1 that fall under 1.85 mg/liter DO-5%	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
Weekly ave percent saturation of dissolved oxygen on farm >/= 60%.	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
Capture-Based Aquaculture (CAP) No relevant criteria.	Applied average country data: No standard.
Copper-Based Antifoulants (COP) *For farms that use copper-treated nets, evidence that nets are not cleaned or treated in situ in the marine environment*	Applied standard's criteria: *No in situ cleaning results in 20% reduction of copper leaching into environment so set copper/antifoulant use to 80%*
For any farm that cleans nets at on-land sites, evidence that net-cleaning sites have effluent treatment	Applied standard's criteria: *0% copper escape from net cleaning on land*
For farms that use copper nets or copper-treated nets, evidence of annual testing for copper level in the sediment outside of the AZE (According to methodology in Appendix 1, subsection 1)	Applied average country data: Standard does not set a limit.
In instances where the Cu concentration in the sediment exceeds 34 mg Cu/kg dry sediment weight, demonstration that the Cu concentration is consistent with reference sites and backgrounds levels	Applied average country data: Standard does not set a limit.
Evidence that the type of biocides used in net antifouling are approved according to legislation in the European Union, or United States, or Australia	Applied standard's criteria: Same as country regulations so same as average country data
Ecological Energy (ECOE) No relevant criteria	Applied average country data: No standard

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Salmon Aquaculture Dialogue (Draft)

Escapes (ESC) *Maximum number of escapes episodes (defined as involving 200 or more fish), with the exception of episodes that are clearly documented as being out of the farm's control-0 episodes in the most recent production cycle*	Applied standard's criteria: *Escape limit set to no more than 300 fish per production cycle (200 fish/year with 18 month production cycle) and these are farm level standards so applied to half of total number of farms to follow the precautionary approach* *Canada = 112 (225/2)* *Chile = 76 (153/2)* *Norway = 350 (700/2)* *U.K. = 105 (210/2)*
If a non-indigenous species is being farmed, evidence and documentation that the species is already widely used in commercial production locally by the standards release date; AND, one of the following is met: A) There is no evidence of establishment or impact in adjacent ecosystems, B) The species has been approved for aquaculture use by a process based on ICES code of practice on the introductions and transfers of marine organisms or comparable protocol	Applied standards criteria: Updated invasiveness questionnaire in Escapes indicator calculation
Sustainability of Feed (FEED) *Fish oil Forage Fish Dependency Ratio (FFDRo) for grow-out (calculated using formulas in Appendix IV, subsection 1), OR Maximum amount of EPA and DHA from direct marine sources (calculated according to Appendix IV, subsection 2) FFDRo <2.95 or (EPA + DHA) < 30 g/kg feed*	Applied standard's criteria: *Transfer coefficient set to 2.95*
Prior to achieving 4.3.1, the FishSource score for the fishery(ies) from which all marine raw material in feed is derived. (See Appendix IV, subsection 4 for explanation of FishSource scoring.) All individual scores ≥6, and biomass score ≥8	Applied standard's criteria and removed any species scoring below 6 overall and 8 for biomass
Feed containing fishmeal and/or fish oil originating from by-products or trimmings from fish species which are categorized as vulnerable, endangered or critically endangered, according to the IUCN Red List of Threatened Species.	Applied average country data: Standard does not set a limit.
Industrial Energy (INDE) *Presence of an energy use assessment verifying the energy consumption on the farm and representing the whole life cycle at sea (see Appendix V for guidance and required components of the records & assessment) measured in kilojoule/mt fish/production cycle*	Applied average country data: Standard does not set a limit.

Parasiticides (PARA) *Zero allowance for use of therapeutic treatments that include antibiotics or chemicals that are banned in any of the primary salmon-producing or -importing countries*	Applied standard's criteria and removed any banned chemicals (e.g., Malachite Green)
Maximum cumulative parasiticide treatment index (PTI) score calculated according to the formula : ∑(Average live weight of salmon at treatment in kg) PTI score < 6.8	
Pathogens (PATH) *Maximum mortality rate of farmed fish ≤20%, during at least two of the previous three production cycles. Farms applying for certification for the first time have to demonstrate mortality ≤20% for one production cycle prior to certification. This cycle then counts as the first of the three consecutive production cycles for this. They will be evaluated under the standard going forward.*	Applied standard's criteria : *Maximum allowable mortality set to 20%*
Establishment of a maximum sea lice load for the entire ABM and for the individual farm that is based on regulatory requirements. In areas of wild salmonids, loads shall also be based on wild fish monitoring (see Standard 3.1.6) and incorporate a precautionary low maximum lice level just before and during outmigration. Option A: 0.1 mature female lice per farmed fish. Option B: 0.1 mature female lice per farmed fish if monitoring reveals lice levels in wild populations has exceed the thresholds described in Appendix III, subsection 2.	Applied standard's criteria: Removed sea lice as mortality-inducing pathogen
If exotic diseases and/or parasites are detected on the farm or in the hatchery, evidence of increased biosecurity measures that include restrictions on movement and evidence of strong disease management practices, including culling "required."	Applied average country data: Standard does not set a limit.

SIGES (SalmonChile) (Atlantic salmon)

Source: *Manual of Regulations and Best Practices SIGES SalmonChile-Version 2.0*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *...Antibiotics and vaccinations shall be administered according to the veterinarian...*	Applied average country data: Standard does not set a limit.
Biochemical Oxygen Demand (BOD) No relevant criteria	Applied average country data: No standard
Capture-Based Aquaculture (CAP) No relevant criteria	Applied average country data: No standard
Copper-Based Antifoulants (COP) *Farms shall not use anti-foulant containing as active components nondegradable or bio-cumulative toxic elements, in nets or other devices used in the activity.*	Applied standard's criteria: *Zero use of antifoulants*
Ecological Energy (ECOE) *Farms shall work to keep an economic conversion factor lower than or equal to 1.3.*	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
Escapes (ESC) *The organisation shall establish Best Practices of the company to prevent fish escapes, like the regular assessment and certification of facilities, equipment, nets; among others.*	Applied average country data: Standard does not set a limit.
Sustainability of Feed (FEED) *Farms shall work to keep an economic conversion factor lower than or equal to 1.3.*	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
Industrial Energy (INDE) *Farms shall work to keep an economic conversion factor lower than or equal to 1.3.*	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
Parasiticides (PARA) No relevant criteria	Applied average country data: No standard
Pathogens (PATH) *Sea and estuary farms shall have a SRS, IPN, BKD and/or other pathology prevention documented programme, including strategies of vaccination or explaining the lack thereof.*	Applied average country data: Standard does not set a limit.

Soil Association (Atlantic salmon)

Source: *Soil Association Organic Standards January 2009*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	Data Used for Assessment
Antibiotics (ANTI) *Permitted...Antibiotics in clinical cases where no other treatment would work, or after major trauma such as surgery or accident, or with vet prescription...*	Applied average country data: Standard does not set a limit.
Biochemical Oxygen Demand (BOD) *You should: ensure your site is at least 5 km by sea from the nearest fish farm.*	Applied standard's criteria: *Calculated area of overlap using the 5 km radius*
Your operation must meet...dissolved oxygen—at least 80% air-saturated value for 90% of the time, dissolved available inorganic nitrogen—no more than 168_g/l (winter values), dissolved available inorganic phosphorus—no more than 6.2_g/l (winter values), pH - between 7 and 9, chlorophyll—no more than 10_g/l...	Applied average country data: Quantitative standard, however it cannot be translated to a GAPI indicator
Capture-Based Aquaculture (CAP) *You should, where possible, use stock that: occurs naturally in the area, or can easily adapt to the local environment, is bred extensively with minimum interference to the broodstock, is reared from your own breeding programme, is domesticated.*	Applied average country data: Standard does not set a limit.
Copper-Based Antifoulants (COP) *Prohibited: Copper-based and other toxic anti-foulants*	Applied standard's criteria: *Zero use of copper-based antifoulants*
Ecological Energy (ECOE) No relevant criteria	Applied average country data: No standard
Escapes (ESC) *Measures to prevent escapes and your plans to reduce the environmental impact if escapes occur...*	Applied average country data: Standard does not set a limit.
Sustainability of Feed (FEED) *Commercially produced compound or blended feeds must be certified by Soil Assoc...Use aquatic ingredients...we recognise as independently certified as sustainable (such as by the Marine Stewardship Council), or failing that, made from the by-products of wild-caught fish for human consumption*	Applied standard's criteria: For feed species only used MSC-certified species from the standard country data
Must not use high-energy diets (more than 28% oil) to increase production or fast track.	Applied standard's criteria: Same as country regulations so same as average country data
Industrial Energy (INDE) No relevant criteria	Applied average country data: No standard
Parasiticides (PARA) *With our permission...you may use licensed emamectin benzoate or cypermethrin-based treatments...You must not use:...benzalkonium chloride (BZK), synthetic pesticides or veterinary treatments including organophosphate and avermectin-based products, or any veterinary medicines not allowed in these standards.*	Applied standard's criteria: Removed any prohibited substances.
Pathogens (PATH) No relevant criteria	Applied average country data: No standard

U.S. National Organic Standard (Proposed)
(Atlantic cod, Atlantic salmon, Cobia)

Source: *NOSB Proposed Organic Aquaculture Standards Fish Feed 2008 & Aquaculture Standards Recommendation National Organic Standards Board March 29, 2007*

- Set a measurable standard
- Set a quantitative standard, but it couldn't be translated into GAPI
- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	**Data Used for Assessment**
Antibiotics (ANTI) *The producer of organic aquaculture products must not: sell, label, or represent as organic any aquatic animal or edible product derived from any aquatic animal treated with antibiotics, any substance that contains a synthetic substance not allowed under § 205.611, or any substance that contains a nonsynthetic substance prohibited in § 205.612; (p. 5)* *When preventive practices and veterinary biologics are inadequate to prevent disease, a producer may administer synthetic medications, provided that such medications are allowed under § 205.611. (1) parasiticides allowed under § 205.611 may be used on aquatic broodstock, but none that are to be sold, labeled, or represented as organically produced; (p 5)* *205.611- In accordance with restrictions specified in this section the following synthetic substances may be used in organic aquatic livestock production: a) As disinfectants, sanitizer, and medical treatments as applicable. b) As topical treatment, external parasiticide or local anesthetic as applicable. (f) Excipients, only for use in the manufacture of drugs used to treat organic livestock when the excipient is: Identified by the FDA as Generally Recognized As Safe; Approved by the FDA as a food additive; or Included in the FDA review and approval of a New Animal Drug Application or New Drug Application. (p. 9)*	Applied standard's criteria of zero use of antibiotics
Biochemical Oxygen Demand (BOD) *...Monitoring...temperature, pH, salinity,photoperiod, dissolved oxygen, ammonia, and nitrite concentrations, without sudden changes or prolonged exposure to extremes (p. 6)*	Applied average country data: Standard does not set a limit.
Aquaculture facility must include a suitable waste management approach which must: *i. Meet a performance target of recycling a minimum of 50% of nutrients (Nitrogen and Phosphorus).* *ii. Have discharge levels that meet all local, state, federal or territorial requirements for nutrient discharge into water way to minimize or even improve the immediate or surrounding environment. (p. 7)*	Applied standard's criteria: *Reduced N portion of the BOD score by 50%*
(9) In all cases, benthic habitats surrounding net pens must be shown to not have significant measurable changes in chemistry and biodiversity. (p. 8)	Applied average country data: Standard does not set a limit.
Capture-Based Aquaculture (CAP) *...broodstock may be collected from the wild provided that they are collected in a sustainable manner, and where appropriate, in collaboration with government agencies...*	Applied average country data: Standard does not set a limit.
Copper-Based Antifoulants (COP) *ii. Except as may be provided in § 205.609 through § 205.612, chemical-treatment of bio-fouling organisms on nets is not allowed. iii. Copper based anti-fouling materials are prohibited from use (p. 8)*	Applied standard's criteria: *Zero use of antifoulants*
Ecological Energy (ECOE) *The aquaculture working group proposes these draft standards with a prohibition on the use of by-products of terrestrial animal processing in feed as is the case with livestock.*	Applied average country data: Standard only applies to future goals.
(a) Fish meal and fish oil from wild-caught fish and other wild aquatic animals, Except if produced from environmentally responsible food grade wild-caught fisheries and fed in the following step-wise levels: a maximum combined total of 25% during year 1 through 5 after this regulation is implemented,..	Applied standard's criteria: *A maximum of 25% fish in feed*
Escapes (ESC) *Only native fish of local genotype shall be cultured. Non-native species or native species with significant genetic divergence compared to wild stock (i.e., due to selective breeding or other processes) may not be certified as organic if produced in net pens. (p. 8)*	Applied standard's criteria: Adjusted the Invasiveness questionnaire to reflect native species only.
Operations with escapes greater than 0.5% of cultured stock (within any containment device) over the course of a grow out season shall have their organic status revoked.(p. 8)	Applied standard's criteria: *A limit of 0.5% of cultured stock for maximum allowable escapes rate*

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U.S. National Organic Standard (Proposed)

Sustainability of Feed (FEED) *Fish meal or fish oil may not be sourced from any fishery classified by relevant state/provincial, national, or international fisheries authorities as follows: "at risk of reduced reproductive capacity;" "suffering reduced reproductive capacity;" "harvested outside precautionary limits;" "over-exploited;" "depleted;" "over-fished;" "overfishing is occurring;" or any other comparable classification, or at significant risk of those conditions within the next recruitment cycle.*	Applied standard's criteria: Removed any species with FAO codes of overexploited or depleted
The following nonsynthetic substances may not be used in organic aquatic animal production: *(a) Fish meal and fish oil from wild-caught fish and other wild aquatic animals, Except if produced from environmentally responsible food grade wild-caught fisheries and fed in the following step-wise levels: a maximum combined total of 25% during year 1 through 5 after this regulation is implemented, a maximum combined total of 15% during year 6 through 8, and a maximum combined total of 10% during year 9 through year 10, and a maximum combined total of 5% during year 11 and 12, with the percentages by weight of feed being averages over the production cycle of the aquatic animal.* *(1) fish meal and fish oil may not be stabilized with synthetic stabilizers unless allowed on §205.611* *(b) Feed from forage fisheries (p. 9)*	Applied average country data: Standard only applies to future goals.
Industrial Energy (INDE) *...proposes...prohibition on the use of by-products of terrestrial animal processing in feed as is the case with livestock.*	Applied average country data: Standard only applies to future goals.
(k) Open water net pens and enclosures are permitted in situations where water depth, current velocities and direction, stocking densities, and other factors act to adequately disperse metabolic products in order to minimize any negative impacts on the environment in areas surrounding the pen location(s). The net pens must be situated in such manner that avoids migratory routes of native species and does not disturb reproductive patterns of local wild fish populations, as well as the habits of other local species like predators and birds and any other flora or fauna. (p. 7)	Applied standard's criteria: *Use of open net pens*
(a) Fish meal and fish oil from wild-caught fish and other wild aquatic animals, Except if produced from environmentally responsible food grade wild-caught fisheries and fed in the following step-wise levels: a maximum combined total of 25% during year 1 through 5 after this regulation is implemented,	Applied standard's criteria: *A maximum of 25% fish in feed*

Parasiticides (PARA) *...Producer may not administer synthetic parasiticides except as allowed under § 205.611...(p. 5)*	Applied standard's criteria of zero use of parasiticides
205.611- In accordance with restrictions specified in this section the following synthetic substances may be used in organic aquatic livestock production: *a) As disinfectants, sanitizer, and medical treatments as applicable.* *b) As topical treatment, external parasiticide or local anesthetic as applicable.* *(f) Excipients, only for use in the manufacture of drugs used to treat organic livestock when the excipient is: Identified by the FDA as Generally Recognized As Safe; Approved by the FDA as a food additive; or Included in the FDA review and approval of a New Animal Drug Application or New Drug Application. (p. 9)*	Applied standard's criteria of zero use of parasiticides
Pathogens (PATH) *Whether or not diseased fish are treated, they may not be sold as organic. (p. 5)*	Applied standard's criteria: *Zero percent mortality due to disease*
Producers must implement measures to prevent transmission of diseases and parasites between cultured and wild aquatic animals and must: *i. Site net pens in such a manner as to prevent contamination and disease from conventional fish pens or native fish populations taking into account factors like current and seasonal changes.* *ii. Consider buffer zones for other potential sources of contamination by any substances not allowed in organic production. (p. 8)*	

Whole Foods Market (Atlantic cod, Atlantic salmon, European seabass, Gilthead seabream)

Source: *Whole Food Market Seafood Quality Standards Farm Standards for Finfish and Shrimp, July 1, 2008. Version 1.0* and *Whole Foods Market Seafood Quality Standards Farm Standards for Salmon 2008 Version 2.0*

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- No relevant standard
- No measurable limit of impact
- Standard set at conventional level, applied standard's criteria but same as industry or country standard practices

Relevant Initiative Criteria *(excerpted from source)*	**Data Used for Assessment**
Antibiotics (ANTI) *No antibiotics permitted...*	Applied standard's criteria: *Zero use of antibiotics*
Biochemical Oxygen Demand (BOD) *Calculate total nitrogen and phosphorus inputs in the form of feed (kg nitrogen/mt of fish produced in 1 year).* *Load of nutrient x, kg/ton = {[(total feed used, kg/yr) x (concentration of nutrient in feed, presented as a decimal fraction)] – [(biomass of fish harvested per year, t) x (concentration of nutrient in the biomass, presented as a decimal fraction)]} / Annual production* ***(Atlantic Salmon)*** *Farms must be sited at adequate distances from other salmon farms...* ***(Finfish and Shrimp)*** *Record total annual farm discharge, m3/year (amount of water discharged from farm annually).* *• Calculate load of variable. Load of variable (kg/yr) = farm discharge in m3/year x annual concentration of variable (mg/L or g/m3) x 103 kg/g*	Applied average country data: Standard does not set a limit.
Capture-Based Aquaculture (CAP) ***(Atlantic Salmon)*** *You should, where possible, use stock that is reared from your own breeding programme*	Applied average country data: Standard does not set a limit.
(Finfish and Shrimp) *...Wild-caught grow-out stock is prohibited...*	Applied standard's criteria: *Zero individuals removed from the wild*
Copper-Based Antifoulants (COP) ***(Atlantic Salmon)****...Whole Foods Market will purchase 50% or more salmon from farms with untreated nets by 2010.*	Applied standard's criteria: *50% use of copper-based antifoulants was applied across all countries to reflect Whole Foods Market standard.*
(Finfish and Shrimp) *Annual reporting on progress toward eliminating toxic anti-foulants on nets...*	Applied average country data: standard only applies to future goals
Ecological Energy (ECOE) *...Slaughterhouse by-products from avian or mammalian species are prohibited in feed....*	Applied standard's criteria: *Zero use of livestock in feed*
Escapes (ESC) ***(Atlantic Salmon)*** *Measures to prevent escapes and your plans to reduce the environmental impact if escapes occur...*	Applied average country data: Standard does not set a limit.
(Finfish and Shrimp) *For net pens/net cages: Detailed protocols for preventing escapes*	Applied average country data: Standard does not set a limit.
Sustainability of Feed (FEED) *Feed, including by-products of fish processing, cannot be sourced from fisheries determined by independent, peer-reviewed science to be overfished, over-exploited, depleted, or in decline. To reduce pressure on populations of wild fish, fish products used for feed will be preferentially sourced from by-products of fish processing.*	Applied standard's criteria: Removed any species with FAO scores of 3 or 4
...Use of "trash fish" for feed is prohibited.	Applied standard's criteria: Same as country regulations so same as average country data
(Atlantic Salmon)*...moving toward the target level of no greater than a 1:1 Fish In, Fish Out Ratio...*	Applied average country data: Standard only applies to future goals.
(Finfish and Shrimp) *Annual reporting on progress toward meeting Maximum Fish In, Fish Out ratios, Cod: 1:1...*	Applied average country data: Standard only applies to future goals.
Industrial Energy (INDE) *...Slaughterhouse by-products from avian or mammalian species are prohibited in feed....*	Applied standard's criteria: *Zero use of livestock in feed*

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Whole Foods Market

Parasiticides (PARA) ***(Atlantic Salmon)*** *Use of Malachite Green, crystal violet, Tributyltin compounds (TBT), and emmamectin benzoate at any stage of egg, smolt, or fish production or processing is prohibited*	Applied standard's criteria: Removed any prohibited substances
(Atlantic Salmon)*...Producers must cease using all synthetic parasiticides on fish destined for Whole Foods Market by July 1, 2012.*	Applied average country data: Standard only applies to future goals.
(Finfish and Shrimp) *Prohibited: Use of Malachite Green, crystal violet, and Tributyltin compounds (TBT) at any stage of egg, smolt, or fish production.*	Applied standard's criteria: Removed any use of Malachite Green from data
(Finfish and Shrimp)*...No parasiticide treatments allowed after July 1, 2013*	Applied average country data: Standard only applies to future goals.
Pathogens (PATH) ***(Atlantic Salmon)*** No relevant criteria	Applied average country data: No standard
(Finfish and Shrimp) *Farms must be sited appropriately to minimize the risks of disease or parasite transfer to wild aquatic life and ecosystems.*	Applied average country data: Standard does not set a limit

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