

# Chapter 30

## **Fisheries and Oceans**

The Effects of Salmon Farming in British  
Columbia on the Management of Wild  
Salmon Stocks



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## Fisheries and Oceans

# The Effects of Salmon Farming in British Columbia on the Management of Wild Salmon Stocks

### Main Points

**30.1** Fisheries and Oceans is managing the salmon farming industry on the basis that it poses an overall low risk to wild salmon and habitat. However, the Department is not fully meeting its legislative obligations under the *Fisheries Act* to protect wild Pacific salmon stocks and habitat from the effects of salmon farming. We found that the Department:

- is not fully carrying out its current regulatory responsibilities to enforce the *Fisheries Act* with respect to salmon farming operations;
- is engaged in research and is working with the Province of British Columbia (B.C.) to develop a regulatory framework for salmon farming, but there are shortfalls in research and monitoring to assess the effects of salmon farming operations; and
- has not put in place a formal plan for managing risks and for assessing the potential cumulative environmental effects of proposals for new sites, should the decision be made to expand the industry.

**30.2** There is an urgent need for the Department to address these shortcomings in consultations with the Province if their goal of ensuring the co-existence of sustainable salmon fishing with the farming industry is to be achieved. The Department has recently obtained additional funds, which it plans to use to respond to industry and public concerns. Some projects include habitat management, further study on the environmental effects of aquaculture operations on fish habitat, and the effects of farmed and wild stock interaction. The Department has also notified the Province of B.C. and the salmon farming industry that it intends to begin assessing all fish farm operations to ensure that they are in compliance with the *Fisheries Act*.

### Background and other observations

**30.3** This is our third audit since 1997 of the Department's Pacific salmon management programs. In previous chapters we reported on habitat protection and management of the salmon fisheries. We found that loss of salmon habitat continued and that some wild salmon stocks were declining. Salmon farming has the potential to create additional stress on wild salmon stocks over time, especially if the industry expands. We found that the Department has not developed a plan to evaluate and manage the risks in the long term.

**30.4** Reaching conclusions on the effects of salmon farming is difficult because there have been few scientific studies that apply directly to the B.C. situation. Recent scientific evidence of escaped Atlantic salmon reproducing in B.C. streams, and the potential for expansion of the industry, are raising new questions regarding effects on wild salmon stocks, including the cumulative effects on the environment and fisheries resources.

**30.5** Atlantic salmon are raised initially in freshwater hatcheries, and at the juvenile stage they are transferred to open net pens in marine coastal waters in B.C. to complete their growth. They are harvested as adult salmon. It is while they are being reared in open net pens that possible interactions with wild salmon and their habitat can occur. Furthermore, open net pens are vulnerable to damage, which can result in escapes of farmed salmon.

**The Department concurs with the contents of the chapter.**



## Introduction

### Size and status of salmon farming industry

**30.6** British Columbia's salmon farming industry can be traced back to the early 1970s. Farms were concentrated originally in the Sechelt/Sunshine Coast and Campbell River areas and later on the northeast and west coasts of Vancouver Island, as cooler water provided better conditions for raising fish (see Exhibit 30.1). In the last decade, production has grown steadily. Today, 17 salmon farming companies, including 3 of the world's largest, operate 105 active salmon farms in British Columbia (B.C.). Farm production is dominated by Atlantic salmon (81 percent), followed by chinook (16 percent) and coho salmon (3 percent) (see Exhibit 30.2). North Vancouver Island has become the most active production area, accounting for over 50 percent of the provincial output. In 1999, the industry estimated that it had generated 1,800 direct jobs and 1,600 indirect jobs, and contributed \$677 million to the B.C. economy. This represented a 10 percent increase from 1998. Salmon farming has become an established industry in B.C. and is a significant contributor to the Province's economy.

**30.7** Canada is the fourth largest farmed salmon producer in the world after Norway, Chile and the United Kingdom; in 1999 it produced five percent of the world's farmed salmon. B.C.'s share was 49,100 metric tonnes, nearly 70 percent of Canadian production. In 1999, B.C. exported 77 percent of its farmed salmon, valued at \$308 million. The United States was the main consumer, with the balance sold either domestically or in Japan and Taiwan. Markets for farmed salmon are expanding (see Exhibit 30.3).

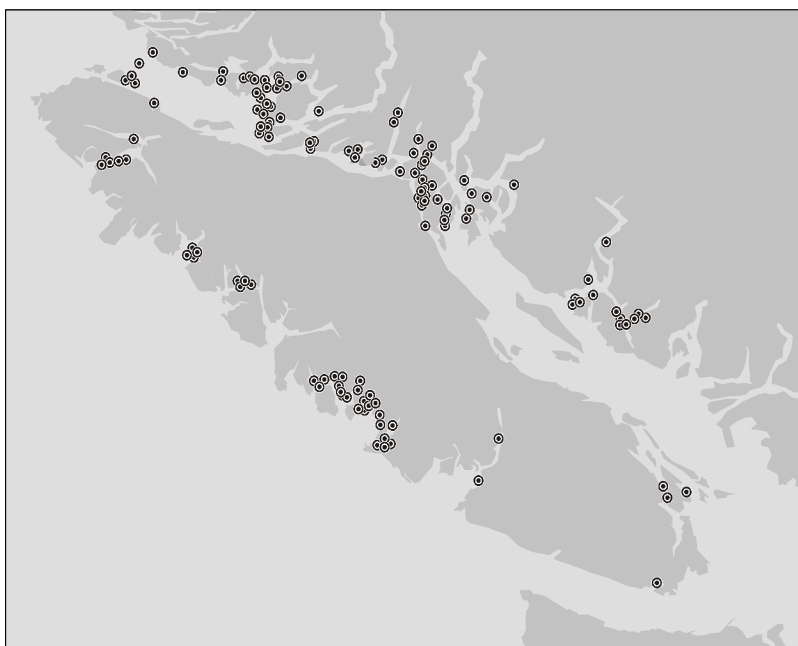
**30.8** In 1995, the Province of British Columbia, in consultation with Fisheries and Oceans, implemented a moratorium on expansion of the salmon farming

industry; this was in response to public concern about the effects of the industry on wild salmon stocks and the marine environment. Indications are that the moratorium may be lifted in two to three years pending the development of a regulatory framework for managing farming operations, an evaluation of industry compliance, technical developments, and consultation with coastal communities. A public poll on salmon farming in B.C. reported in 1999 that 69 percent of respondents would support expansion, assuming the guidelines in the B.C. Salmon Aquaculture Review are turned into workable regulations. The primary concern facing governments is how to address current and emerging environmental and ecological issues that are associated with the industry, and to ensure that the wild salmon stocks are not adversely affected any time during their life cycle (see Exhibit 30.4). It is in the Department's and B.C.'s mutual interest to create an environment in which wild

**Salmon farming has become an established industry in British Columbia.**

Exhibit 30.1

Location of Salmon Farms in British Columbia



Source: Fisheries and Oceans, Pacific Region, Habitat and Enhancement Branch



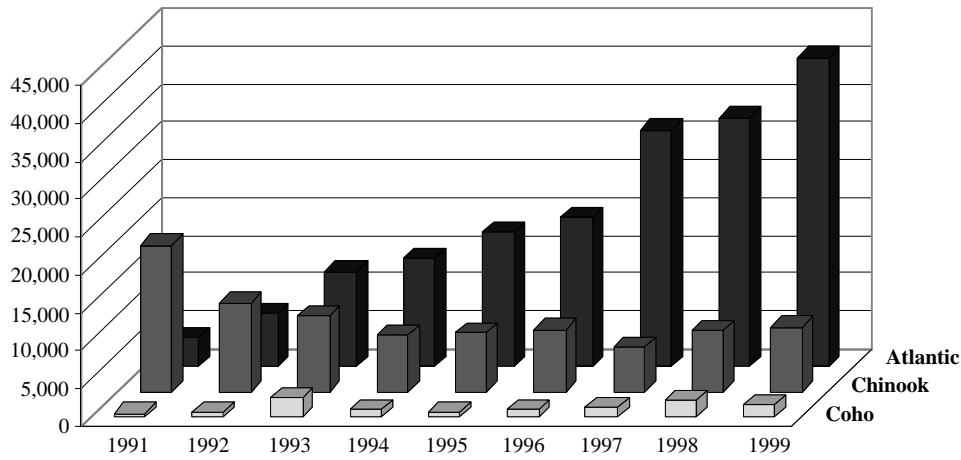
*Examples of salmon farm open net pens in marine coastal British Columbia (see paragraph 30.6).*



Exhibit 30.2

**British Columbia Production of Farmed Salmon by Species**

(round tonnes)

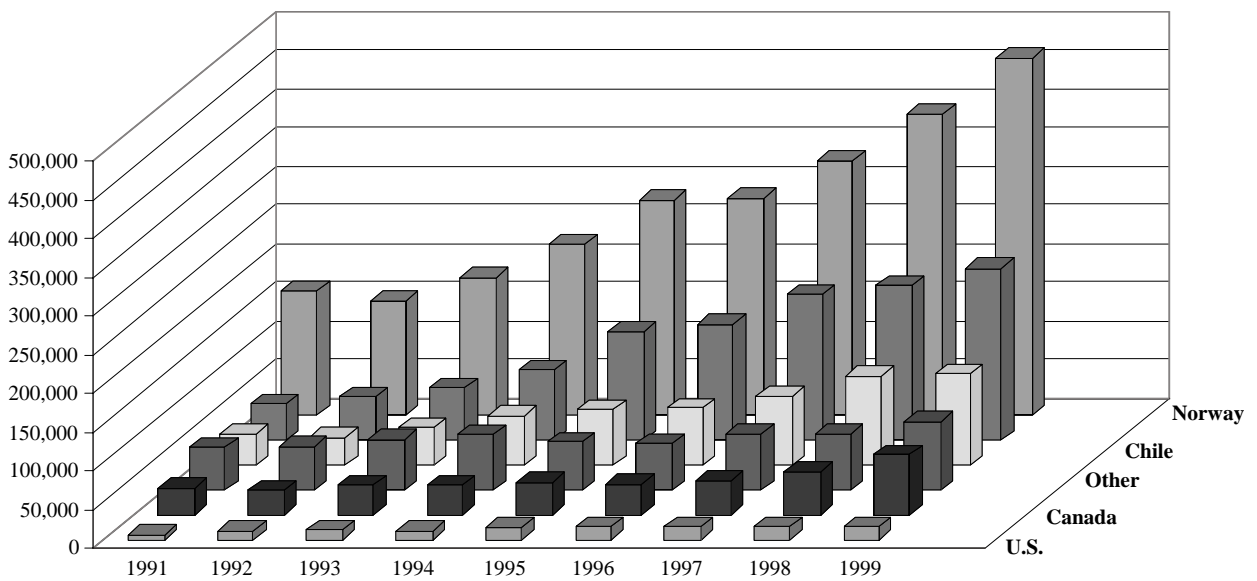


Source: British Columbia Salmon Farmers' Association

Exhibit 30.3

**World Production of Farmed Salmon and Sea Trout by Country**

(metric tonnes rounded weight)



Source: British Columbia Salmon Farmers' Association

**There are conflicting views on the effects of salmon farming on wild salmon stocks and the environment.**

salmon and the farming industry can co-exist, thus maximizing sustainable economic benefits.

**30.9** The Department has a lead role in determining this outcome, given its responsibilities for conserving and protecting wild Pacific salmon stocks and their habitats under the *Fisheries Act* and its emerging role in coastal zone management under the *Oceans Act*.

**30.10** There are conflicting views on the effects of salmon farming on wild salmon stocks and the environment. Expert opinion on the probabilities and consequences of such effects is diverse, emphasizing the uncertainty surrounding the issue at this time.

**Focus of the audit**

**30.11** This is our third audit of Fisheries and Oceans' Pacific salmon management

programs. The first, reported in 1997, examined the Department's management of the resource base, concentrating on the conservation of salmon habitat. The second, reported in 1999, examined the Department's management of the salmon fisheries.

**30.12** The objective of the current audit was to determine whether the Department, as the agency responsible for the conservation and protection of wild salmon stocks, is meeting its obligations under the *Fisheries Act* and the *Oceans Act*, while participating in the regulation of the salmon farming industry in B.C. The *Oceans Act* deals with the conservation, management and exploitation of marine resources. These resources will be managed through an Oceans Strategy being developed by the Department in consultation with those departments and agencies having marine responsibilities. Both the salmon fishing and salmon farming industries will be managed within this context. The Minister of Fisheries and Oceans is responsible for enforcing the provisions of both the *Fisheries Act* and the *Oceans Act* in their entirety.

**30.13** As no relevant regulations have yet been developed under the *Oceans Act*, our audit focussed on the *Fisheries Act*. The audit examined aspects of the Department's regulatory role in this area, including its operational responses to current and emerging environmental and ecological problems posed by the industry. We did not focus on the industry itself other than to familiarize ourselves with salmon farming operations by visiting several salmon farms and by gathering facts and statistics through interviewing key industry personnel and examining industry publications. We did not include the Department's salmon enhancement program in the scope of this audit.

**30.14** Further details on the audit are found at the end of the chapter in **About the Audit**.

**Exhibit 30.4**

**Life Cycle of Pacific Salmon**



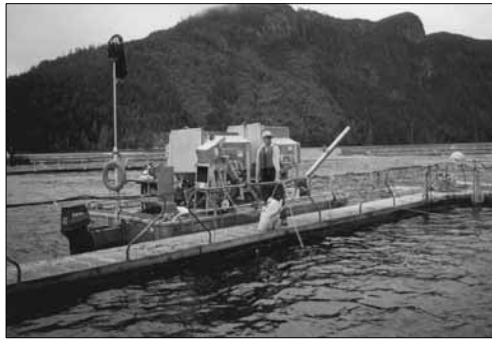
Source: Fisheries and Oceans



*Open net pen setup*



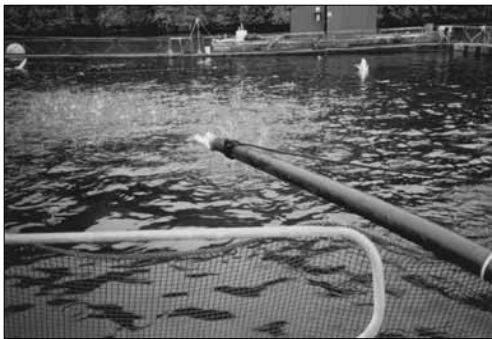
*Protecting young salmon from predators*



*Feeding salmon manually*



*Harvesting adult salmon from pens*



*Automatic feeding system*



*Sorting Atlantic salmon for harvest*

*Examples of salmon farming operations in British Columbia (see paragraph 30.13).*

## Observations and Recommendations

### Departmental Mandate to Conserve and Protect Wild Salmon and Habitat

**30.15** Fisheries and Oceans' mandate requires it to conserve and protect wild salmon and its habitat. The primary vehicle for the regulation of effects on fish and fish habitat is the federal *Fisheries Act*. Sections 35 and 36 prohibit the harmful alteration, disruption or destruction (HADD) of fish habitat and the deposit of any amount of a deleterious substance, though the Department can authorize HADD or develop regulations governing the release of deleterious substances. Where an activity is likely to result in HADD or in the deposit of a deleterious substance, the Minister is authorized under section 37 to request information about planned activities and to require modifications or restrict the proposed activity. These sections of the *Fisheries Act* provide the basis for the Department's role in reviewing applications and setting conditions for salmon farming licences submitted to the Province of B.C.

**30.16** Regulations under which the Department carries out its regulatory role with respect to salmon farming include the Fish Health Protection Regulations, Marine Mammal Regulations, and the Fisheries Regulations (General).

**30.17** Since federal and provincial jurisdictions overlap in the regulation of fish farming, separating the authority held by the parties is sometimes difficult. Fisheries and Oceans and B.C. came to an agreement on responsibilities and co-ordination of activities in their 1988 Memorandum of Understanding (MOU) on Aquaculture Development. Under the MOU, B.C. has the primary responsibility for management and development of the

aquaculture industry in consultation with Fisheries and Oceans. The Department retains regulatory responsibility in a number of areas, including conservation and protection of fish and fish habitat.

### A policy framework for the conservation and protection of wild salmon stocks

**30.18** Fisheries and Oceans has several key policies and strategies that direct its actions to conserve and protect wild salmon stocks; these are its Strategic Plan (2000), its Policy for the Management of Fish Habitat (1986), and A New Direction for Canada's Pacific Salmon Fisheries (1998). These strategies and policies reflect Canada's international commitments to the precautionary approach, to be implemented through the *Fisheries Act* and the *Oceans Act*.

**30.19** The new Strategic Plan confirms conservation of resources as one of the Department's highest priorities. Under the Plan, the Department is to use a precautionary approach when making decisions. The Pacific Regional office has developed its own strategic plan that recognizes the need to conserve and protect oceans, and to manage resources to ensure sustainability. The plan's focus is on safeguarding biological diversity and maintaining the economic potential of the ocean and its resources. Principles for managing salmon and salmon fisheries are embodied in the New Direction for Canada's Pacific Salmon Fisheries and will also be developed in subsequent policies, such as the Wild Salmon Policy, now at the draft stage.

**30.20** The Department released the draft Wild Salmon Policy for consultation in March 2000. At the conclusion of our audit, the Department was still holding consultations on the draft, and was aiming to finalize the policy in spring 2001. This policy, according to the Department, is not meant to address industry-specific operational questions. The development of an operational policy and plan that would

Federal and provincial jurisdictions overlap in the regulation of fish farming.

Under its new Strategic Plan, the Department uses a precautionary approach when making decisions.

set clear priorities for decisions on conserving and protecting wild salmon stocks from any effects of salmon farming will follow. However, the Department has not yet indicated when it will release such a policy.

## **Development of a Management Plan for Salmon Farming**

### **Lack of a formal plan to manage risks**

**30.21** As a regulator of the effects of salmon farming on wild salmon, the Department is in the business of risk management. Although it is addressing the risks associated with present farming operations, it has no formal plan for managing risks associated with an expanded industry should the moratorium be lifted.

### **Environmental assessment carried out by British Columbia**

**30.22** Rather than conduct its own risk assessment, the Department participated in the provincial Salmon Aquaculture Review (SAR), which was completed in 1997. The SAR was a comprehensive environmental assessment of salmon farming. It provided 49 recommendations to mitigate potential risks/effects of salmon farming on the environment. The technical advisory team for the provincial Review was tasked with evaluating all the available scientific literature, research and observational information available at the time.

**30.23** The Department has accepted the SAR's conclusion that salmon farming poses a low risk to wild Pacific stocks and has based its actions on this level of risk. It should be noted that the Review was based on existing production levels and practices and was not meant to prejudge the outcome of environmental assessments of future growth in the industry. Such assessments would need to take into account increased knowledge and

awareness of environmental issues, as well as improvements resulting from the implementation of the SAR recommendations.

## **Developing a Regulatory Framework**

**30.24** Canada is taking an advocacy role in aquaculture and has national strategies to guide this work; the centrepiece is the Federal Aquaculture Development Strategy (FADS), introduced in 1995, with Fisheries and Oceans as the lead department. The Strategy also recognizes the Department's responsibility for fish conservation and protection and requires its aquaculture development activities to be sustainable.

**30.25** The FADS makes two separate commitments to conduct legislative reviews. These are:

- to undertake a comprehensive review of all federal legislation and any accompanying regulations to identify and remove, where appropriate, constraints to aquaculture development; and
- to develop and implement a responsive and effective regulatory and policy framework to ensure that aquaculture is conducted in an environmentally sustainable manner, in co-operation with the provinces/territories and industry.

**30.26** The Commissioner for Aquaculture Development, who reports to the Minister of Fisheries and Oceans, is conducting a legislative review, and has made recommendations for removing constraints and ensuring that there are controls in place to safeguard the environment. It is important that, in response to these recommendations, the Department give appropriate consideration to environmental issues, in accordance with its mandate.

**The Department is in the business of risk management.**

**Some progress has been made in developing a regulatory framework.**

## Regulatory and Co-ordination Issues Requiring Attention

**It is unclear to what extent wild salmon are affected when they are in the vicinity of farming operations.**

**30.27** In 1977 Fisheries and Oceans developed Fish Health Protection Regulations under the *Fisheries Act* to minimize the potential for introducing or transferring diseases of salmonids. At the time of the Salmon Aquaculture Review, egg importation to the Pacific region was permitted only for research or broodstock development programs. The Department plans revisions to the regulations to meet new and emerging international standards and to broaden the regulations to include all finfish.

**30.28** As noted earlier, salmon farming effects are to be regulated through sections 35 and 36 of the *Fisheries Act*, which prohibit the harmful alteration, disruption or destruction (HADD) of fish habitat and the deposit of deleterious substances. Such substances — for example, products used to suppress the build up of marine growth on nets — may be used in salmon farming. Others may be produced when there is buildup and decomposition of organic material (uneaten food and feces) on the ocean floor. When decomposition takes place in the absence of oxygen, hydrogen sulfide may be produced, which is harmful to marine life. It is a widely held view within the Department and the environmental community that salmon farming (in some instances) has had such effects on fish habitat under and adjacent to net pens. However, it is unclear at this time if, and to what extent, wild salmon are affected when they are in the vicinity of farming operations.

**Salmon farms are not monitored for effects on fish and fish habitat.**

### A need for science support

**30.29** Fisheries and Oceans is still considering how the *Fisheries Act* is to be applied to salmon farming. This relates specifically to the use of HADD authorizations or the development of regulations to allow the deposit of a deleterious substance at certain levels (yet

to be determined). The Department is currently conducting and participating in research with a view to determining how to enforce the *Fisheries Act* in keeping with the principle of “no net loss of habitat” embodied in the Policy for the Management of Fish Habitat. Some of these issues are being considered through a National Habitat Management Working Group on Aquaculture, although progress is slow. Under the Department’s Environmental Science Strategic Research Fund, departmental scientists are conducting studies of the effects of salmon farming at the sites and further afield. The studies will aid the Department in defining the broad scale effects of aquaculture on fish habitat. In our opinion, such studies need to include the effects on Pacific salmon of contaminants in the water column in the vicinity of the net pens.

### Inadequate monitoring and enforcement

**30.30** Fisheries and Oceans is not ensuring that salmon farms are monitored for effects on fish and fish habitat, with a view to enforcing the *Fisheries Act*. A major constraint to enforcing habitat provisions is the Department’s lack of scientific information that would enable it to develop administrative criteria for what constitutes harmful alteration, disruption or destruction (HADD) of habitat with respect to salmon farming. Without such information, field officers do not know how to monitor farming activities to ascertain compliance with the Act.

**30.31** The Department is not currently monitoring effects on marine habitat or on juvenile or adult Pacific salmon in the vicinity of net cages. However, earlier this year, the Department became involved in a provincially led Technical Advisory Group that is working to co-ordinate monitoring activities between governments and with industry. The Department has also received funding for aquaculture-related activities, including \$22.5 million (nation-wide) for an improved management and regulatory framework. Enhanced monitoring

including the assessment of the effectiveness of new regulations may be part of this package, though information on specific activities has yet to be released.

**30.32** Responsibility for administering section 36 of the *Fisheries Act* (dealing with deleterious substances) has been delegated to Environment Canada, under the terms of a 1985 Fisheries and Oceans/Environment Canada Memorandum of Understanding (MOU); however, Fisheries and Oceans retains ultimate authority for all sections of the *Fisheries Act*. A 1987 Regional Working Agreement for the B.C. and Yukon Region on the same subject further delineates responsibilities. We found that the MOU and Agreement contained clear accountability requirements, along with a means to revisit the terms of the agreements if they were not functioning properly.

**30.33** There is a problem with how Environment Canada is carrying out its monitoring responsibilities under the MOU and the Agreement. In practice, Environment Canada is monitoring the effects of salmon farming only on shellfish beds and not on salmon and their habitat. Therefore, the commitments it made with respect to salmon farming are not being fully implemented.

**30.34** Both departments are aware of the limited coverage under section 36. Officials told us that Environment Canada has committed to establishing a working group, including Fisheries and Oceans, to report on the desirability of a section 36 regulation to deal with deleterious substances by 2001. However, if Environment Canada is unable or unwilling to take action on section 36 responsibilities, the onus is on Fisheries and Oceans, as the responsible authority, to do so.

### **Problems with enforcing compliance**

**30.35** Under the *Fisheries Act*, the Department can authorize salmon farming activities that may bring about the harmful alteration, disruption or destruction of habitat (HADD). It has not done this; yet there is a widely held view within the Department that salmon farming, in some instances, has had some highly negative effects on fish habitat. No salmon farm operator has been prosecuted under the *Fisheries Act* for the release of a deleterious substance having an impact on fish habitat. However, the courts have interpreted the *Fisheries Act* broadly and have found that it applies even where the impact may be limited or indirect, if the impact threatens fish or fish habitat. For example, in our opinion, the definition of HADD would then apply to any contamination of waters used by Pacific salmon at any time during their life cycle.

**30.36** A private prosecution was recently lodged against a salmon farm operator. However, the Crown Counsel of the federal Department of Justice stayed the charges on the grounds that licensing of the site (with knowledge of the effects) would reduce the chances of a conviction. It was acknowledged that there was evidence of damage to the sea bed below and adjacent to the salmon farm. Fisheries and Oceans recently informed salmon farmers that, in light of Crown Counsel's findings, it intends to enforce the *Fisheries Act* with respect to salmon farming; but it has not yet provided information on how it will determine the administrative criteria for HADD and (if a regulation is developed) for deleterious substances.

**30.37** **Fisheries and Oceans should act immediately to strengthen its monitoring and enforcement capabilities for salmon farming operations.**

**No salmon operator has been prosecuted under the *Fisheries Act* for the release of a deleterious substance having an impact on fish habitat.**

## Use of Siting Criteria

### Siting of salmon farms used as alternative to monitoring and enforcement

**30.38** Fisheries and Oceans has reasoned that well-sited farms at approved production levels will not produce deleterious substances or HADD. The Department's role is to examine proposals for the siting of salmon farms and to determine whether they are likely to result in HADD, or in the deposit of a deleterious substance in water frequented by fish.

**30.39** Fisheries and Oceans scientists drafted siting criteria in 1985 and refined them in 1986. This was subsequent to determining that farms located at shallow, poorly flushed sites were negatively affecting the organisms living on the ocean floor under net pens, as well as causing production problems for operators. To date, these siting criteria have undergone some minor changes, but remain in draft form and have never been formally adopted by the Department. Fisheries and Oceans is now planning to follow the siting criteria that have been developed by the Province (based on the B.C. Salmon Aquaculture Review recommendations) and vetted through the B.C. Fish Farm Review Committee (in which the Department plays an advisory role). These are similar to the Department's criteria.

### Lack of a scientific basis for siting criteria

**30.40** We expected that the Department would have done more work to provide a scientific basis for its siting criteria and/or to modify its siting criteria using the precautionary approach. Our expectation was based on the Department's concerns about the potential effects of poorly sited salmon farms and the potential for future

expansion of salmon farming on the West Coast.

**30.41** A 1998 workshop of Fisheries and Oceans habitat scientists concluded that because siting criteria designed to protect both vulnerable wild fish stocks and sensitive habitats are not scientifically based, they leave the Department vulnerable if challenged legally. The Department's Pacific Scientific Advice Review Committee, in its review of the workshop findings, confirmed the need for a scientific basis for the siting criteria. The B.C. Salmon Aquaculture Review also recommended that scientific studies be conducted in specific areas to provide information for developing more credible criteria.

**30.42** The Department has recognized the need for such research and has initiated studies to provide a scientific basis for the criteria. However, these studies do not consider any potential effects of salmon farming on wild salmon in the vicinity of net pens.

**30.43** The Province is now making decisions on the relocation of about 40 poorly located operations to new areas. It has identified 11 sites in the first round of relocations and is calling on the Department to comment on both the siting criteria and the individual re-siting applications. However, at this time, the Department is unprepared for the demands of the Province's current relocation process and must still base its input to the process on the existing criteria and on scientific judgment.

**30.44** The Department has recognized the need for siting criteria to be flexible, as site characteristics are unique and must be considered on a case-by-case basis. Therefore, it is anticipating that new criteria will still require scientific judgment in the assessment of individual sites.

**The Department has initiated studies to provide a scientific basis for the siting criteria.**



## Assessment of Cumulative Effects

### Recent evidence and risks to be considered in environmental assessments

**30.45** The status of wild salmon has become a concern. Ocean productivity has been poor for certain stocks; some coho stocks are in serious trouble and closures of both coho and sockeye fisheries have occurred; and salmon habitat continues to be lost. In addition, the proposed species at risk legislation before the House of Commons at the time of the audit could result in the listing of endangered or threatened salmon stocks. This would require the Department to take action to impose protective measures and develop recovery plans for stocks at risk. While the Department has done some work in this area, the number of salmon stocks that may be listed has yet to be determined.

**30.46** Although the number of salmon farms has been capped at 121 since 1995, overall production has increased. We are concerned that, given this situation, the potential for escapes may increase over time. Both the Department and the Province recognize the need to control Atlantic salmon escapes in the interest of environmental sustainability. Implicit in this recognition is a concern about the risk associated with salmon escapes, especially if the number of farms is increased and some are located near streams containing stocks at risk. We note that in October 2000 the Province announced the introduction of new regulations to prevent salmon escapes. While the possibility of escaped Atlantic salmon actually spawning was accounted for in the B.C. Salmon Aquaculture Review, recent evidence on interactions between Atlantic salmon and wild stocks (as noted in paragraphs 30.51–55) still needs to be taken into account in future environmental assessments.

### Review of environmental effects is needed before lifting moratorium

**30.47** Proposals for new salmon farms could require assessment under the *Canadian Environmental Assessment Act (CEAA)*. An assessment would be triggered by the Department's consideration of an authorization for the harmful alteration, disruption or destruction of fish habitat by a salmon farm, or to issue an approval under the *Navigable Waters Protection Act*. Furthermore, the *CEAA* requires that any cumulative environmental effects that are likely to result from projects or activities be considered during environmental assessments. In our opinion, the potential cumulative environmental effects of multiple salmon farm proposals warrant public review before a decision is made to lift the moratorium.

**30.48** The Department is currently unable to assess the cumulative environmental effects of salmon farm operations, as required by the *CEAA*. However, it recognizes that it needs to determine how to assess the effects of multiple salmon farms on wild salmon stocks, and how salmon farming operations interact with other human activities in the coastal zone. It has recently started work to develop a model to assess the cumulative effects of waste discharge from salmon farming operations on the coastal zone environment. However, the Department is doing little on the effects of escaping Atlantic salmon, except for the Atlantic Salmon Watch Program, which provides some information on interactions between Atlantic and wild Pacific salmon (see paragraphs 30.65–71).

### Shortfalls in Research and Monitoring to Assess Effects

#### Research needs not fully identified nor priorities established

**30.49** The 1997 B.C. Salmon Aquaculture Review identified a wide

**Both the Department and the Province recognize the need to control Atlantic salmon escapes.**

**The potential cumulative environmental effects from multiple salmon farm proposals warrant public review before a decision is made to lift the moratorium.**

**Fisheries and Oceans is not giving adequate attention to prioritizing research requirements.**

range of research needs associated with the salmon farming industry and its effects on the environment in general and on wild salmon in particular. Others with interests in this area have since contributed information, including scientists working on all aspects of salmon biology and ecology as well as environmental and ecosystem issues. The Department is not giving adequate attention to prioritizing research requirements to guide its science program or to fostering co-operative research in this area. However, it has scheduled a workshop to be held in October 2000 to identify research priorities for reducing critical knowledge gaps. It has also carried out some scientific projects in support of the recent court case (see paragraph 30.36).

**Recent evidence on interactions between Atlantic and Pacific salmon requires attention**

**30.50** There is recent evidence on the presence of Atlantic salmon in B.C. rivers and streams. At the time of the B.C. Salmon Aquaculture Review, Atlantic salmon ready to spawn had been observed in B.C. streams, but no juveniles from spawning Atlantic salmon had been captured. Since then, Atlantic salmon

have successfully reproduced in at least two rivers on Vancouver Island, the Tsitika and the Amor de Cosmos. In view of the possible effects on life history processes of wild Pacific stocks, this information needs to be taken into account in assessing potential effects of an expanded industry. An increase in the number of salmon farms could result in an increase in the overall number of escaping Atlantic salmon. The larger the number of Atlantic salmon present in B.C. waters, the greater the chance of their disrupting the life history processes (migration, reproduction, competition and predation) of the wild Pacific salmon.

**30.51** There is evidence that farmed Atlantic salmon are present in B.C. streams at all life history stages. However, according to a recent gathering of experts convened by Simon Fraser University in March 2000, more information is needed on the effects of interaction between Atlantic and wild Pacific salmon (see Exhibit 30.5). The need for such information, which was also identified in the B.C. Salmon Aquaculture Review, assumes greater importance when consideration is given to increasing the number of farm sites.

**30.52** The Department has participated in determining the origin of juvenile Atlantic salmon in the two locations on Vancouver Island. It has also done some research to date on the interactions with wild Pacific salmon, including laboratory hybridization experiments. A graduate student at the University of Victoria in B.C. is currently working on interactions in the field; the work is nearing publication.

**30.53** The Department's current assessment of low risk is based on conclusions and information considered in the B.C. Salmon Aquaculture Review (see paragraph 30.22). The review's conclusion is based on a large body of evidence on unsuccessful historical introductions of Atlantic salmon into B.C. coastal streams between 1905 and 1935 and in



*Example of mature adult Atlantic salmon ready for harvest (see paragraph 30.51).*

Washington State between 1951 and 1991. However, we believe that the recent evidence of the presence of Atlantic salmon at various life stages in B.C. rivers warrants further attention. For example, while past introductions failed, were the attempts made under different circumstances than those occurring today? Also, were Atlantic salmon adapted to local conditions as is now occurring through salmon farming operations?

**30.54** Although there are differing opinions on the conditions under which exotic species become established, there is support for the belief that if an exotic species is repeatedly introduced into a suitable habitat, the likelihood of it becoming established increases over time. Although the Department's evaluation

may be acceptable given the present level of farm production, we believe that the matter should be revisited under the terms of an expanded industry.

**30.55** Further research is needed into effects on the health of wild salmon stocks. An independent group of scientists, referred to in paragraph 30.51, concluded that diseases seen in salmon farms are found in wild stocks, and pathogens are known to move from those stocks to farm salmon. The Department acknowledges that it does not have enough information available to assess the risk of disease transfer from farmed salmon to wild stocks. Its Canadian Stock Assessment Secretariat reports, along with international studies, indicate that there is a serious lack of information in this area.

**Exhibit 30.5**

**Status of Knowledge/ Information Gaps on the Interactions Between Atlantic and Pacific Salmon**

*(Either recently escaped or wild spawned)*

Area of Concern	Has it been examined?	Has it been demonstrated/ documented?	What is the potential for impact on wild Pacific stocks?
<b>Marine</b>			
Competition for food	No	No	Unknown
Interference/disruption of migration	No	No	Relatively low risk
Attraction of wild salmon to net-cage sites (both lighted and not lighted)	No	No	Possible interruption of seaward or adult return migration patterns
<b>Freshwater</b>			
Interference with spawning (behavioural or egg consumption)	No	No	Risk is anticipated but magnitude is unknown
Pacific salmon eggs dug up by spawning Atlantic salmon	No	No	Risk is anticipated but magnitude is unknown
Competition between juveniles for food and space	Yes	Yes	Potentially high; needs to be evaluated
Habitat displacement in freshwater among juveniles	Yes – in laboratory	Yes but appropriate controls lacking	Risk is anticipated but magnitude is unknown

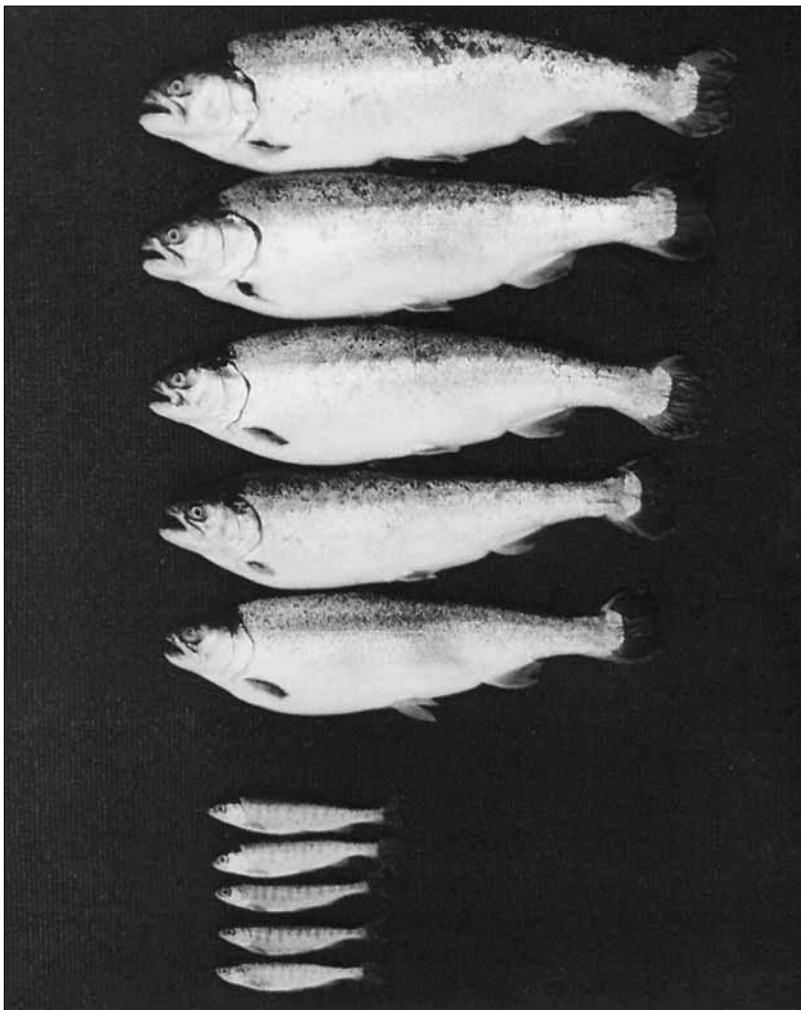
**Source:** Continuing Studies in Science at Simon Fraser University, Salmon Workshop Proceedings – Aquaculture and the Protection of Wild Salmon, July 2000.

**One line of transgenic Atlantic salmon is being developed by a private company in Eastern Canada.**

This prevents any meaningful assessment of the potential implications on fish health of interaction between wild stocks and farmed salmon. However, the Department enforces Fish Health Protection Regulations, and no exotic diseases have been found in B.C. waters to date.

**30.56** There are many sources of antibiotics in the marine environment, including human sewage, and discharges from agricultural operations, federal and provincial salmon and trout enhancement facilities, and salmon farming. Antibiotic resistance could result from any of these

sources as well as from natural causes. A 1990 study suggested that bacteria had developed a resistance to antibiotics at fish farms on Jervis Inlet (along the Sunshine Coast) and at Tofino (west coast of Vancouver Island). The Department recognizes that the use of antibiotics in salmon farming is a concern. It states that antibiotic resistance could become a priority research area if antibiotics are to be used more heavily; but a 2000 departmental review paper stated that there is no evidence of a current problem in B.C. waters.



*“Transgenic” coho genetically modified for growth enhancement (top) compared with normal coho juveniles (bottom), both at 14 months of age (see paragraph 30.57).*

**Source:** Fisheries and Oceans

**Research on genetically modified and sterile salmon**

**30.57** Genetically modified or “transgenic” salmon are currently not in commercial use anywhere in the world, but their use is being contemplated internationally. Interest in these fish as safe to eat has increased significantly. Although there is currently no interest in B.C. in farming transgenic salmon, the situation could change if global opinion endorses the use of transgenics abroad, giving foreign salmon producers advantages in the market. In fact, at least one line of transgenic Atlantic salmon is being developed by a private company in Eastern Canada. While safety is the primary concern, the use of transgenic salmon also raises questions about their behaviour and their effects on wild salmon stocks and habitat, should they escape into B.C. waters.

**30.58** At its West Vancouver Laboratory, the Department is conducting research for risk assessment purposes into coho genetically modified for growth enhancement. There is not enough information yet to reliably predict potential effects on the B.C. environment and wild salmon stocks. However, the Province has announced that it has adopted as policy the Salmon Aquaculture Review recommendation that government should continue to prohibit the

commercial farming of transgenic salmon in marine net cages.

**30.59** Induced sterility and use of only female salmon have been proposed as ways to prevent the establishment of wild stocks and thereby reduce the risks posed by genetically modified salmon. The Department is currently studying the effectiveness of sterilization methods and looking at the associated uncertainties. As options for preventing reproduction are more promising, it is important that the Department keep up with research in this area.

**30.60 Fisheries and Oceans should identify areas of needed research to understand the potential effects of an expanded salmon industry. It should assign priorities to ensure the most effective use of limited resources within the time period remaining before new farm site proposals are reviewed.**

**No monitoring of sensitive coastal habitat adjacent to farm sites**

**30.61** The Department is not monitoring sensitive coastal habitat adjacent to existing and potential salmon farm sites. Its new \$75 million funding to implement its Program for Sustainable Aquaculture may provide the resources it needs to become actively involved with the Province in monitoring and evaluating existing and proposed farm sites from this perspective. However, specific information about how the funds will be allocated is not yet available.

**30.62** Stream classification systems are only used in the siting of aquaculture operations to consider the presence or absence of nearby salmon-bearing streams. They are not used as a guide to establishing a comprehensive monitoring program. Both the B.C. government and the Department have noted that, in their sensitivity to the siting of salmon farms, small streams containing wild salmon stocks are as important as rivers and contribute to the biodiversity of stocks.

**No regular monitoring of wild salmon stocks adjacent to farm sites**

**30.63** The Department does not regularly monitor the status of wild salmon stocks in the vicinity of existing and proposed farm sites. B.C.'s Salmon Aquaculture Review concluded that native salmon stocks closest to salmon farms are at higher risk than stocks inhabiting areas farther from large farms, although some escaped salmon are known to travel long distances. The areas of greatest salmon farm activity are the northeast and west coasts of Vancouver Island. These areas have some stocks of all salmon species that are at risk, as noted in the Review.

**30.64** The Department has an active stock assessment program but is only monitoring selected stocks. It is taking action to protect the biodiversity of wild salmon stocks, as reported in the Auditor General's December 1999 Report, Chapter 20, Pacific Salmon: Sustainability of the Fisheries. However, there is only limited information on stocks along the north and central coasts, where some salmon farming sites may be relocated.

**Inadequate monitoring for the presence of Atlantic salmon**

**30.65** The level of monitoring by the Department for the presence of escaped farm salmon is low, and the information available to the Department, the Province, and the public on escaped Atlantic salmon in B.C. is limited (see Exhibits 30.6 and 30.7.) The Atlantic Salmon Watch Program (ASWP) is the only dedicated program on the Pacific coast for the collection of information on escaped Atlantic salmon. It is funded by B.C., with staff and facilities provided by Fisheries and Oceans. While draft data from 1998–99 were available, the most recent publication was the 1997 annual report.

**30.66** The ASWP involves sampling only when opportunities arise, and it is likely to underestimate by an unknown factor the number of Atlantic salmon in the wild. The primary sources of

**The Department is not monitoring sensitive coastal habitat adjacent to existing and potential farm sites.**

**Few streams have been surveyed for the presence of Atlantic salmon.**

information on the presence of Atlantic salmon in freshwater systems are fishermen and biologists, who observe only a small percentage of stream areas potentially occupied by Atlantic salmon. The frequency of observation in each region generally reflects the level of effort, which has been greatest along the west coast of Vancouver Island. The completeness of the marine data is a concern. The commercial fishing industry is the primary source of information on numbers of Atlantic salmon in the marine environment. However, captures of Atlantic salmon are directly related to catch effort, and the commercial fishery has been reduced since 1996. As a result,

recent data are highly variable and no trend over time is apparent.

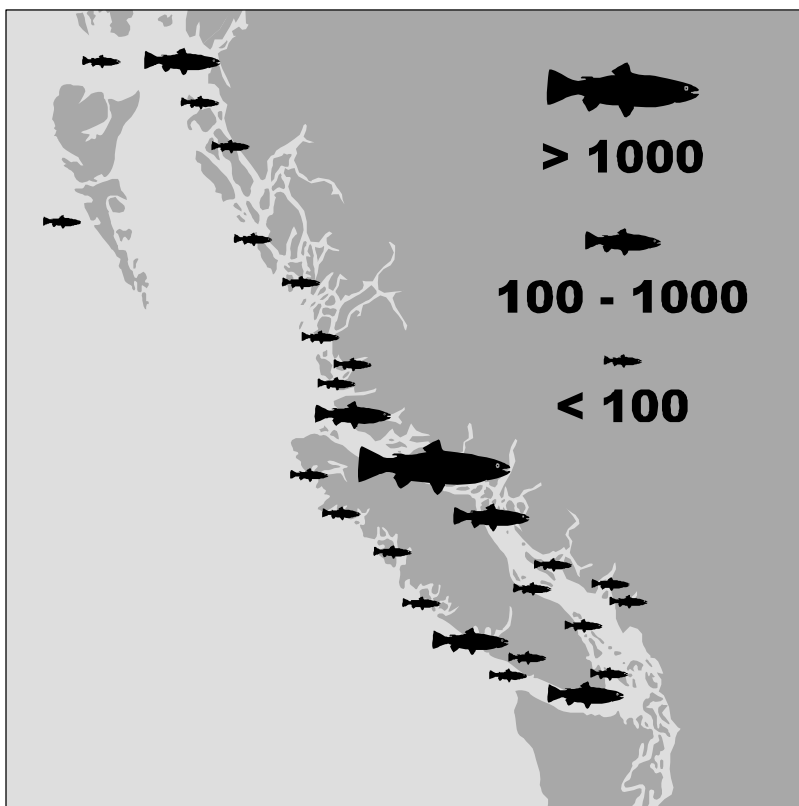
**30.67** Relatively few streams have been surveyed for the presence of Atlantic salmon. Since 1995, the Department has conducted regular surveys to assess chinook salmon stocks in streams on the west coast of Vancouver Island. Sightings of Atlantic salmon are recorded during these surveys. The B.C. government has also conducted stream surveys that have recorded Atlantic salmon sightings. However, only a small number of streams are surveyed each year, and the work is confined primarily to Vancouver Island.

**30.68** The Department informs us that there are currently four active survey programs for Atlantic salmon that will involve 30 to 35 river systems on Vancouver Island and the mainland. Other streams are monitored as part of the Department's normal stock assessment process. Due to the difficulty and expense of accessing remote areas, no streams have been surveyed on the mainland across from the Broughton Archipelago, where the majority of farms operate. Furthermore, monitoring is focussed on sites where Atlantic salmon have been observed, rather than extending over a wider geographical area.

**30.69** The number of escaped Atlantic salmon in the northeast Pacific coastal waters may be increasing, although no clear trend has been established. Farm salmon routinely escape from their enclosures, either in small numbers or in large events as a result of net failures or tears. From 1991 to 1999, more than 345,000 Atlantic salmon, both juveniles and adults, reportedly escaped from B.C. salmon farms. While this number may appear relatively insignificant given the high level of production, even at this level of escapes Atlantic salmon are entering and reproducing in B.C. streams. In fact, some very large escapes have occurred. For example, in the United States on 19 July 1997, 370,000 Atlantic salmon escaped from a farm site in Rich Passage,

**Exhibit 30.6**

**Catch Data for Adult Atlantic Salmon in the British Columbia Marine Environment, 1988–1999**



**Source:** Fisheries and Oceans, Atlantic Salmon Watch Program, 2000.

Washington. Atlantic salmon have been caught off the coast of Washington, B.C. and Alaska, and their presence has been documented in 79 rivers and streams in B.C.

**30.70** The Atlantic Salmon Watch Program has prepared a draft proposal for an enhanced monitoring framework to actively monitor the presence and abundance of Atlantic salmon. However, this framework will be triggered only if Atlantic salmon are reported through the existing program, in which reporting is passive. The enhanced framework would improve the quality of existing data, but it would not increase the number of streams surveyed. The Department has committed \$30,000 for the program for this year. In addition, the program's coverage is being expanded through efforts at increasing public awareness of Atlantic salmon in B.C. rivers and streams.

**30.71** The information gathered from the program includes data on the presence, distribution and number of Atlantic salmon, especially in streams containing weak or "at risk" stocks of wild salmon. This information is part of the evidence that the Department and the Province need to assess the cumulative effects of an expanded industry in the context of the present technology. Later, the information will be vital to assess the effectiveness of new regulations and permit requirements.

**30.72** Given that escapes of Atlantic salmon from open net rearing facilities are expected to continue into the foreseeable future, Fisheries and Oceans should expand and improve the Atlantic Salmon Watch Program to provide the information necessary to assess the effectiveness of its regulatory and management activities.

## Resolution of Federal-Provincial Issues

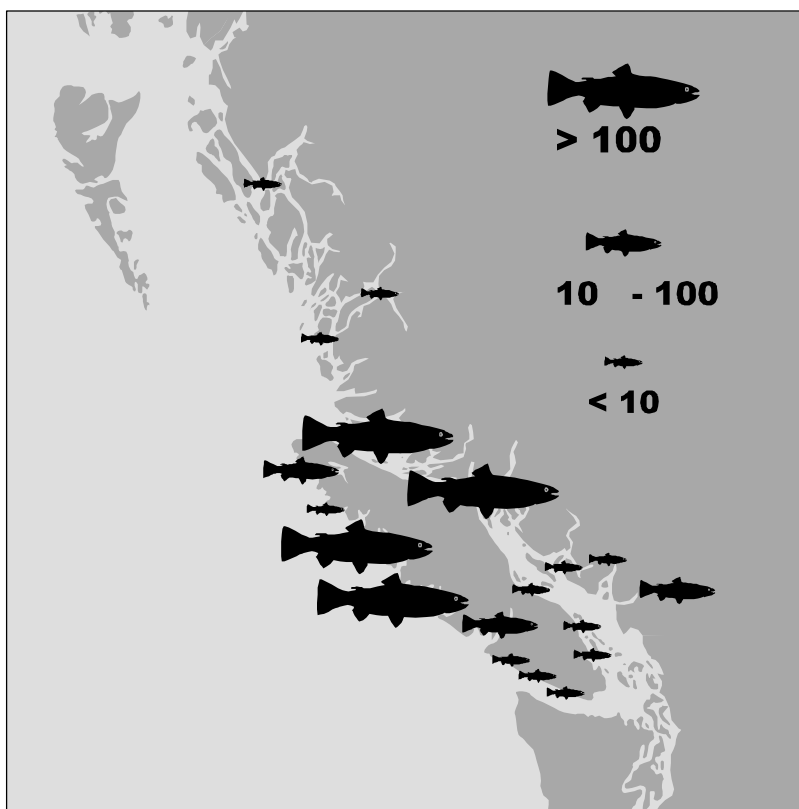
### Action taken to co-ordinate efforts

**30.73** Fisheries and Oceans and B.C. have shared responsibilities for managing salmon farming effects. In order to clarify their respective roles and responsibilities in developing the aquaculture industry, the federal and provincial governments entered into a Memorandum of Understanding in 1988. Under the agreement, the Department does not delegate responsibility to B.C. for managing the environmental effects of salmon farming. Both parties still look to

The presence of Atlantic salmon has been documented in 79 rivers and streams in B.C.

Exhibit 30.7

Sightings and Catch Data for Adult Atlantic Salmon in the British Columbia Freshwater Environment, 1990-1999



Source: Fisheries and Oceans, Atlantic Salmon Watch Program, 2000.

this agreement as a guide for division of responsibilities. Much of the agreement focusses on the need for co-ordination, which would be done through a joint management committee. While there is currently no management committee in place for the MOU, Fisheries and Oceans has been invited to participate in the Province's review process.

**30.74** The Federal Aquaculture Development Strategy (FADS) called for the establishment of aquaculture implementation committees in each province. In B.C., this would basically have mirrored the management committee under the MOU. The establishment of such a committee and the implementation of FADS were delayed throughout the moratorium period. However, B.C. continued to examine salmon farming issues with the Department's participation.

**30.75** Since announcing its Salmon Aquaculture Policy in October 1999, B.C. has taken a lead role in co-ordinating the development of standards for salmon farming. The Department is a member of the Province's Salmon Aquaculture Implementation Advisory Committee (a stakeholder committee), its Technical Advisory Group for co-ordination of research (which includes industry), its

Fish Farm Review Committee (for relocations), and its Salmon Aquaculture Implementation Project Committee. However, the Department plays a mainly advisory role on these committees.

**30.76** B.C. is working to develop performance-based standards under its *Waste Management Act*. In co-operation with industry and with some involvement by Fisheries and Oceans, the Province is directing an Interim Monitoring Program to provide information for finalizing the standards. These call for use of chemical and physical indicators in the marine environment (outputs — for example, feces and uneaten food) to determine the health of communities of organisms adjacent to salmon-rearing pens, and for the regulation of effects rather than inputs (for example, fish food). There is potential conflict between B.C.'s planned performance-based standards, which will provide thresholds for demonstrated effects, and section 35(1) of the federal *Fisheries Act*, which prohibits the harmful alteration, disruption or destruction (HADD) of habitat unless authorization is given.

**30.77** The Department recognizes that this potential conflict needs to be addressed and is currently reviewing the Province's draft of the performance-based standards. Through the Technical Advisory Group, the Department is providing input to the Interim Monitoring Program by commenting on study design, and is co-ordinating its own research.

#### **More work is needed to resolve issues**

**30.78** As discussed earlier in this chapter, the Department does not have the information necessary to develop administrative criteria for identifying thresholds for HADD, resulting from salmon farming, and is currently not enforcing sections 35 and 36 of the *Fisheries Act* with respect to salmon farming operations. It is therefore planning to use the results of the Interim Monitoring Program along with the results



*Example of a mature adult farmed Atlantic salmon (see paragraph 30.69).*



of its research program and input of other agencies to determine how to apply the *Fisheries Act* to salmon farming.

**30.79** The Department is not currently keeping pace with the provincial process of determining the effects of salmon farming and developing standards, and is having trouble co-ordinating its own involvement. It is important that the Department and the Province reach an agreement on the work to be done by each partner before consideration is given to lifting the moratorium.

**30.80 Fisheries and Oceans should take immediate action to determine how the concept of “harmful alteration, disruption or destruction of habitat” will be applied to salmon farming and how the “deposit of a deleterious substance” will be addressed, so it can provide the Province of British Columbia with comprehensive comments on potential conflicts between federal legislation and provincial regulations.**

## Conclusion

**30.81** Fisheries and Oceans has legislative responsibility to protect wild salmon from the effects of salmon farming, and it is managing on the basis that salmon farming poses an overall low risk to wild salmon and habitat. The Department is still evaluating information on the effects of salmon farming. It is not certain when it will have enough information to assess and to mitigate against cumulative environmental effects.

**30.82** The Department lacks the scientific information it needs to ensure that its compliance monitoring and enforcement activities protect wild salmon and salmon habitat, in keeping with its legislative responsibilities. It is therefore unable to enforce the provisions of the *Fisheries Act* with respect to salmon farming. Furthermore, it is not ensuring

that, where it has delegated responsibilities, the requirements of the *Fisheries Act* are being met.

**30.83** The Department has not yet made adequate progress on identifying areas and priorities for research on the effects of Atlantic salmon interaction with wild salmon stocks. This work needs to be done to prepare for an environmental assessment of new proposals if the industry is to be expanded or to relocate existing farms.

**30.84** The Department is now reviewing the federal regulatory framework that applies for aquaculture, with a view to creating more specific controls for aquaculture operations. However, it will need to apply the precautionary approach by:

- applying new knowledge from ongoing research in the development of new regulations;
- monitoring and enforcing compliance with new regulations over the long term; and
- assessing the effectiveness of these regulations in protecting wild salmon stocks.

**30.85** Because the Department has not determined how to apply and enforce its legislation, it cannot play a leadership role in ensuring that the *Fisheries Act* is addressed in the development of provincial standards. The Department may, therefore, find itself in the position of enforcing federal legislation that conflicts with provincial regulations.

**30.86** In summary, we have concluded that Fisheries and Oceans is not fully meeting its legislative obligations under the *Fisheries Act* while participating in the regulation of salmon farming in B.C.

***Fisheries and Oceans’ overall response:***  
*Fisheries and Oceans is committed to sustainable development of the aquaculture industry, and the Department*

**The Department is not currently keeping pace with the provincial process.**

*is meeting its challenges through a multi-pronged action plan.*

*In August 2000, the Department announced its Program for Sustainable Aquaculture (PSA) — a \$75 million investment over five years for sustainable aquaculture in Canada. This program invests in environmental and biological science (\$13.75 million), strategic research and development (\$20 million), measures to ensure the quality and safety of fish and fish products (\$20 million), and an improved regulatory and management framework for the aquaculture sector (\$21.5 million). These program enhancements will increase resources in the Pacific Region to effectively conduct fish habitat and environmental assessments of proposed aquaculture developments as well as monitor compliance with, and enforce, its regulatory responsibilities. Indeed, the Department has recently advised all B.C. salmon farmers that monitoring of their sites will increase to better ensure compliance with the Fisheries Act.*

*The PSA will also enable the Department to build on the existing and growing knowledge base of the potential ecosystem impacts of an expanding salmon industry. Work is already under way by Fisheries and Oceans officials in both the region and in headquarters to prioritize and co-ordinate research initiatives with others, including the federal government's Aquanet Centre of Excellence, the Province of British Columbia's recently announced aquaculture research trust fund, and with ongoing initiatives of the other provinces through the Canadian Council of Fisheries and Aquaculture Ministers Task Group on Aquaculture.*

*As part of a recent review of the legislative, regulatory and policy framework for aquaculture, prepared by the Office of the Commissioner for Aquaculture Development, the Department is also placing a priority on further addressing a number of issues related to*

*environmental and habitat protection. These actions include refining the application of section 35 of the Fisheries Act (harmful alteration, disruption and destruction of habitat) as it applies to aquaculture operations, as well as consideration, in collaboration with Environment Canada, of the development of regulations under section 36 of the Fisheries Act to control the deposit of any deleterious substances from aquaculture operations. In addition, under the auspices of the Canadian Council of Fisheries and Aquaculture Ministers, the Department is working closely with provincial departments responsible for aquaculture to harmonize federal and provincial roles and to reduce unnecessary duplication of effort, thereby freeing resources to focus on priorities and gaps. Finally, the Department is working with provinces and industry to establish a national aquatic animal health program aimed at reducing the incidence of disease and the severity of the impacts. Important environmental outcomes of this program include improved aquatic animal health in wild and farmed populations and further reductions in antibiotic and pesticide use.*

*In response to the concern raised regarding the escapement of farmed fish, escapes from B.C. fish farms now represent only 0.3 percent of the total harvest. The Department is committed to working with the industry and its provincial counterparts to further reduce the risk of future escapes. In B.C. the provincial Ministry of Agriculture, Food and Fisheries has recently announced more stringent measures to help prevent fish farm escapes. The revised regulations require enhanced escape prevention and response plans, expanded reporting requirements, and record keeping. Fisheries and Oceans is committed to such preventive measures and will continue to work to support these and other efforts by the provincial government.*

*As to the specific recommendation to expand and improve the Atlantic Salmon*

*Watch program, the Department has provided additional funding to the Program in 2000–2001 and the number of streams surveyed under its auspices has been increased.*

*Given that Atlantic salmon numbers are small and there are thousands of rivers and streams in British Columbia, the chances of finding salmon are low. The extensive funding required for comprehensive monitoring would divert*

*investments otherwise available to restore habitat and protect wild stocks — activities with proven benefits.*

*Fisheries and Oceans' aquaculture action plan demonstrates its serious commitment to developing the aquaculture sector in a sustainable manner that increases awareness of, and addresses, the potential environmental impacts associated with salmon farming.*



## About the Audit

### Objective

The audit objective was to determine whether Fisheries and Oceans, as the department responsible for the conservation and protection of wild salmon stocks, is meeting its obligations under the *Fisheries Act*, the *Oceans Act* and other legislation while participating in the regulation of the salmon farming industry in B.C.

### Criteria

We expected that the Department would have:

- ensured that its roles and responsibilities in regulating the salmon farming industry in B.C. were consistent with its mandate for the conservation and protection of wild Pacific salmon as defined in key legislation such as the *Fisheries Act* and the *Oceans Act*; and that where agreements are in place for other agencies to administer provisions of the *Fisheries Act*, accountability requirements for these provisions were clearly articulated;
- conducted research and acquired scientific information on the impact of salmon farming operations on the conservation and protection of wild Pacific salmon stocks and their habitat, with special reference to their sustainability and the protection of their genetic diversity, and made such information available to decision makers, stakeholders and the general public;
- used the results of targeted research and related scientific information to support the development of internal policies and strategies relative to the Department's participation in the regulation of salmon farming activities, and ensured that such policies and strategies were consistent with its responsibilities for the conservation and protection of wild Pacific salmon;
- developed or participated in the development of regulations/standards pertaining to salmon farming that are consistent with legislation and departmental policies, and made the necessary internal and external co-ordination arrangements to accommodate this process; and
- ensured that such regulations/standards were enforced directly, or monitored regularly through accountability provisions in administration agreements with other agencies.

### Approach

In order to focus on the Department's need for compatibility of salmon farming management with its core responsibilities for wild salmon management, we asked ourselves three questions:

- Has Fisheries and Oceans identified and evaluated the effects of salmon farming on wild stock management by following a risk management plan?
- Has Fisheries and Oceans formulated an action plan to deal with salmon farming, together with a strategy for its integration into the wild salmon management plan(s) to ensure consistency with the established principles of conservation and the precautionary approach?

- If such an action plan exists, is Fisheries and Oceans implementing its elements?

Our audit included meetings and conversations with departmental staff in Ottawa, in the regional office in Vancouver, and in district offices and research facilities. We reviewed Fisheries and Oceans files and documentation, and made formal requests through correspondence or e-mail for specific information from departmental staff in headquarters and the regional office. A large amount of material was obtained through the review of external and internal reports and from government and other Web sites and by participating in scientific conferences on Pacific salmon. We interviewed some senior officials in the provincial government and obtained from them information relating to federal-provincial activities.

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