An Audit of the Management of Salmon Aquaculture for the Protection of Wild Salmon in British Columbia

Gareth Porter

For BC Pacific Salmon Forum

May 9, 2006

INTRODUCTION

This audit of the management of salmon aquaculture in British Columbia is based on a system of criteria and indicators that were developed in 2003 and revised in 2005 for the explicit purpose of gauging progress in seven member countries of the North Atlantic Salmon Conservation Organization (NASCO) in protecting wild salmon from the impacts of salmon aquaculture. The original scoring system consisted of ten criteria drawn from the 1994 Oslo Resolution ("The Convention for the Conservation of Salmon in the North Atlantic Ocean to Minimize Impacts from Salmon Aquaculture on the Wild Salmon Stocks").

That system of scoring was the basis for my report, *Protecting Wild Atlantic Salmon from Impacts of Salmon Aquaculture: A Country by Country Progress Report*, published by World Wildlife Fund and Atlantic Salmon Federation in 2003. That report compared the seven NASCO countries with Atlantic salmon aquaculture industries in regard to their relative progress in carrying out key provisions of the agreement.

Two years later, I was asked by WWF and ASF to do a second report that would reflect further progress that had been made since the initial report. In preparing for the follow-up report, I revised the system of criteria and indicators in effort to make it more accurate and useful. The revised scoring system altered the language of three criteria to reflect the language of the broader Williamsburg resolution, which had supplanted the Oslo Resolution. The second report, which had the same name as the first, also took into account criticisms of the original system as containing two pairs of criteria that were substantially overlapping in character.

The result was a scoring system with eight criteria falling into three broad areas for regulation. The first two have to do with the siting of aquaculture operations; the next three relate to regulation of fish husbandry and fish health, and the last three cover containment of fish at aquaculture sites.

The revised scoring system used in the second progress report is the basis for this "audit" of the regulation of British Columbia's salmon aquaculture industry in regard to protection of wild salmon. Obviously alternative systems of criteria and indicators could have been used to carry out such an audit. The advantage of this system, however, is that it does allow for comparison between the management of the salmon industry in British Columbia and that in other countries where Atlantic salmon is being farmed.

As with audits conducted on other jurisdictions, a draft of this report was shared with relevant officials of the federal government, the government of British Columbia and the salmon aquaculture industry, and the comments and suggestions of the Ministry of Agriculture and Lands (MAL) were considered and discussed before the final revision of the text. In response to that draft, MAL asserted that the situation of British Columbia's salmon industry is substantially different from that of the industry in other countries which have been covered in previous studies using this framework.

The most obvious difference is that the wild salmon stocks are Pacific salmon species; whereas the bulk of the production of farmed salmon are Atlantic salmon. There are nine anadromous salmonids species in BC, compared with four species of anadromous salmonids in Atlantic

region, and most wild species in BC have much larger adult populations than other jurisdictions with salmon farming industries, because virtually all streams and rivers in B.C. support some species of anadromous salmon, and because Pacific salmon species have life history strategies that contribute to larger population. This situation contrasts with that in European (and North American) jurisdictions in which relatively few streams support such species and where relatively few smolts of larger size are produced.[1]

The MAL asserts that the significance of ecological interaction with wild fish in B.C. is very low and the significance of genetic interaction with wild fish is "nonexistent for Atlantic salmon" and "likely low for Chinook due to low numbers."

The MAL also states that there were major differences between B.C. and other jurisdictions with Atlantic salmon aquaculture industries in regard to the risk of impacts of Infectious Hematopoietic Necrosis (IHN) and sea lice on wild fish. In a summary table the situation in regard to wild fish health is held to be minimal or nonexistent in B.C., in contrast to the situation in European jurisdictions. IHN in B.C. is said to move "to farms from wild fish, [but] does not transmit to wild fish." In European jurisdictions, on the other hand, MAL says, "Disease could move to and from farms, could infect wild fish with devastation effects."

MAL holds, in sum, that in B.C. sea lice "do not seriously affect farmed fish," whereas in European jurisdictions they "adversely affect farmed fish"

Although it is true that genetic and ecological interactions between farmed Atlantic salmon and Pacific salmon can be disregarded as a risk for wild salmon, interactions between farmed Coho and Chinook salmon, which represent 25 percent of salmon production in B.C., and wild salmon cannot be disregarded.

The MAL submission implies that Pacific salmon stocks remain healthy, in contrast to European salmon stocks. In fact, however, Fisheries and Oceans Canada (FOC) conceded in 2000 that Pacific salmon stocks along the West Coast of Canada have been "in sharp decline since the early 1990s." The decline of wild Coho and Chinook numbers has been particularly severe, and although the study by FOC scientists from the Pacific Biological Station does provide estimates, it appears that the decline in Chinook abundance from 1977 and 1999 was in the neighborhood of 90 percent.[2]
If Pacific salmon stocks, and especially the wild salmon species corresponding to the two Pacific salmon species being farmed in B.C., are in serious decline and suffering from a genetic contamination from hatchery fish that may have made it more vulnerable to various threats, then the contrast between B.C. and most European jurisdictions is far less dramatic. The numbers of Pacific and Atlantic salmon being produced, moreover, are of the same order of magnitude.[3]

---

[1]MAL, "Differences between BC and Other Jurisdictions in Wild Salmon Stocks and Their Need for Protection," April 5, 2006.
[2] Donald J. Noakes, Richard J. Beamish and Michael L. Kent, "On the decline of Pacific salmon and speculative links to salmon farming in British Columbia", *Aquaculture* 183 (2000): 363-386.Estimate of decline for Chinook is from Carl Walters and Josh Korman, *Salmon Stocks* (Pacific Fisheries Resources Conservation Council, June 1999), p. 13.
[3] Ministry of Agriculture and Lands escape statistics, 1957-2003, http://www.agf.gov.bc/fisheries/escape/escape_reports.htm

The flat statement that IHN "does not transmit to wild fish" appears to go beyond what is known from scientific evidence. The Pacific Biological Station was planning to conduct experiments in spring 2004 on the susceptibility of all Pacific salmon species to IHNV and to "assess the risk of IHNV transfer from farmed Atlantic salmon to wild populations."[4] However, no data from such experiments was available for this review.

The comparison of sea lice in B.C. and in European jurisdictions avoids the central issue of transmission of sea lice from fish farms to wild salmon stocks. To compare the degree of impact of sea lice on the farmed salmon tells us nothing about the degree of risk to wild salmon stocks in B.C. and in other jurisdictions.

One study comparing the abundance of sea lice on adult wild Pacific salmon caught in Queen Charlotte Strait and Smith and Rivers Inlet in 2004 found little evidence of scale loss or skin damage.[5] However it has long been understood that the real danger from sea lice is to out-migrating smolts, not to adult wild salmon.

This audit is based, therefore, on the premise that B.C. obviously differs from other jurisdictions on various dimensions in varying degrees, but that there are no geographical or other characteristics of B.C. salmon aquaculture that set it completely apart insofar as the applicability of the norms and standards forming the basis of the scoring system.

[4] E-mail from Garth Traxler, February 15, 2004.
[5] R. J. Beamish, C. M. Neville, R. M. Sweeting and N. Ambers, "Sea Lice on adult Pacific salmon in the costal waters of Central British Columbia," *Fisheries Research* 76 (2005): 198-208.

THE SCORING SYSTEM

(Paragraph of the Williamsburg Resolution on which the criterion is based are indicated in brackets)

Criterion 1: Adoption of a siting policy aimed at keeping aquaculture at a safe distance from salmon rivers [Annex 2, paragraph 1.1 and 1.2; Article 8; Annex 6]

Indicators and Results

An adequate minimum distance or exclusion zone is adopted which will help protect more than one salmon river: 10 points

A minimum distance or exclusion zone is adopted which with help protect one salmon river: 5 points

A minimum distance or exclusion zone is adopted which may help reduce the risk to salmon in more than one salmon river: 3 points

A minimum distance or exclusion zone is adopted which may help reduce risk to salmon in one salmon river: 2 points

No minimum distance or exclusion zone has been adopted: 0 points

---

Criterion 2: Degree to which cumulative environmental impacts of salmon farming on an entire bay or other ecosystem are considered in siting decisions [Annex 2, paragraph 1.4]

Indicators and Results

Siting approval regulations require that cumulative impacts of aquaculture operations on the entire ecosystem are taken into account, or policy decisions have been taken to limit or exclude aquaculture operations from a given area, based on scientific study of carrying capacity: 10 points

Siting approval regulations require that cumulative impacts of aquaculture operations on the entire ecosystem are taken into account, but not based on scientific study of carrying capacity: 5 points

Siting approval regulations provide for studies of cumulative impacts in the entire ecosystem under some circumstances, but do not require them: 3 points

No consideration has been given to cumulative impacts on aquaculture operations on the entire ecosystem in siting approval: 0 points

---

Criterion 3: Adequacy of standards for fish husbandry, including best industry practices in regard to year-class separation, fallowing of sites and maximum stocking densities [Annex 2, paragraph 1.4 and 2.1]

Indicators and Results

Regulations or industry codes of practice require best husbandry practices on year class separation, fallowing of sites and stocking densities: 10 points

Regulations or industry codes of practice do not require best husbandry practices on one of the three issues: 7 points

Regulations or industry codes of practice do not require best husbandry practices on two of the three issues: 4 points

Regulations or codes of practice do not require best husbandry practices on any of the three issues: 0 points

---

Criterion 4: Adequacy of monitoring and enforcement of best practices in fish husbandry [Annex 2, paragraph 1.4 and 2.1]

Indicators and Results

Authorities carry out on-site monitoring of compliance with requirements or industry codes of practice for fish husbandry and have appropriate and transparent penalties for non-compliance: 10 points

Authorities do not carry out on-site monitoring of compliance with requirements or industry codes of practice for fish husbandry, but do require industry reporting on compliance and have appropriate and transparent penalties for non-compliance: 5 points

Authorities carry out on-site monitoring or require industry reporting on compliance with requirements or industry codes of practice, but do not have appropriate and transparent penalties for non-compliance: 3 points

No system exists for regularly monitoring or industry reporting on fish husbandry: 0 points

---

Criterion 5: Adequacy of practices and procedures for early detection of an outbreak of any disease or parasitic infection likely to affect Atlantic salmon and rapid response to such an outbreak [Annex 2, paragraphs 2.1-2.5]

Indicators and Results

Regulations include mandatory frequent testing/counting for ISA or other major fish disease and sea-lice by appropriate authorities using specified procedures, and mandatory, automatic disease or sea-lice control actions upon clinical identification of the ISA virus or other major fish disease or of sea-lice numbers exceeding the maximum: 10 points

Regulations include mandatory frequent testing for both the ISA virus or other major fish disease and parasites but not automatic, mandatory actions triggered by clinical detection of ISA virus or other major fish disease or of sea-lice counts above a specified level, or vice versa, or both mandatory testing and mandatory actions for major fish disease but not for sea-lice: 5 points

Regulations include only one of the two elements for either fish disease or other major fish disease sea-lice and neither for the other: 2.5 points

There are no mandatory requirements for detection or actions upon detection for either ISA virus or sea-lice: 0 points

---

Criterion 6: Adequacy of national plans for minimizing escapes in regard to equipment and structures [Annex 3, sections 3 and 4, and 7]

Indicators and Results

Plans include technical standards for aquaculture systems regarding stock containment reflecting industry best practices, as outlined in Annex 3, section 4: 10 points

Plans provide standards for aquaculture systems regarding stock containment, but the standards do not reflect best industry practices: 3 points

Plan does not provide for any technical standards for aquaculture systems: 0 points

---

Criterion 7: Adequacy of national plans for minimizing escapes in regard to management operations, site-specific contingency plans and notification of escapes [Annex 3, Sections 5 and 6 and 7]

Indicators and Results

Plans include standards for management systems and site-specific escape prevention plans reflecting best industry practices, site-specific escaped fish recovery plans and mandatory notification of complete details of escapes: 10 points

Plans include two of the three elements above: 7 points

Plans include one of the three elements above: 3 points

Plans do not include any of the three elements: 0 points

Criterion 8: Adequacy of monitoring in order to assess compliance with the national plan and to verify the plan's efficacy [From Williamsburg Annex 3, subparagraphs 7.2.3]

Indicators and Results

Authorities carry out on-site monitoring to verify compliance with all the containment measures in Criteria 6 and 7: 10 points

Authorities carry out on-site monitoring of most but not all containment measures in Criteria 6 and 7: 7 points

Authorities carry out on-site monitoring for only one or two of the containment measures in Criteria 6 and 7: 3 points

Authorities do no on-site monitoring of any of the containment measures in Criteria 6 and 7: 0 points

SCORING BY CRITERION

Criterion 1:

Adoption of a siting policy aimed at keeping aquaculture at a safe distance from salmon rivers.

B.C. regulations governing the siting of salmon aquaculture operations have long required that the fish farm must be "at least 1 km from the mouth of a salmonid-bearing stream determined as significant in consultation with DFO and the province."[6] That required distance was reviewed by the Salmon Aquaculture Review of 1997 and was considered to be inadequate.
The Review recommended that the government "should prohibit farms with Pacific salmon from being located near streams with sensitive wild stocks." [7]

A workshop of the federal Department of Fisheries and Oceans habitat scientists in 1998 noted that siting criteria which had been adopted in B.C. to protect vulnerable wild fish stocks were not scientifically based. After reviewing the workshop's findings, the Department's Pacific Scientific Advice Review Committee confirmed that siting criteria should be based on scientific evidence. Although the Department undertook scientific studies on specific areas as the basis for more credible criteria, moreover, those studies did not consider the impacts on wild salmon in the vicinity of net pens.[8]

The B.C. Ministry of Agriculture, Food and Fisheries (renamed Ministry of Agriculture and Lands MAL) pledged in 2002 to "determine an appropriate distance to locate farms from streams."[9] However, no change has been made in the regulations to increase the required distance. MAL indicated that "The Ministry review concluded that, lacking any evidence of negative impact, 1 km was adequate to protect streams."[10]

The argument that there is no evidence of impact on wild stocks from farmed salmon in B.C. depends on the validity of claims that there is no significant risk in B.C. salmon aquaculture of genetic or ecological interaction between farmed and wild salmon, or of any transmission of disease or of sea lice from farmed to wild salmon. As discussed in the introduction, however, some Pacific salmon stocks are in vulnerable a state and the degree of risk of each of these types of interaction is still incompletely understood.

MAL concedes that the BC regulation on minimum distance "was not determined strictly as a matter of scientific investigation," but argues that no other jurisdictions have based their minimum distances or exclusion zone policies on scientific studies. However, as documented in the previous report on six Atlantic salmon aquaculture jurisdictions, both Norway and Scotland have, in different degrees, undertaken studies of siting in which additional protection of wild

---

[6] "Criteria for siting new finfish aquaculture facilities," Ministry of Agriculture and Fisheries website, www.agf.gov.bc.ca/fisheries/Finfish/Provincial_Siting_Criteria_March_2000.pdf
[7] Salmon Aquaculture Review
[8] Auditor General of Canada, "The Effects of Salmon Farming in British Columbia on the Management of Wild Salmon Stocks," 2000, paragraphs 30.41 and 30.42.
[9] "Status of Salmon Aquaculture Review Recommendations," MAFF, January 9, 2002, http://www.agf.gov.bc.ca/fisheries/salmonreview_jan02.pdf
[10] Differences between BC and Other Jurisdictions in Wild Salmon Stocks and Their Need for Protection".

salmon was either the central consideration. In both cases, advocates for the wild salmon played roles in making decision on siting.[11]

In the case of British Columbia, an additional siting issue is the location of fish farms in relation to suspected migration routes. The Broughton Archipelago, for example, has the greatest concentration of fish farms in British Columbia, with 27 sites in 2003, of which 16 are located in sheltered inlets directly on wild salmon migratory passages to and from the sea.[12] (See Figure 1)

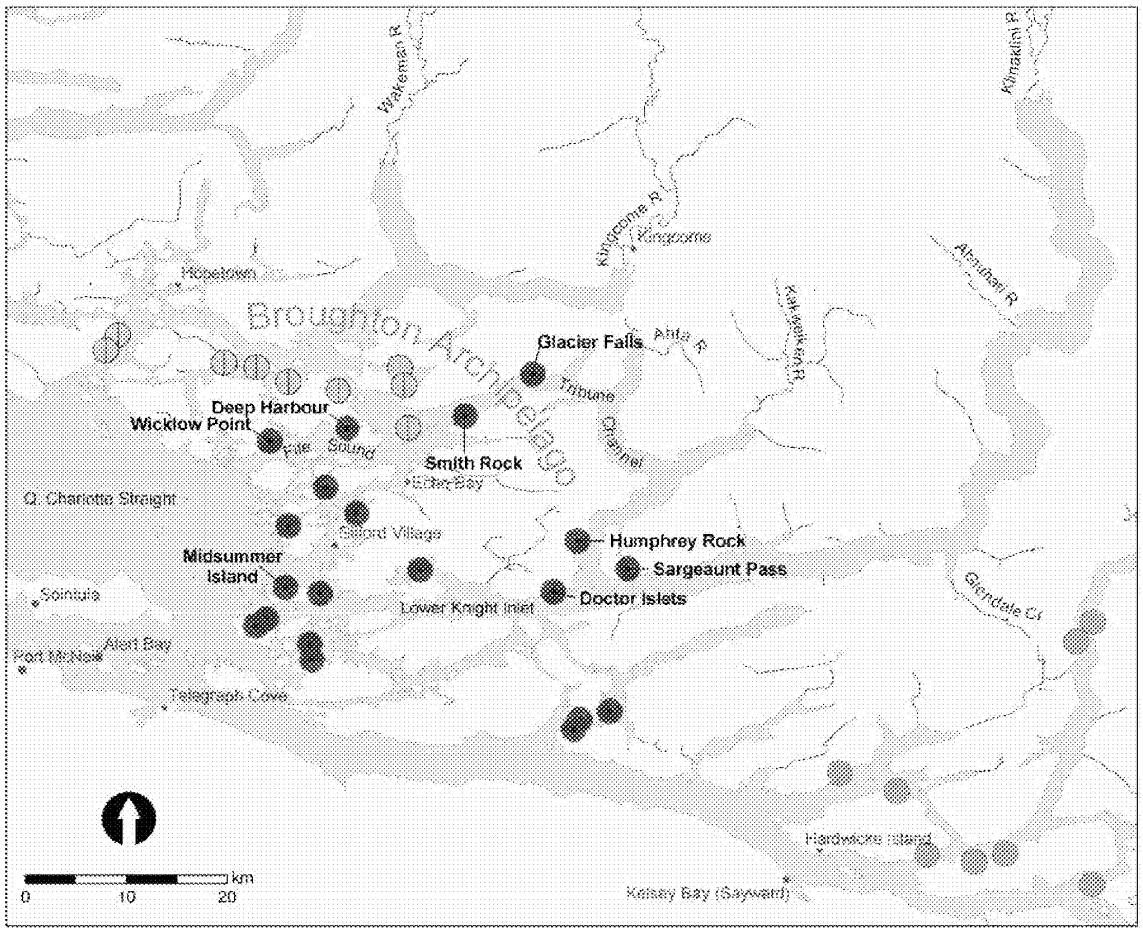

Figure 1: Location of Salmon Farms in British Columbia

[11] Gareth Porter, Protecting Wild Atlantic Salmon from Impacts of Salmon Aquaculture: A Country-By-Country Progress Report, 2nd Report (Washington, D.C. and St. Andrews, N.B., Canada: WWF and Atlantic Salmon Federation, 2005), pp. 31, 38.

[12] MAFF, *Pink Salmon Migration Corridors in the Broughton, January 2003*, 2003, and Living Oceans Society, *Living Oceans Society, Fish Farm Maps*., 2003, cited in "Sea Lice and the Broughton Archipelago," Watershed Watch website, http://www.watershed-watch.org/ww/Sealicefacts/sealicefacts_broughton.htm

These locations could increase the risk of transmission of sea lice from farmed salmon to juvenile wild Pacific salmon in their out-migration to the sea, as the B.C. government acknowledged in 2003 in adjusting its requirements for treatment of sea lice during the out-migration periods.

MAL officials assert that whereas in European salmon aquaculture countries there are is a single migration route to the sea from salmon streams, in B.C., there are always multiple channels leading to open water. Thus, the B.C. aquaculture industry cannot locate anywhere without being on a salmon migration corridor.

Critics have argued, however, that salmon farms could and should be located in less sheltered locations away from the relatively narrow channels through which wild pink salmon pass, and that alternatives are available. The Senate Standing Committee on Fisheries has called for new regulations that would prohibit fish farms for salmon near migratory routes as well as salmon-bearing rivers.[13]

It is unclear whether requiring relocation of salmon farms to protect wild salmon would mean that the aquaculture industry in BC would suffer some contraction. In any case, some other jurisdictions, including the New Brunswick in Canada, also suffer from a shortage of sites with adequate physical characteristics which have resulted in concentration of fish farms in relatively small areas. BC is not alone, therefore, in having physical circumstances that imposes potentially high costs on conforming to the requirement of this criterion.
The present regulation in BC does not reduce the risk to salmon in at least one river, so it does not fulfill the requirements for the lowest score for this criterion, but because there is a regulation, it is also different from the indicator for a zero score. Therefore, it is deemed to fall between a score of zero and the minimum score.

RESULTS FOR CRITERION ONE: 1 Point.

[13] "Aquaculture in Canada's Atlantic and Pacific Regions," Report of the Standing Senate Committee on Fisheries, June 2001.

Criterion 2:

Degree to which cumulative environmental impacts of salmon farming on an entire bay or other ecosystem are considered in siting decisions.

The Canadian Environmental Assessment Act (CEAA) of 1992 requires the assessment in advance of any project in terms of the "cumulative environment effectives that are likely to result from the project in combination with other projects or activities that have been or will be carried out." In the case of the salmon aquaculture industry and wild salmon stocks, that law provides an obvious basis for a siting policy that considers the cumulative effect of all salmon aquaculture operations in a given area.

The 2000 Report of the Auditor General of Canada noted that the federal Department of Fisheries and Oceans was "currently unable to assess the cumulative environmental effects of salmon farm operations, as required by CEAA," and that the Department "recognizes that it needs to determine how to assess the effects of multiple salmon farms on wild salmon stocks."[14]

Four years later the Commissioner of the Environment and Sustainable Development criticized the Department of Fisheries and Oceans for having failed to fill "significant gaps…with respect to the needed research on the potential effects of salmon aquaculture on aquatic ecosystems…."[15]

The MAL points out that most aquaculture projects undergo "screenings" under CEAA, which involve "a systematic approach to documenting the environmental effects of a project and determining the need to minimize or mitigate these effects, modify the project plan, or recommend further assessment through mediation of a panel review." Section 16 of CEAA indicates that every screening of a project must include a consideration of the environmental effects of the project, including a consideration of "any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out".

Fisheries and Oceans Canada (DFO) is now developing "scientific tools" to study and measure such cumulative effects, in order to help industry and provincial agencies better understand cumulative environmental effects, including impacts on wild salmon stocks.. However, it appears that those who are responsible for carrying out studies of cumulative effects still lack the tools needed to address some key scientific issues.

B.C. does have a regulatory requirement for screening that includes cumulative effects, but the study of those effects does not yet have an adequate scientific basis. Therefore, B.C. qualifies for a score of 5 for this criterion.

RESULTS FOR CRITERION TWO: 5 Points

---

[14] Auditor General of Canada, "The Effects of Salmon Farming in British Columbia on the Management of Wild Salmon Stocks," 2000, paragraphs 30.47, 30.48 and 30.63.

[15] Commissioner for the Environment and Sustainable Development, 2004 Report of the Commissioner of the Environment and Sustainable Development to the House of Commons. http://www.oag-vg.gc.ca/domino/reports.nsf/htmlc20041005ce.htm

Criterion 3:

Adequacy of standards for fish husbandry, including best industry practices in regard to year-class separation, fallowing of sites and maximum stocking densities

British Columbia has no formal regulations covering any of the major issues in fish husbandry aimed at minimizing the risk of disease. Fallowing of sites, maintaining year-class separation and limiting stocking densities are not required in order to maintain a license.

The "Total Maximum Production per Production Cycle" for each salmon aquaculture site is approved by the MAL as a condition of license on the basis of a review of the proposed management plan by a biologist. However, the production limit per site does not take into account the factor of risk to fish health. According to an official of the MAL's Aquaculture Development, the biologists look at modeling of expected feed and feces levels to derive estimates of the environmental impact of the proposed biomass level. Those impacts are determined to be low, medium or high.[16] The relationship between stocking density, stress on the fish and susceptibility to fish diseases is not taken into account at any stage of decision-making.

Therefore the technical factors that go into recommending the approval of a given level of biomass on a site does not provide an alternative to a standard for stocking densities that is based on considerations of risk to fish health.

MAL suggested that stocking densities would be covered by the fish health veterinarian. An inquiry with the Office of Fish Health Veterinarian revealed that stocking densities, fallowing and year-class separation are not part of that office's responsibility either.[17]

Each salmon aquaculture site is required to have a Fish Health Management Plan, which should identify risk factors in regard to fish health and "minimize their effect on fish health and their role in predisposing fish to disease." However, the 2003 "Required Elements" document on these factors does not make reference to any of the three fish husbandry issues. It does specify that operators will "minimize the time fish are exposed to stressful events such as anesthesia/sedation, crowding, and out of water events…." But this language offers no indication of what "best practice" is expected of operators in regard to stocking densities.

The "Manual of Fish Health Practices" issued in 2004 also fails to address stocking densities or fallowing.

The British Columbia Salmon Farmers Association (BCFSA) promulgated its own "Code of Practice" in February 2005, which does touch on stocking densities, providing in paragraph 14.2: "Companies will maintain densities, in consultation with qualified fish health professionals, to provide good health and prevent undue stress on farm stock."

---

[16] Phone interviews with Al Castledine, Manager, Finfish Aquaculture Development, Ministry of Agriculture and Land, January 10, 2006, phone interview with Bill Harrower, Regional Operations, Finfish Aquaculture Development, January 11, 2006.

[17] Phone? Interview with Joanne Constantine, January 11, 2006.

However, the Code of Practice assumes that there can be no general guidelines for maximum stocking densities. The Chair of the Compliance Committee for BCFSA explains that the decisions on stocking density are up to operators on the basis of their own calculations and are not subject to review by the Committee. [18]

The MAL requirements for fish health plans require the separation of year classes on site "by keeping them in different holding units, where possible." It further calls for accounting for differences in disease or infection status of year-classes in management operations to "reduce the risk of cross contamination." [19] This is a much weaker standard than best industry practice, which requires that different year classes not be held on the same site.

The BC Fish Health Veterinarian explained that the absence of stronger requirements for year class separation was because the document in question was intended to cover all producers, including those which are marginal to total production and cannot afford to practice year-class separation. She said she must balance the desirability of the standard against the fact that she would be putting people out of business whose production is too small to affect overall conditions for fish health.

The fact that small producers cannot afford to meet the requirements of best practices in the industry does not appear to be an adequate reason for having no formal requirement on such a critical issue of fish husbandry. There is a reason for having regulations rather than simply leaving it to the discretion of government officials. If there is a sound reason for making distinctions in regard to year class separation based on size of farm, those distinctions could be included in a regulation.

The BCFSA Code of Practice does not refer at all to year class separation or fallowing; BCFSA explains this omission as the result of the waste regulation that went into effect in 2003. They assert that a general requirement for fallowing would not make sense, because the need for fallowing depends on biophysical characteristics of a site, such as water temperature and current, and on whether the site is in an area that is exposed to disease pathogens or sea lice infestation.

However, there are clearly multiple adjacent sites which do share such biophysical characteristics and have been subject to disease pathogens and sea lice infestation over a period of years. These sites should be subject to fallowing requirements either through regulation or through a transparent process of ensuring compliance with a Code of Practice.

Because neither the regulations now in force nor the industry Code of Practice requires best industry practices for any of the three fish husbandry issues, B.C. does not fulfill the requirements for the minimum score for this criterion.

RESULTS FOR CRITERION THREE: 0 Points

---

[18] Interview with Sean Burke, Marine Harvest, January 19, 2006.
[19] "Manual of Fish Health Practices: Supplement to the Template for Writing a Facility Specific Fish Health Management Plan," August 2004, p. 25.

Criterion 4:

Adequacy of monitoring and enforcement of best practices in fish husbandry

The BC Ministry of Agriculture and Lands does not monitor any of the fish husbandry practices. According to BC's Fish Health Veterinarian, the surveillance audit done by the MAL fish health staff on finfish health at 25 percent of all active salmon sites each quarter on a random sample basis does not check on any of these fish husbandry practices. It is aimed at early detection of disease and sea lice by examining mortalities, taking diagnostic samples and sampling sea lice.[20]

The BCSFA Code of Practice is the subject of an internal audit by the BCSFA Compliance Committee—a collection of information on implementation of the Code by member companies through a detailed questionnaire filled out by each company. The information is then compiled in a "State of the Industry" report. But because the Code does not prescribe any concrete norms for any of the three fish husbandry issues, it does not provide any monitoring of fallowing, year class separation or stocking densities.

The Code of Practice calls for aquaculture operators to monitor salmon stocks on a daily basis for "signs of stress or other abnormalities as a preventive measure." However, there are no guidelines for interpreting this language and no effort is made to enforce it.

The MAL does not monitor stocking densities, year class separation or fallowing, according to the Fish Health Veterinarian.[21]

Thus no system of monitoring and enforcement now exists in regard to these fish husbandry issues, and B.C. does not fulfill the requirements for a minimum score for this criterion.

RESULTS FOR CRITERION FOUR: 0 Points

[20] Phone interview with Joanne Constantine, Fish Health Veterinarian, January 11, 2006.
[21] Phone interview with Joanne Constantine, January 11, 2006.

Criterion 5:

Adequacy of practices and procedures for early detection of an outbreak of any disease or parasitic infection likely to affect wild salmon and rapid response to such an outbreak

Prior to 2001, British Columbia had no requirement for monitoring and reporting on fish diseases or sea lice, using a specified common protocol, nor did it have any mandatory actions for depopulation or treatment upon clinical identification of the disease or an appropriate triggering level of parasite abundance on the farmed fish.

On December 1, 2000, the MAFF established an Auditing and Disease Surveillance pilot program, which did an initial survey of fish health and served as an audit for a Fish Health Database Pilot Project which was developed by the BCSFA and began operating in September 2001. That industry-led initiative involved fish farm reporting to their own database, and there was no legal requirement to report to MAFF.

As of June 2003, a Fish Health Management Plan (FHMP) was required of all aquaculture operators to maintain their license and the required elements of an FHMP were issued. Disease surveillance by industry then became a requirement for license holders. The document required that fish farm operators "regularly and systematically inspect fish and fish holding units for signs of disease," and increase their monitoring "for groups of fish showing unusual morality rates, signs of morbidity or subjected to stressful events that could predispose them to disease."

Operators contributed their aggregate data on mortalities each quarter to the industry's own fish health database or provided its sampling and test findings to the provincial Fish Health Veterinarian on a quarterly basis.

As for notification in the event of a disease outbreak, the language of the main FHMP document prescribing the elements of an FHMP limited the obligation of the fish farm owner: "Operators must…notify Provincial and Federal authorities in the event of outbreaks in accordance with existing regulations or surveillance agreements." The Template Fish Health Management Plan issued in August 2004 said, "Where appropriate and/or in accordance with existent regulation, operator's management will report the outbreak to Provincial or Federal authorities." There are no reportable fish diseases in Canada, nor is there any other legal or regulatory requirement for such reporting by aquaculture operators.

MAL officials suggested that the World Organization for Animal Health (OIE), of which Canada is a member, lists IHN as a reportable disease. However, OIE is an international organization, and the requirement is at a national level. That reporting requirement does not translate into any additional regulatory requirement for aquaculture operators to report.

Operators were not required to act immediately to remove fish exposed to disease from the water in the event of an outbreak of the highly contagious IHVN. They were required to have a "rapid response plan to reduce the spread of disease and initiate when a disease outbreak is detected," but not to carry out any specific actions for dealing with IHVN upon discovery of a fish disease. There are no mandatory steps regarding depopulation of cages or sites upon clinical verification of any disease found on the site. The Template Plan made it clear that any decisions about

whether to depopulate a site would be made by the company management without any involvement by authorities. "The Veterinarian, Fish Health Management and site management will work together to review fish health records and make further management decisions." The official document on "biosecurity procedures" for sites found to be positive for IHN virus provides only "recommended procedures" for processing and harvesting IHN virus-infected fish.[22]

Sea lice monitoring and actions are treated separately in the B.C. system of management. The first sea lice monitoring in the province began in February 2003, when provincial regulators established the Interim Sea Lice Monitoring program for 16 salmon farms in the Broughton Archipelago, of which 14 were surveyed for sea lice. The operators at the 14 sites examined lice on a sample of twenty fish per cage from three cages per site, and measured sea lice abundances and report at least once a monthly, and then to twice monthly. The MAL did its own monitoring of 25 percent of the sites (i.e., four fish farms) chosen at random every two weeks at the same time as the sampling by the farm operators, then increased the monitoring to 50 percent of the sites.[23]

During the year beginning October 1, 2003, the requirements were extended for industry monitoring and reporting on lice abundances to the entire province. The requirement for sea lice sampling based on a standardized protocol was made part of the FHMP required as a condition of licensing as of November 1, 2003. The Ministry continued its own independent monitoring of lice levels on 25 percent of farms randomly selected to ensure industry compliance with reporting requirements and to verify the industry reporting.[24]

Also during that year, a requirement was established to reduce lice levels through either harvesting of the fish or chemical treatment of stocks whenever the count of mobile lice reached 3 or 6, if it occurs during the period of pink salmon out-migration. If those triggering levels are reached, monitoring and reporting must also be increased to twice a month.[25] In 2005, the trigger level for such actions was changed to 3 mobile lice per fish throughout the entire year, and the MAL increased its own monitoring program to 50 percent of active sites during the 2nd quarter, which coincides with juvenile out-migration to the sea.[26]

The combination of the formal requirement for Fish Health Management Plans, the specificity of the actions to be taken and the ability to monitor compliance through the MAL random sampling gives these treatment actions upon reaching a triggering level of sea lice regulatory force.

B.C. has in place a requirement for frequent industry monitoring and reporting on fish disease in general, including sea lice. The actions for treatment of sea lice at trigger levels are mandatory.

---

[22] "Biosecurity Procedures for IHNV Positive Farm Sites," revised February 2004, www.agf.gov.bc.ca/fisheries/health/ihnv_Isolation_Control_Procedures.pdf.
[23] "Broughton Archipelago Sea Lice Action Plan," http://www.agf.gov.bc.ca/fisheries/health/science_BA_monitoring.htm
[24] "Review of Sea Lice Management Oct. 1, 2003 thru Sept. 30, 2004," www.agf.gov.bc.ca/fisheries/health/sealice_MS-2004.htm; "Sea Lice Management Strategy 2004," http://www.agf.gov.bc.ca/fisheries/health/sealice_MS_2004.htm#Mandatory.
[25] Ibid.
[26] "Sea Lice Management 2005," http://www.agf.gov.bc.ca/fisheries/health/Sealice/sealice_strategy_05.pdf

There are no mandatory actions to be taken upon clinical identification of IHN on salmon farms, however. Therefore B.C. fulfills the requirements for the second highest score for this criterion

RESULTS FOR CRITERION FIVE: 5 Points

Criterion 6:

Adequacy of national plan for minimizing escapes in regard to equipment and structures

British Columbia adopted an Aquaculture Regulation in April 2002 (BC Reg. 78/2002) which provides rigorous standards for containment structures and cage support systems, including design, installation and maintenance of net cages and net cage mesh strength. The standards for containment structure design required field trials, and analysis of performance trial or review by professional engineer to ensure compatibility with the proposed location.

The standards for net cages called for minimum net cage mesh breaking strength, depending on net cage dimensions. It required testing of that breaking strength according to a specific BC testing procedure. A further requirement is for an underwater inspection on all containment structures before initial introduction of a new group of fish and every 60 days by divers or another comparable method.

These new regulations meet the requirements for highest score for this criterion.

RESULTS FOR CRITERION SIX: 10 Points

Criterion 7:

Adequacy of national plan for minimizing escapes in regard to management operations, site-specific contingency plans and notification of escapes.

The new aquaculture regulation adopted requires that, within 180 days of the regulation coming into force, license holders must "develop and follow a best management practices plan" for the operation and maintenance of finfish aquaculture facilities to prevent escapes into the environment. The plan is to include the specific best practices and procedures used at the site to prevent escapes, must be reviewed and endorsed by the license holder and certify that the employees responsible for implementing the plan have received training in carrying it out.

The regulation requires that license holders report any escape events within 24 hours. They also require that the license holder must "take all reasonable measures" to prevent the escapes of fish into the environment.

A separate requirement is for escape response plans that include detailed procedures for preventing further escapes and reporting any escapes that have taken place. It further requires that "all reasonable measures" consistent with regulations be taken to "recapture a significant proportion of the lost stock."

All escape incidents, even those which have not resulted in any loss of fish, are investigated by the MAL Licensing and Compliance Branch on site. Such investigations depend for the most part on the willing cooperation of the operator and the staff of the operation. Only in relatively rare cases of large escapes is evidence from fishermen used in the investigation. However, such investigations have become more sophisticated in recent years, as feeding records have been used to identify sudden changes in the number of fish on hand.

This regulation fulfills all the requirements for the highest score for this criterion.

RESULTS FOR CRITERION SEVEN: 10 Points.

Criterion 8:

Adequacy of monitoring in order to assess compliance with the national plan and to verify the plan's efficacy.

Inspectors from the B.C. MAL Licensing and Compliance Branch visit all licensed aquaculture operations at least once a year to review and assess compliance with the regulations on escapes. Inspectors interview company officials and review on-site records relating to those regulations.

Inspectors also interview employees and examine log books to determine the requirement that escapes or suspected escapes must be reported within 24 hours. The limitations on this part of the monitoring process should be understood. If a company wishes to cover up an escape, they may do so simply by not making note of it in the log book. There is no effort by the inspectors to review inventory records with a view to verifying that no losses took place. The only inspection of such records is to assess the requirement that such records be kept on site.

Inspectors also review the Best Management Practices document detailing specific practices and procedures used to prevent fish escapes during phases of the operation where the risk of escapes is higher. They do not assess the quality or effectiveness of the plan but only whether a BMP exists, whether it includes all the components required, and whether a copy is located on-site, and whether the BMP was reviewed and endorsed by the holder. Thus the monitoring of that element of compliance with escape regulations is quantitative rather than qualitative in character.

The compliance visit may include examination of daily logs of required inspections of equipment and net maintenance records. These are apparently not examined beyond the most cursory viewing to ascertain that the records are indeed kept on site.

Inspectors assess whether the company has developed an escape response plan and, and on some occasions, at least, question staff members on their ability to describe the contents of the plans. Compliance with the requirement for training in carrying out the response plan does not appear to be systematically monitored or reported.

The on-site monitoring also includes an above-water inspection of net cages and supporting infrastructure by the inspector. However, an underwater dive audit of the system is also needed to verify that the system avoids problems that could result in tears in the net. Such dive audits are only carried out on a limited and random basis rather than on all sites. In 2003, for example, only five sites – about 6 percent of the 77 active sites that year – were subject to a dive audit.

Thus the on-site monitoring by the B.C. government covers all the necessary aspects of a national plan for preventing or minimizing escapes, even though it is limited to checking on the record-keeping requirements rather than assessing the effectiveness of required plans for responding to escapes, best management practices and equipment and regular on-site inspections. The monitoring system lacks a systematic underwater inspection of the containment system. Nevertheless, the system of inspection fulfills the requirements for the highest score for this criterion.

RESULTS FOR CRITERION EIGHT: 10 Points.

Overall B.C. and Comparative Results

Table 1: Overview of British Columbia's Results

Criterion	Score
1. Minimum distance or exclusion zone	1
2. Cumulative impacts and siting decisions	5
3. Adequacy of standards for fish husbandry	0
4. Monitoring and enforcement of standards for fish husbandry	0
5. Practices and procedures for disease detection and response	5
6. Containment: standards for equipment and structures	10
7. Containment: standards for management, contingency plans and notification.	10
8. Containment: monitoring for compliance and efficacy	10
B.C. Average Score	**5.1**

Table 2: Comparisons of Scores by Criterion

Criterion	British Columbia	Atlantic Canada	Iceland	Ireland	Norway	Scotland	United States	Average by criterion
One	1	0	10	0	10	0*	0	3
Two	5	0	10	0	5	10	10	5.7
Three	0	4	10	4	7	0	4	4.1
Four	0	0	10	0	10	1	3	3.4
Five	5	10	10	10	10	2.5	10	8.2
Six	10	1	10	10	10	3.5	10	8
Seven	10	1	7	10	10	10	10	8.2
Eight	10	1	10	4	10	0	10	6.4
Average by state	**5.1**	**2.1**	**9.6**	**4.4**	**9.0**	**3.4**	**7.1**	**5.8**

*The result for Scotland on Criterion 1 was erroneously published in the 2005 report as a 3; it should have been 0, based on the analysis provided. That reduces Scotland's average score from 3.8 to 3.4.

Source for other states: Gareth Porter, *Protecting Wild Salmon from Impacts of Salmon Aquaculture: A Country-by-Country Progress Report, 2nd Report*