Chapter 2 • Recommendations

The minister's ultimate decision-making authority

Several previous reports have emphasized that the federal minister of fisheries and oceans must hold ultimate decision-making authority over the Fraser River salmon fishery. In 1995, the Honourable John Fraser wrote that the Department of Fisheries and Oceans (DFO) "has no right to transfer Canada's constitutional responsibilities to protect the [fisheries] resource to anyone, Native or otherwise," and that "[t]his responsibility must be retained always by the Government of Canada."[1] That position was reflected in two recommendations of the Fraser River Sockeye Public Review Board chaired by Mr. Fraser:

> We recommend that DFO retain and exercise its constitutional conservation responsibilities and not in any way abrogate its stewardship of resources under federal jurisdiction.
> …
> We recommend that DFO ensure that AFS [Aboriginal Fishing Strategy] agreements clearly identify the Minister's responsibility for conservation, and that final authority to regulate and protect fish and fish habitats remain vested in DFO.[2]

The report of the Standing Committee on Fisheries and Oceans on the 2001 Fraser River salmon fishery also recommended that "the Minister of Fisheries and Oceans reassert his authority to manage the fishery."[3]

In 2005, the Honourable Bryan Williams strongly criticized DFO's efforts to share management of the fishery with First Nations, commercial fishers, sport fishers, and environmental organizations, noting that "[s]triving to achieve solutions that satisfy every interest may result in actions that satisfy none." He concluded that, although public involvement is a good thing, ultimately "the public expect DFO to maintain responsibility for good resource management and will hold DFO accountable." Mr. Williams

recommended that costly collaborative management approaches be evaluated explicitly against the goals set for fisheries management and compared with the costs and benefits of in-house or independent delivery of programs.[4]

For the reasons that follow, it is my view that the ultimate authority over the management of the Fraser River sockeye salmon fishery should continue to rest with the minister and that DFO ought to act in a manner that respects this authority. However, I recognize that, in relation to the conservation of Fraser River sockeye salmon habitat, jurisdiction is shared between the Parliament of Canada and the Legislative Assembly of British Columbia.

In the 1996 case of *R. v. Nikal*, the Supreme Court of Canada stated that "[i]f the salmon fishery is to survive, there must be some control exercised by a central authority," and this central authority is the federal government.[5] The requirement for a central authority in managing the fishery became apparent to me over the course of the hearings. The management of the Fraser River sockeye salmon fishery is a complex task requiring technical expertise and the rapid synthesis of great volumes of constantly changing information. Decisions critical to both fishers and the conservation of the resource must be made frequently and swiftly throughout the fishing season, requiring those involved in fisheries management to devote considerable time to carrying out their responsibilities. Some aspects of fisheries management require a high degree of technical understanding. For example, I heard from DFO and non-DFO witnesses alike of the difficulty stakeholders and First Nations faced in understanding the Fraser River Sockeye Spawning Initiative (FRSSI), which relies on a mathematical simulation model to provide information for setting the escapement targets for returning fish – an essential component of DFO's fisheries management function.[6]

Aboriginal fisheries organizations expressed a desire to participate in the management of the fishery at the highest levels. In recognizing the complexity of fisheries management, many of these groups submit that they require stable, long-term government funding in order to engage meaningfully in fisheries decision making.[7] This funding would be used to build their organizational and technical capacity for fisheries management, including hiring fisheries advisors and biologists. As I set out in Volume 1, Chapter 5, Sockeye fishery management, many millions of dollars have already been spent for this purpose.

During the hearings, I also heard that DFO is faced with a funding environment that has forced its fisheries managers to make do with less. With decreasing or uncertain funds available for test fishing, stock assessment, catch estimation, and science, for example, the department is faced with making difficult decisions on how to maintain its own organizational and technical capacity for fisheries management, let alone provide funds for others to join in this function.

In my view, the fishery must be managed by the federal government as the central authority, not only for the reason that fisheries management is a complex and demanding task but also because of the fiscal reality that the technical expertise required to manage the fishery cannot reasonably be replicated among all the parties that seek to participate in fisheries management. Where funds are limited, they must first be applied to meeting the organizational and technical capacity needs of DFO so it can fulfill its responsibilities, as described throughout this Report. However, this authority is not to take away from the pivotal role that First Nations and stakeholders ought to continue to play in informing DFO's management decisions for the fisheries. As I explain below in my discussion of the strategic and integrated planning process under the Wild Salmon Policy, First Nations and stakeholders bring with them important contributions and perspectives that should be considered.

Complementary to the minister's ultimate decision-making authority over fisheries management is DFO's ultimate responsibility for conservation of the fisheries resource. As the Supreme Court of Canada noted in *R. v. Marshall II*, the minister's primary objective under the *Fisheries Act* is the conservation of the resource, and "this responsibility is placed squarely on the Minister and not on aboriginal or non-aboriginal users of the resource."[8] In circumstances where DFO has shared its authority with another organization, I heard concerns that this co-management has created uncertainties or gaps as to which organization was responsible for certain obligations. For example, as I discuss below in my recommendations on habitat enforcement, DFO has delegated authority for the administration and enforcement

of section 36 of the *Fisheries Act* to Environment Canada. Despite a series of memoranda of understanding and working agreements between the two departments, uncertainty and public confusion remain as to which responsibilities are held by each one. In my view, maintaining the minister's ultimate authority over fisheries management also serves to clarify the ultimate responsibility of the minister for fisheries conservation.

Consideration of whom, exactly, fisheries management is intended to serve also supports the argument that the minister must have the ultimate decision-making authority over the fisheries. The Supreme Court of Canada has stated that "Canada's fisheries are a 'common property resource' belonging to all the people of Canada," and that the minister is to "manage, conserve and develop the fishery on behalf of Canadians in the public interest."[9] While I recognize that constitutionally protected Aboriginal and treaty rights carry unique priorities in the fishery, the fishery overall should be managed for the benefit of everyone.

Throughout the hearings, members of First Nations, fishing sectors, environmental groups, and the public have shared their concerns and suggestions about the management of the Fraser River sockeye salmon fishery. Each group carries unique interests and ambitions. Although there were some areas of agreement among the views expressed, there were also many points of conflict. In this situation, DFO must play a special and necessary role. First, as Kaarina McGivney, former regional director of the Treaty and Aboriginal Policy Directorate, noted, "Ultimately, if there is a broad range of interests in the fishery and different views, there needs to be someone to make a final decision to move things forward."[10] Second, as the only organization at the table that is accountable to all Canadians, the Government of Canada, through DFO, is tasked with making fisheries management decisions that take into account the public interest. In my view, while DFO should seek out and carefully consider input from those groups most directly involved in the fishery, it does not need to share ultimate decision-making authority with them. No matter how inclusive a shared-authority management process may be, to the extent that it reduces the minister's ultimate authority over the fishery, it may also reduce DFO's ability to manage the fishery in a manner that accounts for the interests of all Canadians, including those not privy to the shared-authority management structure.

I conclude from Canada's final submissions, Ms. McGivney and from internal DFO documents that DFO has no present intention to enter into agreements that abrogate the ultimate decision-making authority of the minister.[11] Moreover, DFO's Wild Salmon Policy clearly asserts that, even in the context of a strategic and integrated management process involving First Nations and stakeholders, the minister "retains the authority and accountability for the protection and sustainable use of fisheries resources and their habitat."[12] However, I also note that several of the department's other policies and practices over the years have created an expectation among some First Nations and stakeholders that a management process with shared ultimate authority over the fisheries is possible. For example:

- Since 2004, DFO's Aboriginal Aquatic Resource and Oceans Management (AAROM) program has provided Pacific Region Aboriginal fisheries organizations with approximately $6 million to $7 million per year to build their capacity to participate in "co-management."
- In 2005, DFO introduced Pacific Fisheries Reform, which identified the sharing of fisheries management responsibility and accountability with First Nations, stakeholders, and others as a key element. DFO envisioned that First Nations and stakeholders would be "involved in decision-making and share accountability for the conduct of the fishery" and would assume "a greater role in operational decision-making and program delivery" through "effective co-management processes."[13] The Integrated Harvest Planning Committee grew out of the Pacific Fisheries Reform initiative.
- In 2006, the Integrated Aboriginal Policy Framework set out seven strategies for the management of Aboriginal fisheries, including "increased Aboriginal participation in co-management of aquatic resources."[14] The framework defined co-management as "the sharing of responsibility and accountability for fisheries management" between DFO and resource users, eventually encompassing the sharing of authority. It also states that it is DFO's policy to shift away from its "top-down

centralized management of the fisheries resource" to a "shared stewardship" model that includes the "devolution of certain fisheries management authorities to resource users."[15]
- In 2008, DFO established the Fraser River Salmon Roadmap, a forum where Aboriginal groups could meet with each other and with DFO staff to design a permanent co-management process for Fraser River salmon.

In summary, previous reports on the Fraser River salmon fishery and judgments of the Supreme Court of Canada have supported maintaining the minister's ultimate decision-making authority over fisheries management and conservation. The evidence before me also suggests that, although First Nations and stakeholders have an important role to play in informing fisheries management decisions, there are important reasons for maintaining the minister's authority over the decisions ultimately made. In coming to this conclusion, I am aware that many Aboriginal groups assert an Aboriginal right to manage the fishery. However, it is not within my mandate to assess the merits of such claims.

While I strongly encourage consultation, co-operation, and collaboration with First Nations and stakeholders, I find that DFO should consistently articulate in unambiguous terms its respect for the minister's ultimate authority over Fraser River sockeye conservation and fisheries management decisions.

The minister's ultimate decision-making authority

1 In relation to Fraser River sockeye, the Department of Fisheries and Oceans should follow the principle that the minister is the ultimate authority in decisions about conservation, fisheries management (subject to the Pacific Salmon Treaty), and, within areas of federal juristiction, fish habitat. DFO should consistently reflect this principle in all its agreements and processes with First Nations and stakeholders.

DFO's responsibility to conserve wild sockeye salmon stocks

DFO's mandate in relation to wild fish

Historically, DFO's mandate in relation to Fraser River sockeye salmon has been twofold: to conserve the wild stocks and to ensure the future sustainability of the fishery.

The goals of conservation and a sustainable wild fishery are complementary. Conservation measures are intended to promote abundant, healthy wild stocks that may in turn permit harvesting, while fisheries management activities regulate the catch so that future productivity is assured. There are checks and balances within the regulatory regime aimed at ensuring that harvesting activities do not threaten conservation, and except when low abundances threaten the health of stocks, conservation measures allow a measure of harvesting.

In relation to fisheries, DFO's paramount regulatory objective is the conservation of Fraser River sockeye salmon and other wild fish species.[16] DFO sets strict rules about who may fish for what species, and when and where they may fish for those species. In addition, Parliament has given DFO impressive statutory powers to protect the environment in which wild stocks live. For example, section 35 of the *Fisheries Act* makes it an offence to "carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat." Section 36 makes it an offence to "deposit or permit the deposit of a deleterious substance of any type in water frequented by fish." These provisions acknowledge the importance of productive habitat for a sustainable fishery and comprise a core component of DFO's mandate. They have, more recently, been affirmed in the Wild Salmon Policy. DFO's conservation mandate extends to all fish habitat. It also extends to all fish, not just fish that are important to a fishery.* I accept that diversity in Fraser River sockeye stocks is

* I note that on June 29, 2012, Bill C-38, *An Act to implement certain provisions of the budget tabled in Parliament on March 29, 2012 and other measures*, received royal assent. It amends the habitat protection provisions in section 35 of the *Fisheries Act*. I will comment on this amendment in Chapter 3, Legislative amendments.

essential for conservation and future sustainability of the species.

I heard evidence that suggests confusion on the part of DFO respecting its paramount regulatory objective to conserve the health of wild fish stocks. For example, several DFO witnesses testified about the need for DFO's Science Branch to provide advice to its "clients," such as the Canadian Food Inspection Agency (whose mandate includes trade and economic concerns, not the conservation of wild fish), or to aquaculture management within DFO (whose focus includes sustainability of the aquaculture industry).[17] A similar concern arises in relation to DFO's former Toxic Chemicals Research Program, which had dedicated funding through the Environmental Sciences Strategic Research Fund (ESSRF). When the ESSRF was dissolved in 2004–5, DFO researchers on toxic chemicals were expected to fund all their work under a "client-based" funding system from other DFO sectors, other government departments, and non-government sources.[18]

DFO's mandate in relation to wild fish

2 In relation to wild fisheries, the Department of Fisheries and Oceans should act in accordance with its paramount regulatory objective to conserve wild fish.

DFO's obligations in relation to net-pen salmon farms

Given the paramount regulatory objective to conserve wild fish, DFO faces a challenge in relation to net-pen salmon farming along the BC coast. Salmon farming per se is not the problem. However, before introducing salmon farms into wild salmon habitat, DFO managers and scientists need to assess the risk to wild stocks and institute regulatory measures to minimize or eliminate the risk. If they conclude that regulatory measures cannot protect wild stocks, they can exercise their powers under the *Fisheries Act* to prohibit net-pen salmon farming. DFO's response to the introduction of salmon farms should be no different from its response to other stressors: DFO must protect the health of wild stocks.

However, the current role of DFO in relation to salmon farming is broader than the protection of wild stocks. It extends to promotion of the salmon-farming industry and farmed salmon as a product. In testimony, Claire Dansereau, deputy minister, said that DFO's role is to assist with "market access."[19] DFO's 2002 Aquaculture Policy Framework contains principles to guide DFO's work on aquaculture, including the following:

> Principle 1. DFO will support aquaculture development
> …
> Principle 5. Recognizing that aquaculture is a legitimate use of land, water and aquatic resources, DFO will work with provincial and territorial governments to provide aquaculturists with predictable, equitable and timely access to the aquatic resource base.
> Principle 6. DFO will strive to ensure that its own legislative and regulatory frameworks enable the aquaculture sector to develop on an even footing with other sectors.
> Principle 7. … DFO will support responsible development of the aquaculture sector.
> Principle 8. DFO will make every effort to understand the needs of the aquaculture industry and to respond in a manner that is solutions oriented and supportive of aquaculture development.[20]

DFO also provides support to the commercial wild fishery; for example, DFO has supported certification of the wild fishery under the Marine Stewardship Council (MSC), as described in Volume 1, Chapter 10, Wild Salmon Policy. However, this support is qualitatively different from that provided to the salmon farming industry. Programs promoting the wild fishery should be consistent with conservation of the natural resource. MSC certification requires both compliance with important components of the Wild Salmon Policy and restriction of harvests in order to achieve conservation goals. There are no comparable links between conservation of the wild stocks and promotion of the salmon farming industry.

As I noted in Volume 1, Chapter 8, Salmon farm management, DFO's promotion of and support for the salmon-farming industry are reflected in departmental funding. For example, the Sustainable Aquaculture Program is a $70 million national program, running from 2008 to 2013, designed to enhance global competitiveness and environmental

performance of Canada's aquaculture industry. Of that sum, $25 million is devoted to innovation to enhance the aquaculture sector's competitiveness and productivity, and a further $10 million supports the aquaculture sector's ability to meet domestic market demands along with rigorous international trade and marketing requirements.[21]

I understand the rationale behind the Government of Canada promoting the salmon-farming industry and its products or providing funds to assist with that sector's competitiveness. What does concern me, however, is that, when one government department (in this case DFO) has mandates both to conserve wild stocks and to promote the salmon-farming industry, there are circumstances in which it may find itself in a conflict of interest because of divided loyalties. For example:

- There is a risk that DFO will not proactively examine potential threats to migrating sockeye salmon from salmon farms, leaving it up to other concerned parties to establish that there is a threat.
- There is a risk that DFO will impose less onerous fish health standards on salmon farms than it would if its only interest were the protection of wild fish. Farmed salmon may tolerate certain diseases or pathogens differently from wild salmon, such that the farmed fish would not necessarily require treatment except for their potential to spread disease or pathogens to wild fish. (The treatment of sea lice is a good example: see the discussion in Volume 1, Chapter 9, Fish health management.)
- There is a risk that DFO will be less rigorous in enforcing the *Fisheries Act* against the operators of salmon farms.

I do not suggest that in every case DFO will favour the interests of salmon farms over the interests of wild fish; rather, it is the *risk* that it will do so that creates the conflict of interest. Because of its mandate to promote the salmon-farming industry, there is a risk that DFO will act in a way that favours the industry to the detriment of wild fish.

I recognize that, in relation to wild salmon stocks, DFO's mandate extends to promoting the commercial fishery as well as conserving those stocks. If that creates the potential for a conflict of interest, it can be largely addressed by the checks and balances I referred to in the section above on DFO's mandate in relation to wild fish. DFO's interest in promoting the wild fishery is tempered by its duty to conserve those same wild stocks: without a healthy resource, there can be no commercial fishery to promote. Protecting wild stocks while promoting salmon farms is, in my view, qualitatively different because there are no inherent checks and balances – promotion of salmon farms might, in some circumstances, prejudice the health of wild salmon stocks.

As long as DFO has a mandate to promote salmon farming, there is a risk that DFO will act in a manner that favours the interests of the salmon-farming industry over the health of wild fish stocks. The only way to address this potential conflict is by removing from DFO's mandate the promotion of salmon farming as an industry and farmed salmon as a product, and by transferring the promotion of salmon farming to a different part of the Executive Branch.

I draw no conclusion about whether the Government of Canada as a whole should promote the salmon-farming industry or farmed salmon as a product. There may be meritorious reasons for the federal government to do so. If it chooses to do so, it is inevitable that conflicts will arise from time to time between the protection of wild stocks and the promotion of farmed salmon. In my view, when those conflicts do arise, they ought to be dealt with at the cabinet level.

DFO's obligations in relation to net-pen salmon farms

3 The Government of Canada should remove from the Department of Fisheries and Oceans' mandate the promotion of salmon farming as an industry and farmed salmon as a product.

Implementation of the Wild Salmon Policy

When, in June 2005, after five years of development, Minister Geoff Regan released the Wild Salmon Policy (WSP), he stated that it "significantly transforms the management and conservation of wild salmon, their habitats and dependent

ecosystems."[22] Ms. Dansereau described the policy in her testimony as DFO's "guiding document for the management of Fraser sockeye."[23] The Wild Salmon Policy is Canada's expression of the precautionary principle* applied to Pacific salmon.[24]

The WSP sets out an integrated approach to the management of wild salmon on the Pacific coast, including the gathering of information relating to salmon and salmon habitat as well as planning for conservation and use of salmon. Its stated goal is "to restore and maintain healthy and diverse salmon populations and their habitats for the benefit and enjoyment of the people of Canada in perpetuity."[25] The policy comprises six strategies, which are implemented by specific action steps. The first four strategies are as follows:

Strategy 1	Standardized monitoring of wild salmon
Strategy 2	Assessment of habitat status
Strategy 3	Inclusion of ecosystem values and monitoring
Strategy 4	Integrated strategic planning

Implementation plan

Seven years after the release of the policy, little progress has been made in implementing it beyond developing the methodologies required to monitor and assess the status of salmon Conservation Units and some of their habitats. Although the policy itself promised that an implementation plan would be prepared after the policy's finalization, one that would stipulate what tasks were required, how they would be performed, and when they would be completed, that commitment has not been met.[26]

In Volume 1, Chapter 10, Wild Salmon Policy, I found that documents such as annual staff work plans do not constitute an implementation plan. The current regional director general testified that there used to be an implementation plan but that it is no longer in effect. Instead, there was a "current timetable" for WSP implementation, but she could provide no indication of what WSP tasks would be implemented within the next two or five years.[27] I also heard evidence that DFO performed no comprehensive costing exercise in anticipation of the policy or after its release.[28]

During the final witness panel, the deputy minister, the associate deputy minister, and the regional director general presented me with their interpretation of what is meant by the implementation of the Wild Salmon Policy. In essence, these witnesses suggested that WSP implementation is largely achieved through DFO considering the intent, spirit, and principles underlying the policy when taking regulatory decisions and making recommendations to the minister.[29] As I said in Volume 1, Chapter 10, I do not accept that interpretation. The policy is far more than a guiding principle. Rather, it sets out the specific steps by which Canada's commitment to the precautionary principle is to be applied to the conservation of Pacific wild salmon.

The Wild Salmon Policy is in theory the guiding document for the management of Fraser River sockeye and other salmon species. Successive ministers have committed DFO to its implementation. DFO should, in my view, honour its commitment to implementation and, without further delay, develop and publish a detailed implementation plan as promised in the policy itself. The implementation plan should include a detailed breakdown of implementation costs.

Wild Salmon Policy fund

The current funding model for implementation of the Wild Salmon Policy arises from the policy itself, which states that "implementation must be accomplished within DFO's existing resource capability and will be phased in over time."[30] Pat Chamut, former assistant deputy minister, Fisheries and Aquaculture Management, and former special advisor on the WSP, testified that he was able to cobble together implementation funds from various sources within DFO, which were included in the $1.1 million announced by the minister when releasing the policy in June 2005.[31]

* The essence of the precautionary principle is that, where a risk of serious or irreversible harm exists, a lack of scientific certainty should not be used as a reason for postponing or failing to take reasonable and cost-effective conservation and management measures to address that risk. (See Volume 1, chapters 3, Legal framework, and 4, DFO overview, and the description below in the section on management of salmon farms.)

Funds for WSP implementation average slightly more than half a million dollars annually and are largely pieced together from contributions from the branches within the region – for example, Science and Fisheries and Aquaculture Management. Contributions from the Oceans, Habitat and Enhancement Branch dwindled notably after 2008.[32]

Given the seminal importance of the Wild Salmon Policy and DFO's professed commitment to its implementation, I was surprised and disappointed at the clearly inadequate level of annual funding and the manner in which annual contributions to WSP implementation are made. The evidence satisfies me that, although the WSP is a national DFO policy, the Pacific Region has been left to fend for itself in finding the funds within its own annual allocation to move forward with implementation.

The Pacific Region must set priorities for how it will spend the funds it receives annually from Ottawa. The blunt truth is that, measured in dollars, it attaches greater importance to programs such as salmonid enhancement, promotion of salmon farming, and building the management capacity of First Nations than to implementation of the Wild Salmon Policy.

If this funding model for WSP implementation continues, I have no confidence that the policy will be implemented in the foreseeable future, if ever. Implementation suffers on two counts – low priority within the Pacific Region and lack of interest by DFO nationally to fund one of its national policies properly. I see no sign that DFO, at either level, is committed enough to WSP implementation to quantify the costs and set a realistic time frame for implementation, let alone set aside adequate funds for implementation.

If Canadians cannot count on DFO's Pacific Region or its national headquarters to champion a program that the former minister described as "transformative", then the Government of Canada as a whole must step forward and provide the necessary funding for implementation. It is for that reason that the funding recommendation below is directed at the Government of Canada, not DFO.

Although all strategies of the Wild Salmon Policy require funding, I draw particular attention to Strategy 4, which contemplates a new integrated strategic planning process to guide fisheries management. DFO needs to direct funding and efforts toward the creation of this planning process, which will provide for input from First Nations, commercial fishers, recreational fishers, and others subject to the final decision-making authority of the minister. To facilitate effective Aboriginal participation in this integrated strategic planning, DFO's funding commitment to the Wild Salmon Policy must include funding support for relevant Aboriginal Tier 1 processes. (Tier 1, 2, and 3 processes are described in Volume 1, Chapter 5, Sockeye fishery management, in the Aboriginal fishing policies and programs section.)

In bringing all the processes into one integrated process under Strategy 4, DFO needs to identify and cease funding any duplicative organizations or processes. Funds made available through the elimination of duplicative organizations and processes should be redirected to support the development of the strategic planning process under the Wild Salmon Policy and other aspects of Wild Salmon Policy implementation.

Having regard to the history of WSP development and implementation discussed in Volume 1, Chapter 10, Wild Salmon Policy, I am of the view that, once implementation costs are quantified, the Government of Canada should set aside segregated funds sufficient to complete implementation, making it clear that those funds are available only for WSP implementation and are protected from diversion into other DFO programs.

New position of associate regional director general

I heard evidence that, since 2005, there has been talk of identifying a "champion" for WSP implementation, but to date no such person has been appointed. Members of the WSP Implementation Team expressed frustration with a lack of oversight, leadership, and direction by senior management.

The regional director general is ultimately responsible for implementation of the policy and all other Pacific Region programs and activities but cannot be expected to assume day-to-day management of any specific program or activity. I agree with Mr. Chamut who suggested that someone within the Pacific Region should be accountable to the regional director general for pulling together all the various elements of the WSP to make

implementation happen.[33] Several witnesses talked about the problem of "stovepiping," when officials directing a particular branch are more focused on their branch's priorities than on the organization as a whole. I agree with those who said there needs to be someone above the branch level who can break down barriers among the different sectors and branches – the Fisheries and Aquaculture Management, Science, and Oceans, Habitat and Enhancement branches, for example – ensuring that everyone works together with a common cause throughout the implementation process.[34]

At the same time, implementation of the Wild Salmon Policy will be a challenging, time-consuming, multi-year task, and it would not be appropriate to add this responsibility to the workload of any existing person or position within DFO's Pacific Region. In my view, DFO should establish in the Pacific Region a new position of associate regional director general with lead responsibility for developing the implementation plan for the Wild Salmon Policy and for executing it.

Given the importance of WSP implementation to the future of the Fraser River sockeye salmon fishery and the broader Pacific salmon fishery, I also recommend that the new associate regional director general report annually on progress made toward full implementation and that DFO publish that report on its website.

Finally, the new associate regional director general should, once implementation is substantially complete, estimate ongoing operational expenses under the specific strategies of the WSP. The Government of Canada should ensure that the Wild Salmon Policy fund is sufficiently resourced to cover these expenses.

New position of associate regional director general

4 The Department of Fisheries and Oceans should immediately create a new position in the Pacific Region at the associate regional director general level with responsibility for

- **developing and implementing the Wild Salmon Policy implementation plan recommended under Recommendation 5; and**
- **supervising the expenditure of funds provided under Recommendation 6 for implementation of the policy.**

Wild Salmon Policy implementation plan

5 The new associate regional director general should, by March 31, 2013, publish a detailed plan for implementation of the Wild Salmon Policy, stipulating

- **what tasks are required;**
- **how they will be performed and by whom;**
- **when they will be completed; and**
- **how much implementation will cost, as set out in a detailed itemization of costs.**

Wild Salmon Policy funding

6 The Government of Canada should establish dedicated Wild Salmon Policy funding sufficient to carry out the Department of Fisheries and Oceans' implementation plan and to cover ongoing operational costs.

Annual report on progress in Wild Salmon Policy implementation

7 The new associate regional director general responsible for implementation of the Wild Salmon Policy should, by March 31, 2014, and each anniversary thereafter during implementation, report in writing on progress in implementation of the policy, and the Department of Fisheries and Oceans should publish that report on its website. Each annual report should invite responses from First Nations and stakeholders, and all responses should be promptly published on the DFO website.

Strategies 1 to 4

In Volume 1, Chapter 10, Wild Salmon Policy, I discuss in detail the extent to which DFO has implemented strategies 1 to 4 of the WSP. I concluded that, while measurable progress has been made under strategies 1 and 2, it has largely been in developing the methodologies required to monitor and assess the status of salmon Conservation Units and their freshwater habitats. Little progress has been made toward actually using these methodologies. For Fraser River sockeye Conservation Units, there has been only one limited, incomplete status

assessment under Strategy 1. No discernible management action was taken on this status assessment (including no recovery plan).

Almost nothing has been done to assess or monitor Fraser River sockeye Conservation Unit habitat status under Strategy 2. In Volume 1, Chapter 11, Cultus Lake, I observed that the Cultus Lake sockeye Conservation Unit likely would have benefited from DFO's completion of a habitat status report under Strategy 2. The lack of implementation of Strategy 2 parallels DFO's failure to fully implement the 1986 Habitat Policy, which, similarly, although 20 years earlier and for more than just Pacific salmon, envisioned habitat monitoring, including studies to determine baseline habitat conditions. Finally, despite Canada's expressed commitment to ecosystem-based management, there has been no demonstrable progress on implementing Strategy 3 as it applies to Fraser River sockeye.

Strategy 4 also requires transparent and informed decision making, using the best available information. It requires a transparent process to ensure that DFO, the minister, and all interested parties understand the competing interests and how those interests are balanced. While in some cases DFO may continue to have an obligation to consult directly with First Nations, the collaborative and integrated strategic planning process under Action Step 4.2 should be the central process through which DFO receives external policy advice. Although DFO may need to negotiate arrangements with First Nations, the Province of British Columbia, and/or municipalities to achieve some of its long-range planning objectives, DFO can and must make many decisions in the first instance in relation to habitat and harvest.

Seven years after adoption of the Wild Salmon Policy, DFO has done little of the basic groundwork necessary to begin integrated strategic planning for Conservation Units. Apart from the WSP's own Appendix 2 (A structured five-step planning procedure), DFO has not adopted an integrated strategic planning procedure to consult with other levels of government, First Nations, and stakeholders.

The failure to implement Strategy 4 (integrated strategic planning) raises the concern, expressed by fishers, that the only lever DFO is using to address weak stocks is curtailing harvest through the use of harvest-planning tools.[35] As a result, the harvesters are left to bear the cost of preserving Conservation Units through forgone harvest. The companion measures contemplated by Strategy 4, including restoration measures and habitat improvements, local development planning, and other measures involving all levels of government, have not occurred.

The new integrated strategic planning process contemplated under Action Step 4.2 needs to integrate fisheries management processes, including local fisheries management or advisory processes established under future treaties, such as Joint Fisheries Committees. Similarly, if DFO continues to develop any policy that may change inter-sectoral allocation of the Fraser River sockeye salmon fishery, such as the Aboriginal Fisheries Framework, it should do so through Action Step 4.2 in a transparent and inclusive manner and in consultation with all fishing sectors and the public. (The Aboriginal Fisheries Framework is described in Volume 1, Chapter 5, Sockeye fishery management, in the Aboriginal fishing policies and practices section.)

In my view, specific activities under strategies 2 to 4 need priority attention. In the recommendations that follow, I have identified those activities and have attached dates by which they should be completed. The activities and associated dates are based on the evidence I heard. If the implementation plan prepared by the new associate regional director general varies substantially from what I propose below, it would, in my view, be appropriate to explain the rationale for that course of action in the annual public implementation progress reports proposed in Recommendation 7.

Wild Salmon Policy: strategies 2 and 3

8 By January 31, 2013, the new associate regional director general should decide whether the Habitat Management Program (Ecosystem Management Branch)* or the Science Branch should take the lead role in implementing strategies 2 and 3 and what support should be provided by the other branch. The new

* The Ecosystem Management Branch was formerly the Oceans, Habitat and Enhancement Branch, and this latter term has been used throughout this Report.

associate regional director general should also identify who is responsible for, and set deadlines respecting, the following activities:

- **preparing habitat status reports;**
- **monitoring and assessing habitat using the habitat indicators and benchmarks developed by Stalberg et al.* and**
- **finalizing habitat indicators and benchmarks where possible.**

The new associate regional director general should coordinate with the Habitat Management Program to ensure consistency in implementing both this Recommendation and Recommendation 41.

Wild Salmon Policy: Strategy 4

9 In order to begin integrated strategic planning under Strategy 4 in relation to Fraser River sockeye without further delay, these key deliverables should be completed according to the following schedule:

- **By March 31, 2013, identification of red zone Conservation Units under Strategy 1, based on the Grant Draft Paper 2011.†**
- **By September 30, 2013, preparation of overview reports for the Fraser River watershed and marine areas relevant to Fraser River sockeye salmon, based on the best available information at that time. Knowledge gaps of concern to the drafters should be identified in the overview reports and a plan developed to address those knowledge gaps.**
- **By December 31, 2013, development of habitat indicators and benchmarks for assessment for the Strait of Georgia, Juan de Fuca Strait, Johnstone Strait, and Queen Charlotte Sound.**

10 As part of the implementation of Strategy 4 in relation to Fraser River sockeye, these key deliverables should be completed according to the following schedule:

- **By March 31, 2013, the Department of Fisheries and Oceans should complete a socio-economic framework for decision making in the integrated strategic planning process; it should also integrate meaningful socio-economic input into fisheries management decision making, beginning with planning for the 2014 fishing season.**
- **By January 31, 2014, integrated strategic planning processes should begin for Fraser River sockeye salmon using the best currently available information and following the procedure outlined in Appendix 2 (A structured five-step planning procedure) of the Wild Salmon Policy.**
- **By March 31, 2013, response teams should be formed for all Conservation Units in the red zone and for those that could significantly limit fishing and other activities.**
- **By December 31, 2014, response teams should complete plans for the protection and restoration of priority Conservation Units, and in developing such plans, they should give full consideration to approaches beyond curtailing fisheries.**

Management of salmon farms

Although promoting salmon farming conflicts with DFO's core mandate to conserve wild stocks (see section above concerning DFO's obligations in relation to net-pen salmon farms), regulating and managing salmon farming do not. My review of the regulatory system for salmon farms, the information that system generates, and the state of scientific knowledge about the effects of salmon farms on Fraser River sockeye lead to a number of recommendations for the future sustainability of the Fraser River sockeye fishery.

Much of the current regulatory regime for salmon farms stems from the 1997 Salmon

* Exhibit 175.

† Exhibit 1915.

Aquaculture Review (SAR) prepared by the BC Environmental Assessment Office. The SAR concluded that salmon farming presented a "low overall risk to the environment."[36] In response to the 49 SAR recommendations, the province enacted legislation and regulations and set up policies and procedures for the management of salmon farms.[37]

For practical reasons, in December 2010, when DFO took over as the primary regulator for BC aquaculture, it adopted many of the procedures, practices, and systems – with some variations and improvements – that the province already had in place. For example, DFO implemented a system using a combination of industry self-reporting and government audits that was similar to the provincial system for monitoring salmon farms.[38] It continued to use the diagnostic laboratory run by the BC Animal Health Centre in Abbotsford for analyzing fish samples collected as part of DFO audits of salmon farms.[39] As well, DFO adopted the siting criteria established after the SAR and implemented a similar application process to that formerly used under the provincial regime (though it has delayed any significant decisions about new applications until it has had the opportunity to consider the recommendations of this Inquiry).[40] DFO also chose to maintain the status quo by licensing, without further review, all of the approximately 120 net-pen salmon farms then licensed by the province.[41]

It has now been 15 years since the SAR. In reviewing the state of aquaculture regulation, my mandate is much more specific than the SAR. I have been tasked with identifying recommendations for the future sustainability of the Fraser River sockeye salmon fishery, not the broader environmental, social, and economic impact of aquaculture. I have had the benefit of testimony about how the system is working – in particular, its achievements and its shortcomings in protecting Fraser River sockeye.

My review of the regulatory system for salmon farms and the state of knowledge about the effects of salmon farms on Fraser River sockeye has led me to make recommendations in two areas: fish health data from salmon farms; and minimizing risks and uncertainty. I make related scientific research recommendations concerning the health of Fraser River sockeye salmon later in this chapter.

Fish health data from salmon farms

The SAR recommended that British Columbia improve the quality and accessibility of information about fish health from salmon farms. Toward that end, in October 2003, the province completed a fish health database and required industry to self-report information to that database. It used information in the database to generate quarterly and annual reports. Public access to this information occurred through summaries in the annual reports.[42]

Information held in this fish health database formed the basis for Technical Report 5A, Salmon Farms and Sockeye Information. As I describe in Volume 2, Chapter 5, Findings, I accept the evidence of Dr. Josh Korman (author of Technical Report 5A, Salmon Farms and Sockeye Information), Dr. Donald Noakes (author of Technical Report 5C, Noakes Salmon Farms Investigation), and Dr. Craig Stephen (lead author of Technical Report 1A, Enhancement Facility Diseases) that the quality and quantity (in terms of breadth of data collected) of the fish health database are impressive, especially when compared with monitoring programs in other sectors.[43] However, I also accept Dr. Korman's evidence that the short data record (from 2004 to 2010) means that the statistical power of that data to show relationships (if they exist) between salmon farm variables and measures of sockeye health or productivity is "very low." Additionally, I accept the evidence of Dr. Korman and Dr. Lawrence Dill (author of Technical Report 5D, Dill Salmon Farms Investigation) that this limitation in the data should disappear with another 10 years of data collection.[44]

Transparency and accessibility of fish health data from salmon farms have been topics of considerable controversy. In the past, the public and non-government / non-industry scientists have not been given access to the raw data in the fish health database. Instead, they have been given summaries of overall fish health in the provincial annual reports. As I describe in Volume 1, Chapter 8, Salmon farm management, I received many public submissions about a lack of transparency in the provision of information about salmon farms to the public. As well, non-government researchers told me of the difficulties they faced in accessing data about fish farms.[45] A salmon-farming industry

representative told me that the public has never had access to the kind of information that was made available during this Inquiry.[46] DFO recognizes that transparency is an issue that needs to be addressed, and it has taken steps to provide more information to the public than has been available previously.[47] However, at the time of the hearings on salmon farms in August and September 2011, DFO had not made fish health data (other than sea lice monitoring data) publicly available, even though it had made other salmon farm data – such as incidents of Atlantic salmon escapes and incidental catch – available through its website.

In my view, DFO needs to be even more transparent and should allow non-government and non-industry researchers to have access to the fish health database for the purposes of original analysis. The information in the database is collected to assist in the assessment of risks posed to wild stocks and should not be treated as proprietary. Although DFO has a mandate to analyze these data, it does not hold an exclusive mandate to do so. Indeed, DFO's conservation mandate may be advanced by the provision of data to non-government and non-industry scientists, who may apply fresh perspectives and analysis to these data and, by doing so, prompt DFO to ask new questions that further scientific understanding about the impact of salmon farms on wild stocks. This input could ultimately lead to regulatory advances that protect wild Fraser River sockeye.*

Also in relation to DFO's collection of fish samples from salmon farms, I note that, beyond routine auditing, DFO has not accounted for the need for fish samples for research. This gap became apparent in the testimony of DFO research scientist Dr. Kristina Miller about her difficulty accessing samples of farmed Atlantic salmon to test for a mortality-related signature, or parvovirus (see description of mortality-related signature in Volume 2, Chapter 4, Decline-related evidence).[48] The ability of DFO researchers to request and promptly receive fish samples – either live fish or fresh silvers (recently deceased fish) – from salmon farms is crucial to support a proactive research agenda that meets DFO's conservation mandate for wild stocks. While routine monitoring looks for known diseases, DFO also needs to look for changes in salmon farms (such as new or novel diseases and pathogens) and to be able to relate conditions it finds in the broader environment (such as conditions affecting wild salmon) to what is happening on salmon farms.

The privilege of being allowed to conduct a business that poses risk to wild stocks should carry a concomitant requirement to provide access to government scientists for research purposes beyond the scope of routine monitoring. It is through such research that new discoveries are made which can lead to better monitoring and the implementation of better precautionary measures to protect wild stocks. Diseases and pathogens are dynamic; they evolve and adapt to their environment. Researchers and managers alike must be equipped to look for and deal with the unexpected in order to manage new risks to Fraser River sockeye proactively as soon as they develop.

Fish health data from salmon farms

11 In order to provide a longer time series of data on which to test for relationships between stressors found at salmon farms and the health of Fraser River sockeye salmon, the Department of Fisheries and Oceans should continue to require the collection of fish health data directly from operators of salmon farms and through DFO audits.

12 For research purposes beyond routine monitoring, the Department of Fisheries and Oceans should require, as a condition of licence, that the operator of a salmon farm provide, on reasonable demand by DFO, fish samples, including live fish or fresh silvers (recently deceased fish), in a quantity and according to a protocol specified by DFO.

13 The Department of Fisheries and Oceans should give non-government scientific researchers timely access to primary fish health data collected through DFO's routine

* I note that, on April 30, 2012, the Government of British Columbia tabled Bill 37, *Animal Health Act*, for first reading in the British Columbia Legislature. Part 3, Division 1, of Bill 37 addresses the collection, use, and disclosure of information related to animal health. It appears to contemplate a much more restrictive release of information than what I have recommended in this Report.

monitoring programs, including data that relate to farmed or wild salmon.

Minimizing risks and uncertainty

As discussed in Volume 2, Chapter 5, Findings, salmon farming is an activity that poses some risk to Fraser River sockeye, though the extent of that risk is far from certain. The precautionary principle addresses situations involving risk and scientific uncertainty. As discussed in Volume 1, chapters 3, Legal framework, and 4, DFO overview, the precautionary principle – expressed in international agreements to which Canada is a party (such as the *Convention on Biological Diversity*), domestic legislation (such as the *Oceans Act* or the *Species at Risk Act*), and various DFO policies – guides my consideration of the management and conservation of Fraser River sockeye. The essence of the precautionary principle is that, where a risk of serious or irreversible harm exists, a lack of scientific certainty should not be used as a reason for postponing or failing to take reasonable and cost-effective conservation and management measures to address that risk. The precautionary principle does not mandate specific conservation and management actions to be taken once the principle is engaged. Canada's approach to the application of precaution is "flexible and responsive" to various situations.[49] One witness referred to the precautionary principle as an "elegant connection between risk-based management and adaptive management."[50]

Over the course of 128 days of hearings, 10 public forums, and numerous submissions from the public and formal participants in the Inquiry, I have formed the view that Fraser River sockeye are extremely important to British Columbians. They generally expect a high level of protection for this iconic species. However, this expectation does not mean that British Columbians accept no risk to this species. Virtually all development along the Fraser River sockeye migratory route (e.g., logging, agriculture, urban development, pulp mills) poses some risk to Fraser River sockeye. British Columbians may well accept some risk of serious harm in return for benefits such as the employment arising from salmon farms. However, based on the evidence and submissions I heard, I am satisfied that British Columbians will not tolerate more than a minimal risk of serious harm to Fraser River sockeye from salmon farming.

In using the precautionary principle to guide my consideration of the appropriate response to the risks that salmon farms pose to the future sustainability of Fraser River sockeye, I have asked myself four questions:

- What is the likelihood of harm occurring?
- Is the potential harm serious or irreversible?
- Do current management measures ensure that the risk of serious or irreversible harm is minimal?
- Could further reasonable and cost-effective measures be employed to reduce the risk and/or the scientific uncertainty?

I discuss each of these questions in the sections below, and then make recommendations for minimizing the risk and uncertainty around salmon farms and their effects on Fraser River sockeye.

What is the likelihood of harm occurring?

In Volume 2, Chapter 4, Decline-related evidence, I set out the evidence relating to whether salmon farms have contributed to the decline of Fraser River sockeye and whether they pose future risks to Fraser River sockeye. The evidence suggests that waste and chemical discharges from salmon farms are unlikely to have any effects on Fraser River sockeye at the population level. I reached the same conclusion about Atlantic salmon escapes from fish farms. However, researchers testifying before me did not agree on whether diseases and pathogens from fish farms may have contributed to the decline or may pose risks of significant harm to Fraser River sockeye. I accept the evidence that the state of scientific research about sockeye–fish farm interactions is not sufficiently developed to rule out diseases on salmon farms as contributing to the decline of Fraser River sockeye and posing future risks.

Of all the expert witnesses I heard from on the topics of salmon farms or diseases, no one told me there is no likelihood of harm occurring to Fraser River sockeye from diseases and pathogens on fish farms. Some said the risk could never be zero, and

others told me that salmon farms do increase the risk to Fraser River sockeye. (See the discussion of salmon farms in Volume 2, Chapter 4, Decline-related evidence.) Dr. Noakes, who ventured to quantify the likelihood of harm occurring, told me that, because of proactive policies and practices, it was "low." Others (Dr. Dill, author of Technical Report 5D, Dill Salmon Farms Investigation, for instance) said the state of information was such that the likelihood of harm occurring could not be quantified, and therefore disease and pathogens on salmon farms could not be ruled out as posing a significant threat to Fraser River sockeye. I accept the undisputed evidence that Fraser River sockeye face some likelihood of harm occurring from diseases and pathogens on salmon farms.

However, I cannot quantify the likelihood of harm occurring based on the evidence before me. Scientists do not know enough about farmed–wild fish interactions, and about how pathogens present on salmon farms affect Fraser River sockeye, to be able to quantify those risks to wild sockeye. Dr. Noakes and Dr. Dill agreed that more research into the effects of diseases on wild stocks such as sockeye is necessary, and Dr. Michael Kent, author of Technical Report 1, Infectious Diseases, and other witnesses told me that little population-level research about disease has been done on Fraser River sockeye.[51] As David Marmorek, lead author of Technical Report 6, Data Synthesis, aptly described the situation: in the absence of research, scientists are left with plausible hypotheses and mechanisms whereby salmon farms might cause disease in wild fish.[52] The likelihood of this outcome occurring and resulting in harm requires further study.

Is the potential harm serious or irreversible?

Having concluded that there is some likelihood of harm occurring to Fraser River sockeye as a result of salmon farms, the next question is whether the potential harm is serious or irreversible.

As described by Dr. Dill in Technical Report 5D, Dill Salmon Farms Investigation, Fraser River sockeye migrate through a "complex of passages through the Discovery Islands." Many of these passages are narrow channels containing salmon farms. One passage through the Discovery Islands (in fish health sub-zone 3-2)* is the focus of particular concern by conservation organizations and has been dubbed the "Wild Salmon Narrows" by those groups.[53] Once sockeye smolts have made their way through the Discovery Islands, they encounter fewer salmon farms. For example, Fraser River sockeye smolts do not swim into the Broughton Archipelago – the next major salmon farm area along the coast – though they may interact with salmon migrating out of that area.[54] During the course of this Inquiry I heard concerns in public submissions, from participants, and from witnesses, that salmon farms sited on the migration route of Fraser River sockeye may transfer diseases and pathogens to Fraser River sockeye.[55] Some suggested that net-pen salmon farms should be removed completely from the Discovery Islands; others suggested removing salmon farms from the Wild Salmon Narrows in order to "clear one migratory route through the Discovery Islands for wild salmon."[56]

I also heard expert evidence that farmed fish carry diseases and pathogens.[57] These diseases and pathogens can be transmitted directly to wild Fraser River sockeye through the water or indirectly – for example, sea lice may carry other pathogens from fish to fish. (See the discussion of sea lice and salmon farms in Volume 2, Chapter 4, Decline-related evidence.) Dr. Kent told me there are two ways that fish farms can affect wild fish: by introducing new or novel diseases, and by making endemic diseases worse.[58] New diseases would include infectious salmon anemia (ISA), which scientists had not confirmed in British Columbia at the time of the hearings and which has been a problem on salmon farms in other areas such as Atlantic Canada. Endemic diseases are those already present in wild Pacific populations, such as bacterial kidney disease or infectious hematopoietic necrosis. Farmed fish catch endemic diseases from wild fish. The high numbers of hosts on fish farms can then "bio-magnify" such diseases. As well, high numbers and densities of hosts on fish farms may "select for fast-growing, early-transmitted and more virulent pathogens," which could, as noted above, be transmitted back to wild Fraser River sockeye.[59]

* Fish health sub-zones are depicted in Figure 1.9.3 in Volume 1, Chapter 9, Fish health management.

(See the discussion in Volume 1, Chapter 9, Fish health management.)

Further, Dr. Kent said a devastating disease could sweep through a wild population, killing large numbers of wild fish without scientists being aware of it.[60] And, as I discussed in Volume 2, Chapter 3, Other investigations, other scientific investigations into the causes of the decline of Fraser River sockeye (such as the June 2010 Pacific Salmon Commission workshop) identified pathogens and disease as strong contenders for causes of the decline. Irrespective of whether the source of any particular disease is a fish farm or wild fish, the potential for disease to cause significant population declines indicates "serious harm." If a disease were to wipe out a vulnerable stock of Fraser River sockeye, such harm could also be irreversible.

I therefore conclude that the potential harm posed to Fraser River sockeye salmon from salmon farms is serious or irreversible. Disease transfer occurs between wild and farmed fish, and I am satisfied that salmon farms along the sockeye migration route have the potential to introduce exotic diseases and to exacerbate endemic diseases that could have a negative impact on Fraser River sockeye.

Do current management measures ensure that the risk of serious or irreversible harm is minimal?

Having concluded that there is some (at present unquantifiable) likelihood of harm to Fraser River sockeye from salmon farms, and that the potential harm is of a serious or irreversible nature, the next question is whether current management measures ensure that the risk of harm is minimal. As I noted above, based on the information before me, British Columbians will not tolerate more than a minimal risk of serious harm to Fraser River sockeye from salmon farms.

DFO's Wild Salmon Policy indicates that the risks to wild stocks from salmon farming are mitigated through measures such as improved cage structure, proper farm siting, and Fish Health Management Plans (FHMPs).[61] I heard little evidence on improved cage structures; however, I infer they may reduce the risk of Atlantic salmon escapes, though, as stated above, Atlantic salmon escapes do not pose a risk of serious harm to Fraser River sockeye.

For farm siting to mitigate risks to Fraser River sockeye, consideration must be given to the Fraser sockeye migration route and the potential negative cumulative effects to sockeye from migrating past multiple salmon farms. In my view, proper farm siting holds the potential to address the risks of disease and pathogen transfer that salmon farms pose to Fraser River sockeye because it can address issues of increased risk that come with the proximity of Fraser River sockeye to a fish farm. However, as described below, current siting practices need to be revised to achieve this result.

When salmon farmers apply for new aquaculture sites, DFO and the province apply siting criteria to screen out unsuitable applications. In early 2000, the province established the current siting criteria in consultation with DFO. These siting criteria do not explicitly require consideration of Fraser River sockeye migration routes. Instead, they state that salmon farms should not be located within 1 km of the mouth of a "salmonid bearing stream determined as significant."[62] However, this criterion has little relevance to the protection of Fraser River sockeye because it does not address the risk to migrating sockeye beyond 1 km of the mouth of the Fraser River. Of greater concern to Fraser River sockeye are the narrow passages along the smolt outmigration route, particularly through the Discovery Islands, where the wild smolts are brought into close contact with salmon farms, thereby increasing the potential for disease transfer between farmed and wild fish. In my view, the risk of serious harm that salmon farms pose to Fraser River sockeye along their entire migration route – not just 1 km from the mouth of the river – needs to be considered and reflected in siting criteria.

In testimony, DFO management staff said that the siting criteria could be revised.[63] As these criteria have been in use for several years, they may not reflect the most recent scientific knowledge about the risks posed to wild stocks by salmon farms. They should be updated to reflect the best available science as well as input from First Nations and stakeholders affected by the siting of fish farms.

DFO witnesses told me that, although not mentioned in the siting criteria, sockeye migration routes and the potential for disease and pathogen

transfer along those routes have been considered in the siting of salmon farms.[64] Indeed, in evidence were three screening assessments under the *Canadian Environmental Assessment Act* (CEAA)[65] that considered the introduction of diseases and disease transfers to wild stocks in the siting of salmon farms.* However, other evidence leaves me questioning whether these issues have been considered for all farm sites. DFO was not able to tell me that every salmon farm has received an environmental assessment.[66] Also, past assessments appear to have focused on the impact of salmon farms on the benthos, the bottom of the ocean, rather than on issues more likely to affect migrating sockeye, such as disease or pathogen transfer.[67] A witness from the province told me that, in the past, sites were approved on a case-by-case basis.[68] Further, DFO Science has done little or no research to assess the combined impact on sockeye salmon as they migrate past several different salmon farms along their migratory route.[69] In summary, although proper farm siting holds the potential to minimize the risks of serious harm to Fraser River sockeye, it requires the explicit assessment of the proximity of farm sites to migrating Fraser River sockeye.

The Wild Salmon Policy also lists FHMPs as tools to mitigate the risks of salmon farms. Salmon farmers prepare FHMPs according to a DFO template. They set out measures for broodstock screening and for controlling diseases within the net cages. Specific management practices in the plans (e.g., vaccinations, disease control options such as treatment or culling fish, and biosecurity measures) are intended to reduce the risk of disease transmission from farmed to wild fish by keeping the fish inside the net pens as healthy as possible. (See the discussion in Volume 1, Chapter 9, Fish health management.) Farmed fish are screened for diseases, beginning at the egg stage, through freshwater development, and during their time in marine net pens. Dr. Noakes told me that all the diseases found on fish farms were endemic diseases. He also said that, of the 32 million fish on BC salmon farms, only about 2 percent, or 600,000 per year, are fresh silvers, of which some unknown percentage died of disease. In his view, this is "quite low" compared with the mortality rate of 3 percent per day for juvenile wild salmon.[70] However, I also heard that FHMPs do not eliminate all occurrences of disease and pathogens in net-pen farms.[71]

I accept the evidence that management practices taken within net pens are intended to reduce the risk of disease as much as possible and to keep both farmed and wild fish healthy. However, I cannot determine on the evidence before me whether those measures ensure that the risk of serious harm from disease and pathogen transfer is a minimal one. As described in the section above on the likelihood of harm, too little research has been done on the effects of salmon farms and related diseases and pathogens on Fraser River sockeye for me to reach a conclusion either way. Again, the evidence before me shows plausible mechanisms for harm and many knowledge gaps.

Could further reasonable and cost-effective measures be employed?

Although I cannot assess the extent to which current management practices minimize the risk of serious or irreversible harm to Fraser River sockeye from salmon farms, I can comment and make recommendations about what further reasonable and cost-effective measures could be employed to reduce the risk or reduce scientific uncertainty about that risk.

DFO witnesses told me that, going forward, DFO intends to take an ecosystem-based approach to the management of salmon farms.† Under the new Integrated Management of Aquaculture Plans, DFO intends to evaluate new salmon farm sites on an ecosystem rather than a site-by-site basis.[72] This news is encouraging, but work must proceed quickly to give prominence to the proximity of salmon farms to Fraser River sockeye migration routes.

---

* I note that on June 29, 2012, Bill C-38, *An Act to implement certain provisions of the budget tabled in Parliament on March 29, 2012 and other measures*, received royal assent. Part 3, Division 1, enacts the *Canadian Environmental Assessment Act, 2012* (CEAA, 2012). As a result, references in this Report to the CEAA may not reflect the current law respecting environmental assessment in Canada or the applicability of environmental assessments to salmon farms. As discussed in Chapter 3, Legislative amendments, it may be even less likely that salmon farms would be reviewed under the amended Act.

† I note that, on June 29, 2012, Bill C-38, *An Act to implement certain provisions of the budget tabled in Parliament on March 29, 2012 and other measures*, received royal assent. As discussed further in Chapter 3, Legislative amendments, Bill C-38 amends the habitat protection provisions in a way that may have an impact on DFO's use of an ecosystem-based approach.

Given the risk of serious harm posed by salmon farms to Fraser River sockeye, DFO needs to ensure that existing farm sites conform to the most up-to-date knowledge to ensure that risks are minimal. I note that, in about 2005, when DFO established thresholds of compliance for benthic impact from salmon farms, it did not apply that standard retroactively to existing sites.[73] Similarly, the regional director general of DFO's Pacific Region told me that new standards put in place by DFO for site selection under the Pacific Aquaculture Regulatory Program would apply only to new salmon farm sites, not those originally licensed under the provincial regulatory regime.[74] These examples cause me concern. They provide little confidence that the most up-to-date standards and practices are being applied to all salmon farms potentially affecting Fraser River sockeye, irrespective of when the farm site first became operational. If siting measures are to serve as a useful tool to minimize the risk of serious harm to Fraser River sockeye, they must be adaptive to new scientific information. If new information reveals that existing farm locations pose more than a minimal risk of serious harm to Fraser River sockeye, those farms should be removed.

For the "proper farm siting" mentioned in the Wild Salmon Policy to effectively minimize the risk of serious or irreversible harm to Fraser River sockeye, DFO needs to focus on the following measures:

- Protection of Fraser River sockeye from negative impact along their entire migratory route. Special consideration should be given to areas such as the Discovery Islands, where Fraser River sockeye come into proximity to salmon farms.
- Protection of Fraser River sockeye from the potential negative cumulative effects of swimming past multiple farms sited on their entire migration route.
- Frequent and regular revision of siting criteria to account for new scientific information about the risk of fish farms to Fraser River sockeye.
- Retroactive application of revised siting criteria to existing sites, even if it entails removing or relocating salmon farms off the Fraser River sockeye migration route.

In short, siting should be approached with the goal of the Wild Salmon Policy in mind: restoring and maintaining healthy and diverse salmon populations and their habitats for the benefit and enjoyment of the people of Canada in perpetuity. DFO should seek to approve the best sites to avoid negative impact on wild stocks, such as Fraser River sockeye, rather than the best sites to produce farmed salmon.

DFO also needs to take steps to minimize the scientific uncertainty about salmon farms and to re-evaluate its mitigation measures as that uncertainty diminishes. A 2003 Privy Council of Canada document, *A Framework for the Application of Precaution in Science-Based Decision Making about Risk*, makes these useful points about resolving scientific uncertainty in applying precaution:

- To resolve scientific uncertainty, research and scientific monitoring are key parts of the application of precaution.
- The responsibility for producing scientific data may shift among governments, industry, or other proponents.
- Where scientific information is inconclusive, decisions still have to be made to "meet society's expectations about enhancing living standards and addressing the potential for risks."[75]

Data presented during this Inquiry did not show that salmon farms were having a significant negative impact on Fraser River sockeye. However, as noted above, the statistical power of the database (containing fish health data from 2004 to 2010) was too low to rule out significant negative impact.[76] I accept the evidence of Dr. Korman and Dr. Dill that scientists need another 10 years of regulatory data (until at least mid-2020) before they can more confidently identify any relationships that may exist. As well, other than a few studies related to sea lice (mostly in species other than sockeye), DFO has not completed research into the effects of diseases and pathogens from salmon farms on wild Fraser River sockeye. Nor has DFO done any research into the cumulative effects on sockeye of having multiple salmon farms sited on their migration route. In sum, there are insufficient data (almost no data) to evaluate cause and effect relationships, and insufficient data (in terms of a time series of fish health data) to look for correlations between fish farm factors and measures of sockeye health such as productivity. As a result, significant scientific uncertainty remains

around the effect of salmon farms on Fraser River sockeye salmon.

Continuing to collect fish health data from salmon farms into 2020 will eventually allow for a more statistically robust assessment of whether fish farms along the sockeye migration route are affecting Fraser River sockeye. However, mitigation measures should not be delayed in the absence of scientific certainty. Much research may be done around farm–sockeye interactions and cause- and -effect relationships, which is not dependent on extending the time series of the fish health database. Additionally, in light of the uncertainty, and while DFO takes steps to better account for proximity to Fraser River sockeye in farm siting, it is appropriate to take measures to prevent any likelihood of harm from increasing. For that reason, I recommend no increase to salmon farm production in the Discovery Islands until such time as the impact of salmon farming on Fraser River sockeye can be determined, with some degree of certainty, to be minimal.

In summary, I have concluded that net-pen salmon farming in the Discovery Islands poses a risk of serious harm to Fraser River sockeye through the transfer of diseases and pathogens. The full extent and likelihood of that harm cannot be determined because of scientific unknowns. Precautionary measures should focus on filling the knowledge gaps and enabling DFO to adapt mitigation measures to new scientific information. I recognize that DFO may need some time to fulfill my research recommendations. However, as described above, I am also satisfied that British Columbians will not accept more than a minimal risk of serious harm to Fraser River sockeye from salmon farms. Therefore, it is appropriate to set deadlines to ensure that the uncertainty about the extent and likelihood of harm posed by salmon farms does not languish unaddressed. In the recommendations that follow, based on the evidence I heard about the state of research and the strength of regulatory data, I have chosen September 30, 2020, as the date by which DFO should be able to assess, adequately, the likelihood of net-pen salmon farms causing serious harm to Fraser River sockeye. If, by that date, DFO cannot confidently say the risk of serious harm is minimal, it should prohibit all net-pen salmon farms from operating in the Discovery Islands. If, before that date, DFO finds farms to pose more than a minimal risk of serious harm to Fraser River sockeye, those farms should be promptly removed.

Limiting salmon farm production and licence duration

14 Beginning immediately and continuing until at least September 30, 2020, the Department of Fisheries and Oceans should ensure that

- **the maximum duration of any licence issued under the *Pacific Aquaculture Regulations* for a net-pen salmon farm in the Discovery Islands (fish health sub-zone 3-2) does not exceed one year;**
- **DFO does not issue new licences for net-pen salmon farms in the Discovery Islands (fish health sub-zone 3-2); and**
- **DFO does not permit increases in production at any existing net-pen salmon farm in the Discovery Islands (fish health sub-zone 3-2).**

Revising and applying siting criteria for salmon farms

15 The Department of Fisheries and Oceans should explicitly consider proximity to migrating Fraser River sockeye when siting salmon farms.

16 After seeking comment from First Nations and stakeholders, and after responding to challenge by scientific peer review, the Department of Fisheries and Oceans should, by March 31, 2013, and every five years thereafter, revise salmon farm siting criteria to reflect new scientific information about salmon farms situated on or near Fraser River sockeye salmon migration routes as well as the cumulative effects of these farms on these sockeye.

17 The Department of Fisheries and Oceans should apply revised siting criteria to all licensed salmon farm sites. Farms that no longer comply with siting criteria should be promptly removed or relocated to sites that comply with current siting criteria.

Re-evaluating risk and mitigation measures for salmon farms

18 If at any time between now and September 30, 2020, the minister of fisheries and oceans determines that net-pen salmon farms in the Discovery Islands (fish health sub-zone 3-2) pose more than a minimal risk of serious harm to the health of migrating Fraser River sockeye salmon, he or she should promptly order that those salmon farms cease operations.

19 On September 30, 2020, the minister of fisheries and oceans should prohibit net-pen salmon farming in the Discovery Islands (fish health sub-zone 3-2) unless he or she is satisfied that such farms pose at most a minimal risk of serious harm to the health of migrating Fraser River sockeye salmon. The minister's decision should summarize the information relied on and include detailed reasons. The decision should be published on the Department of Fisheries and Oceans' website.

20 To inform the decision under Recommendation 19, the minister and the Department of Fisheries and Oceans should take the following steps:

- **Conduct the research and analysis recommended in Recommendation 68 and publish the results of this research.**
- **Assess any relationships between salmon farming variables compiled in the fish health database and Fraser River sockeye health or productivity.**
- **Invite from the salmon-farming industry and from other interested parties written submissions respecting the risk that net-pen salmon farms pose to the health of migrating Fraser River sockeye salmon.**
- **Publish on the DFO website the full text of all submissions received.**
- **Provide to submitters a reasonable opportunity to respond in writing to other submissions and publish such responses on the DFO website.**

Salmonid enhancement facilities

Salmon enhancement or production facilities include hatcheries, spawning channels, and other improvements designed to produce fish. In British Columbia there are 23 major federal (DFO) enhancement facilities, 21 community hatcheries operated as part of DFO's Community Economic Development Program, and approximately 350 public involvement projects supported by 18 DFO community advisors. In addition, provincial trout hatcheries are operated under the Freshwater Fisheries Society of BC. (See the section on habitat enhancement and restoration in Volume 1, Chapter 6, Habitat management, for a more detailed description of salmonid enhancement facilities.)

Fish health management at salmonid enhancement facilities

Salmonid enhancement facilities are regulated under the federal *Pacific Aquaculture Regulations*. Fish in enhancement facilities carry diseases and pathogens, and the potential exists for enhanced fish to transfer these pathogens to wild salmon stocks. Indeed, I heard evidence that fish with known and suspected infections have been released from enhancement facilities into fish-bearing waters.[77] In some cases, DFO's practice appears to be to release enhanced fish suffering from endemic diseases – in particular, bacterial kidney disease and endemic skin and gill parasites.[78]

The state of regulatory development for salmonid enhancement facilities is in its infancy:

- There are no standards for acceptable levels of disease or pathogens in enhanced fish.[79]
- There are no standard operating procedures across facilities, though DFO has "done a couple of workshops" to encourage community hatcheries to write their own standard operating procedures.[80]
- There are deficiencies in record keeping – use of different formats, lack of consistent record keeping, and, in some cases, only anecdotal information recorded.[81]

- Many facilities have no facility-specific fish health management plans, though they may have access to a template document.[82]
- There are minimal requirements for monitoring and reporting fish health issues under the facilities' conditions of licence.[83]
- There are no testing requirements under the conditions of licence, although in its major facilities, DFO does some screening for diseases where it knows certain diseases, such as bacterial kidney disease, are present in a watershed.[84]
- There is no auditing system or formal system of oversight, and there is a lack of resources to provide proper oversight, such as auditing Fish Health Management Plans and conducting site visits.[85]
- Facilities do not apply standardized pre-release screening for diseases, and some facilities do no pre-release screening at all.[86]

DFO needs to develop a basic regulatory program for salmonid enhancement facilities. Diseases at these facilities pose risks to Fraser River sockeye. Without established fish health standards, standardized procedures, and proper record keeping and monitoring, scientists and regulators cannot properly assess these risks and take informed preventive actions to reduce risks. DFO ought to take a precautionary approach to the management of disease at salmonid enhancement facilities.

Fish health management at salmonid enhancement facilities

21 The Department of Fisheries and Oceans should, by September 30, 2013, establish conditions of licence and a monitoring / compliance program in relation to salmonid enhancement facilities which contains the following minimum elements:

- **mandatory standard operating practices and record keeping;**
- **mandatory fish health management plans for all salmon enhancement facilities, whether DFO, provincial, or Community Economic Development Program; and**
- **audits / site visits of all enhancement facilities at least once per year by a fish health professional.**

22 The Department of Fisheries and Oceans should establish and maintain a database of enhancement facility fish health – possibly under the Aquaculture Resource Information Management System (ARIMS) that DFO is constructing for salmon farm data. In future years, DFO should use these data to evaluate the effect of diseases and pathogens at fish enhancement facilities on the health of Fraser River sockeye salmon. DFO should provide access to these data to non-government scientists for research purposes.

Interactions between Fraser River sockeye and enhanced salmon

In addition to the risk of disease and pathogen transmission from enhanced salmon to Fraser River sockeye, there are also risks associated with interactions between enhanced salmon and wild Fraser River sockeye in the marine environment.

According to Dr. Randall Peterman, a professor in the School of Resource and Environmental Management at Simon Fraser University, competition for food can occur between wild and enhanced salmon because their diets overlap and they are thought generally to pass through feeding areas at similar times and places.[87] Also, predation-induced mortality on wild juvenile salmon can be increased because predators are attracted by the high abundance of juvenile salmon resulting from large hatchery releases.[88]

Similarly, when wild and enhanced adult salmon co-migrate through fishing areas, pressure is intense on managers to allow high harvest levels. However, because wild stocks generally have lower productivity than enhanced fish, high-percentage harvest rates targeted on enhanced fish can eventually lead to over-harvesting and depletion of the abundance of wild co-migrating stocks that are subject to those same harvest rates.[89] Finally, after adults leave the ocean, large numbers of hatchery fish straying into spawning areas for wild fish can decrease the biological diversity and fitness of wild stocks.[90]

During the hearings on the marine environment, I heard that the interactions between hatchery and wild salmon is a substantial issue in fishery science and that an extensive literature exists on the potential interactions for pink, chum,

chinook, and coho. Dr. Richard Beamish, retired research scientist, DFO, testified that there is evidence of hatchery–wild interactions among various salmon species, although whether there could be a long-term substantial reduction in production is less clear among the scientific community.[91]

At the hearings on habitat enhancement and restoration, Dr. Peterman provided evidence that the body size of adult sockeye salmon decreases as the abundance of competitors increases, and that the survival rate of sockeye salmon can decrease as the abundance of pink salmon competitors increases.[92] He testified that there is a pressing need for research into the potential interactions between enhanced and wild fish. Additionally, at the hearings on the marine environment, Dr. Stewart McKinnell, lead author of Technical Report 4, Marine Ecology, told me that, when the abundance of fish is high in the North Pacific, the mean size of sockeye tends to be low. According to this report, the sea provides only limited amounts of food for growing sockeye salmon. Thus, Fraser River sockeye are smaller when the total abundance of sockeye in the Gulf of Alaska is greater. Dr. McKinnell said there is some evidence that Fraser River sockeye are significantly smaller in brood years that matured in odd-numbered years (e.g., 2005, 2007, 2009). A reduction in mean size in odd-numbered years may be a consequence of the competition for food with pink salmon during the period of overlap in the Gulf of Alaska.

However, Carol Cross, manager, Strategic Initiatives, Salmonid Enhancement Program, testified that neither the Salmonid Enhancement Program nor DFO Science was, at the time of the hearings, looking into the effects of competition between wild and hatchery salmon in the marine environment.[93] In her view, such studies are complex and large, requiring significant resources, and there is a limited capacity to undertake them.[94] She added that the Salmonid Enhancement Program recently asked DFO Science to consider a study to determine the carrying capacity for salmonids in the Strait of Georgia, in order to aid production planning decisions at hatchery facilities there.[95] At the time of the hearings in May 2011, this study had not yet been designed.

As noted earlier, the precautionary principle addresses situations involving risk and scientific uncertainty. The evidence satisfies me that interactions between Fraser River sockeye salmon and enhanced fish in the marine environment do pose a risk of serious harm to Fraser River sockeye. However, in the absence of a risk assessment, it is not possible to quantify the likelihood of the potential harm. Further, despite the evidence that salmon enhancement poses a risk to Fraser River sockeye marine survival and that DFO is aware of the nature of this risk, the department does not account for this risk in its management of the fishery.

In contrast to the evidence that salmonid enhancement poses a risk to Fraser River sockeye, throughout the hearings I heard evidence of the benefits to sockeye of habitat enhancement and restoration. I question, therefore, whether the department's prioritizing of salmonid enhancement over habitat enhancement and restoration is consistent with its conservation mandate. It is important that DFO undertake a risk assessment without further delay so a decision can be made on the future of salmonid enhancement facilities, including whether they should be maintained.

In making the above findings about the risk posed by salmonid enhancement, I recognize that there may be a distinction between salmonid enhancement for the purpose of producing fish to sustain commercial and/or recreational harvest and enhancement for conservation purposes. In my view, the Wild Salmon Policy signalled a partial shift in the department's rationale from enhancement for fisheries purposes to enhancement as a means of rebuilding those Conservation Units that have an unacceptable chance of extirpation.[96] The policy provides that the enhancement program will continue to evolve toward a greater emphasis on community stewardship, habitat restoration, and rebuilding of priority Conservation Units. Although hatchery production solely for conservation purposes may not pose the same risk of harm that large numbers of enhanced salmon for fisheries may pose, the risk to Fraser River sockeye of either type of hatchery production was, at the time of the hearings, unknown. Therefore, DFO should assess the risk of salmonid enhancement for both conservation and fisheries purposes.

Finally, I recognize that the management of any risk posed by salmonid enhancement to Fraser River sockeye will likely require international cooperation. For example, in 2008, Canada released 330 million hatchery salmon, but releases of salmon

fry and smolts for Pacific Rim countries (Canada, Japan, South Korea, Russia, and the United States) ranged from 4.7 billion to more than 5 billion annually from 1993 to 2008.[97]

Interactions between Fraser River sockeye and enhanced salmon

23 The Department of Fisheries and Oceans should, by September 30, 2013, complete and make public a risk assessment of the interactions of Fraser River sockeye salmon with enhanced salmon in the marine environment.

24 The Department of Fisheries and Oceans should work with the North Pacific Anadromous Fish Commission or an analogous international organization to address potential interactions in the high seas among wild and enhanced salmon from different countries, including developing plans for enhancement regulation and activities.

Management of the wild fishery

Integrated Fisheries Management Plan

As I describe in Volume 1, Chapter 5, Sockeye fishery management, as part of Fraser River sockeye salmon pre-season planning, DFO has, since 1999, produced an annual salmon Integrated Fisheries Management Plan (IFMP). The IFMP provides information and guidelines for management of the upcoming fishing season. The process begins with that year's chair of the IFMP process inviting relevant DFO sectors to designate representatives to an IFMP Development Committee. That committee discusses the results of the post-season review from the preceding fishing season and sets timelines for the collection of information. The chair consolidates that information into a draft IFMP. After the Development Committee members review the draft, DFO incorporates their feedback into a second draft IFMP that reflects internal agreement in principle on the main elements, issues, and objectives.

In March and May meetings, DFO invites input on the second draft IFMP from the Integrated Harvest Planning Committee (IHPC) and from the Commercial Salmon Advisory Board, the Sport Fishing Advisory Board, and First Nations. The IHPC, stakeholders, and First Nations are invited to discuss the content of the IFMP, provide additional information, and suggest changes. DFO incorporates some of this feedback into the next draft of the IFMP document.

Internal sector directors also provide input into the draft IFMP. Once a near-final draft is ready, DFO Pacific Region's Salmon Team prepares a briefing note for the minister that includes recommendations regarding sign-off on a final version of the IFMP. The regional director, Fisheries and Aquaculture Management (FAM), and the Pacific Region's regional director general then vet this briefing note locally, followed, at the national level, by vetting by an assistant deputy minister and the director of fisheries resource management.

The IFMP and a briefing note are delivered to the minister in late June or early July. The minister may, before approving the IFMP, make alterations to it. Once approved, the IFMP is posted on DFO's regional and national websites.

As I mention in Volume 1, Chapter 5, Sockeye fishery management, when the IHPC was introduced in 2004, it was understood to be an advisory rather than a decision-making process. It was intended to provide an opportunity for different interests to come together to coordinate fishing plans and resolve potential conflicts. In closing submissions, Canada (on behalf of DFO) described the IHPC as "the key advisory process used by DFO for integrated planning of the Pacific salmon fishery."[98]

During the hearings, some witnesses criticized the IHPC and the IFMP approval processes. For example, Jeffery Young of the David Suzuki Foundation and Marine Conservation Caucus cited a lack of transparency in DFO's decision making, saying that some recommendations made by stakeholders and First Nations during the IHPC process are not incorporated into the final IFMP document, yet no explanation for their absence is provided.[99] As I have described the IFMP approval process above, the draft IFMP document is revised once after the IHPC stage, and the briefing note that DFO then prepares for the minister goes through

four edits, twice regionally and twice in Ottawa. After the minister approves the IFMP, DFO provides no explanation about this decision-making process and the basis for the minister's final decision regarding the IFMP.

I can understand the frustration felt by stakeholders and First Nations, including those involved in the IHPC. They accept that DFO's consultation on the IFMP is only an advisory process, but they often have invested much time and energy into reviewing and commenting on the IFMP. If their suggestions are not acceptable to DFO, they would like to understand why. At the same time, I understand the time constraints DFO is under to receive ministerial approval of the IFMP before the fishing season begins. It would not be realistic to expect DFO to report back to the IHPC, stakeholders, and First Nations at each stage leading up to the minister's final approval.

I do not question either the minister's authority to make final decisions on the Integrated Fisheries Management Plan or the fact that the minister will properly rely on advice from within the department in doing so. However, I think it only fair that DFO be accountable to the stakeholders and First Nations and provide a basis for its decision making.

Integrated Fisheries Management Plan

25 Within 30 days of the minister of fisheries and oceans approving the Integrated Fisheries Management Plan (IFMP), the Department of Fisheries and Oceans should make public the rationale for the harvest rules set out in the Fraser River Sockeye Decision Guidelines section of the IFMP.

Escapement target planning

Between 2002 and 2006, DFO developed the Fraser River Sockeye Spawning Initiative (FRSSI), described as a "quantitative modeling tool for assessing harvest rules for Fraser River sockeye salmon given conservation needs and other management objectives."[100]

Escapement strategies in the FRSSI model are defined as a total allowable mortality (TAM) rule that specifies the total allowable mortality rate for Fraser River sockeye at different run sizes. The escapement strategies are designed around three fundamental considerations:

- no fishing at very low run sizes, except for test fishing;
- fixed escapement at low run sizes to protect the stocks and reduce process-related challenges at this critical stage; and
- a fixed total allowable mortality rate at larger run sizes. Currently, TAM is set at 60 percent, which includes the total number of fish that are caught in the fisheries or that die en route to the spawning grounds.

Fisheries are managed according to the Early Stuart, Early Summer, Summer, and Late-run timing groups (based on the historic timing of the migration to their spawning grounds). Any run-timing group may contain a mix of Conservation Units that are relatively weaker or stronger in terms of productivity.* Accordingly, DFO recognizes a need for precaution in setting the maximum mortality rate.[101] DFO includes options for escapement strategies in its draft IFMP, which is presented to and discussed by the IHPC. As described above, the draft IFMP is provided to, and reviewed by, the harvest sectors outside the IHPC process as well.

Al Cass, DFO scientist and one of the creators of the FRSSI model, testified that the model itself does not allocate harvest. Rather, it determines the TAM rules, after which DFO managers allocate harvest (mortality) among the commercial, recreational, and Aboriginal fisheries and account for mortality through other causes.[102]

The FRSSI model has been the subject of criticism. For some, the 60 percent TAM ceiling is too high. For others, it is too low, allowing too many fish to escape to the spawning grounds and resulting in forgone catch. Rob Morley, vice-president of the Canadian Fishing Company and a member of the Fraser River Panel, expressed concern that DFO does not consider economic trade-offs that must be made in setting total allowable mortality / escapement. He suggested that, when presenting the four optional escapement targets in a given year for a given run, DFO should conduct an economic evaluation of the harvest rates before choosing a model.[103] Other

* Productivity is the number of recruits returning per spawner.

criticism of the FRSSI model and process focused on a lack of consideration of the effect of habitat on productivity and the resulting escapement targets.[104]

In 2010, DFO Science evaluated the FRSSI methodology and identified several priority areas for ongoing work. I was told that DFO intended to review the TAM rules, among other things, in 2011.[105] However, at the time of our evidentiary hearings, that review had not taken place. I encourage DFO to complete this process.

Escapement target planning

26 The Department of Fisheries and Oceans should, by September 30, 2013, complete its planned review of the Fraser River Sockeye Spawning Initiative model and address the criticisms of the model:

- **whether the maximum total allowable mortality as a function of run size should be 60 percent;**
- **whether the model could more explicitly state what values are being weighed and how they are weighed; and**
- **whether habitat considerations and large escapements could be brought into escapement planning.**

Fraser River temperature and flow monitoring

The Fraser River Panel determines the annual management adjustments that are added to the escapement targets. Management adjustments are a way of estimating the number of fish that will be lost to en route mortality through a variety of factors, including high water temperature, high or low water flow, disease, predation, and illegal catches. They also allow for estimation errors when fish are counted. They are a means to ensure that, in season, enough fish arrive at Mission so that sufficient fish subsequently arrive at the spawning grounds to meet the escapement targets set by Canada for each of the Fraser River sockeye run-timing groups.

The number of sites monitored for water temperature decreased in the 1980s and 1990s, when DFO took over from the predecessor to the Pacific Salmon Commission (PSC), but by 2010 monitoring had returned to the level in place in the 1960s. It is important to maintain the full data set of environmental conditions in the Fraser River to enable the most accurate modelling of management adjustments. Currently, DFO monitors in-river temperature and flow to enable the calculation of management adjustments. Environment Canada has the mandate to monitor water quality, of which water temperature is a main attribute, though I heard evidence that it could be doing more in this area.

Fraser River temperature and flow monitoring

27 The Department of Fisheries and Oceans and Environment Canada should continue to monitor, at not less than 2010 levels, Fraser River temperature and flow.

In-season management

Test-fishing program

Early in the year, the Pacific Salmon Commission provides to Canada and the United States a test-fishing plan, which includes the proposed budget required from each country to fund test fisheries. The purpose of the test-fishing program is to collect physical, biological, and catch per unit effort information that is used to provide estimates of run size and other stock assessment data for key stock components of Fraser River sockeye salmon runs.

In the case of Canada, once the test-fishing plan is agreed to, Canada transfers funds to the PSC. The PSC issues all the contracts for test fishing in Panel and non–Panel Area waters, although in non–Panel Area Canadian waters, DFO staff direct the test fishers. For the fiscal year ending March 31, 2010, the total cost of the Pacific Salmon Commission's test-fishing program for Panel and non–Panel Area waters was $1.3 million.[106]

The regional director general for DFO Pacific Region told me that the test fishery provides key information that informs the management decisions and is very important to the day-to-day management of the fishery.[107]

Historically, DFO funded its share of the test-fishing program by allowing fishers participating in the program to keep their catch. However, in

the 2006 *Larocque* decision, the Federal Court of Appeal determined that, because fish are a common property resource belonging to all the people of Canada, in the absence of express legislative authority, DFO does not have the power to finance its scientific research activities by selling them.[108] In response, DFO earmarked funds for test fisheries through its "*Larocque* relief funding," a five-year national program ending in 2011. I was told that Canada has repeatedly asked the Pacific Salmon Commission to reduce test fishing because of the cost of the program to DFO, a request the PSC has resisted.[109] At the time of the evidentiary hearings, DFO had not committed to continuing this funding after 2011. However, on June 29, 2012, Bill C-38, *An Act to implement certain provisions of the budget tabled in Parliament on March 29, 2012 and other measures*, received royal assent. Section 411 amends the *Fisheries Act* to authorize the minister to determine "a quantity of fish or fishing gear and equipment that may be allocated for the purpose of financing scientific and fisheries management activities that are described in a joint project agreement entered into with any person or body, or any federal or provincial minister, department or agency." (For further discussion of Bill C-38, see Chapter 3, Legislative amendments.)

I am satisfied that the test-fishing program is critical to the Fraser River sockeye salmon fishery, providing key information on stock composition, run sizes, and run timing used to make prudent harvesting and escapement decisions. It is, in my view, essential that DFO's contribution to the cost of the test-fishing program continue. Without these test-fishing data, and those from the hydroacoustic facilities discussed below, DFO could not manage the Fraser River sockeye fishery.

Test-fishing program

28 The Department of Fisheries and Oceans should continue to contribute to the Pacific Salmon Commission's test-fishing program so it is capable of operating at the 2010 level.

Funding of hydroacoustic facilities

Under the Pacific Salmon Treaty, the Pacific Salmon Commission is responsible for operating the hydroacoustic facility at Mission. PSC staff collect data to reflect daily returning sockeye abundance. These data, coupled with those obtained in the test fisheries, are essential to the determination of in-season run size. Mike Lapointe, chief biologist with the Pacific Salmon Commission, testified that the Mission hydroacoustic facility is the single most important part of the in-season run size estimation. The Mission facility captures data on 10–15 percent of the fish swimming up the Fraser River, whereas fish caught in the test fisheries represent only approximately 0.5–1 percent of the fish.[110]

DFO's Science Branch conducted hydroacoustic monitoring at Qualark (2–3 days farther upstream for migrating salmon) between 1993 and 1998 and reinstituted monitoring there in 2007, using a new sonar system. According to Dr. Brian Riddell, CEO of the Pacific Salmon Foundation, Qualark allows for more accurate abundance data because of the new equipment, coupled with a narrow passage for the fish, and the fact that pink salmon do not migrate this far upstream.[111] Mr. Lapointe testified that Qualark data provide a very good cross-check or confirmation of the Mission data.[112] Indeed, in 2010, in-season adjustments were made to the Mission estimates based on Qualark data.[113]

There is no funding agreement for Qualark, and DFO has not, at the time of the evidentiary hearings, made a commitment to future funding for Qualark. According to Mr. Lapointe's November 2010 report to the PSC's Fraser River Panel, the annual operating cost for Qualark is approximately $300,000.[114]

I am satisfied that the Mission and Qualark hydroacoustic facilities each provide the Pacific Salmon Commission and DFO with the best available information about in-season run size and that the Qualark data are a very good confirmation of the Mission information. In my view, DFO should continue to fund both facilities.

Funding of hydroacoustic facilities

29 The Department of Fisheries and Oceans should continue to provide sufficient funding to enable the Pacific Salmon Commission's hydroacoustic facility at Mission and DFO's hydroacoustic facility at Qualark to operate at the 2010 level.

Selective fishing

Since the mid-1990s, there have been initiatives in Canada and internationally to develop responsible fisheries practices, as I discuss in Volume 1, Chapter 5, Sockeye fishery management. For example, in 1998, Canada's commercial fishing industry developed a *Canadian Code of Conduct for Responsible Fishing Operations* that states, in Principle 6, "To the extent practical, fish harvesters will minimize unintended by-catch and reduce waste and adverse impacts on the freshwater and marine ecosystems and habitats to ensure healthy stocks."[115]

Between 1998 and 2002, DFO funded the Pacific Salmon Selective Fisheries Program, to develop, evaluate, and facilitate implementation of selective fishing techniques in commercial, First Nations, and recreational salmon fisheries. In 2001, DFO released A Policy for Selective Fishing in Canada's Pacific Fisheries (Selective Fishing Policy), which defined selective fishing as "the ability to avoid non-target fish, invertebrates, seabirds, and marine mammals or, if encountered, to release them alive and unharmed."[116]

In its 2001 Integrated Fisheries Management Plan for the South Coast, DFO introduced selective fishing measures that were then translated into commercial fishing licensing conditions, including brailing for the seine fleet, maximum set times for the gillnet fleet, barbless hooks for the troll fleet, and revival boxes for all three fleets. The Selective Fishing Policy and these licence conditions were, at the time of the hearings, still in force, but no directed programs addressed selective fishing, and there was no designated DFO lead for the policy. In my view, it is essential that DFO designate an individual to coordinate scientific, educational, and management efforts in relation to selective fishing practices.

Dr. Brent Hargreaves, a DFO research scientist who conducted selective fishing research in the 1990s and 2000s, testified that, as a result of the cessation of the Selective Fisheries Program, there is a gap in the research concerning the long-term survival of released fish. He explained that "the value of those [selective fishing] methods depends entirely on the post-release survival rates and the effectiveness of those fish to get back and spawn successfully."[117] The authors of Technical Report 7, Fisheries Management, Karl English and others, agreed:

> Unfortunately, there is almost no scientifically defensible information on post-release mortality associated with any freshwater gear type and across all three fishing sectors for Pacific salmon … There has been little research to quantify levels of mortality or to understand the mechanism underlying mortality in order to better mitigate or prevent mortality. Without this type of information, especially in an era of warming rivers wherein we expect higher stress-related mortality … it is difficult to ensure sustainability of salmon fisheries and conservation of stocks.[118]

I accept this evidence. I am satisfied that selective fishing practices promote conservation. However, without some effort to coordinate selective fisheries activities, led by a designated individual, the Selective Fishing Policy by itself will not lead to more responsible fisheries practices.

Selective fishing

30 The Department of Fisheries and Oceans should

- **designate an individual to coordinate scientific, educational, and management efforts in relation to selective fishing practices; and**
- **study post-release survival rates for all fisheries.**

Fisheries monitoring and catch reporting

Knowing the number of fish that are harvested in the commercial, recreational, and Aboriginal (food, social, and ceremonial [FSC] and economic opportunity) fisheries is important for several reasons. DFO scientists use the previous years' catch estimates in preparing pre-season forecasting models, which fisheries managers then use to plan the fisheries. DFO and the Fraser River Panel rely on estimates of catch from Canada in their decisions regarding in-season fishery openings. DFO scientists rely on catch estimates to support stock assessment research and activities. Also, without accurate catch estimates, it can be difficult to determine what impact a particular fishery may have on individual stocks of concern.

Fisheries-monitoring and catch-reporting programs differ among the commercial, recreational, and Aboriginal sectors and among the gear types and areas in each fishery. Catch estimates may rely on fishers reporting their own catch numbers (fisher dependent), on information collected by monitors independent of the fishers (fisher independent), or on a combination of the two. Where catch reporting is fisher dependent, there is the potential for inaccurate reporting of catch, whether inadvertent or intentional. Independent verification of catch numbers and fishing effort may be used to validate the accuracy of fisher-dependent numbers.

In the commercial fishery, catch estimation is primarily fisher dependent, with varying levels of independent catch validation in some fisheries. DFO requires commercial fishers to complete phone-in reports to DFO, typically by the following morning and no more than 24 hours after fishing. All commercial licence holders must record their catch in a logbook that is returned to DFO at the end of the fishing season. However, DFO also conducts or contracts some fisher-independent on-the-water patrols. Some commercial fisheries are also subject to dockside monitoring, in which a percentage of returning boats have their catch numbers validated by an independent monitor.

In the recreational fishery, catch estimation is primarily by a creel survey, which includes rod counts (estimating the number of people fishing on the river at a given time) and an access survey, in which DFO staff interview recreational fishers as they are leaving their fishing locations and obtain information about how long they were fishing, their target species, and how many fish they caught and released or kept.

In the Aboriginal FSC fishery, catch reporting varies, depending on the area and the method of fishing, and includes a census program, an aerial roving access survey, and hail programs complemented by DFO or Aboriginal fishery officer patrols and final hail counts at the close of the fishery. Some First Nations have a monitoring program where all FSC fish are counted and reported to DFO weekly. Aboriginal economic opportunity fisheries in the Lower Fraser River are monitored using a mandatory landing program, in which 100 percent of fish harvested are counted by a dockside monitor. The mandatory landing programs are run by First Nations fisheries organizations funded through agreement with DFO.

Several witnesses were asked for their understanding of the effectiveness of fisheries monitoring and catch-reporting programs and the accuracy of the catch estimates they produce. Dr. Robert Houtman, catch-monitoring biologist, DFO, told me that his "sense" and the "Department's sense" is that commercial catch estimates for sockeye are "quite a good estimate."[119] When asked to explain what "quite good" meant, he said that it is "difficult to put a number on" it, but he suspects that 95 percent of the commercial catch is accounted for.[120] Matthew Parslow, acting management biologist, DFO, who works with Lower Fraser First Nations, said he thinks that DFO has a "good program" in place that achieves a "fairly good estimate of the catch" in the Aboriginal set net fishery and "quite good" estimates for the Aboriginal drift net fishery.[121] He later stated that probably 90 percent of the catch, if not more, was accounted for.[122] Lester Jantz, area chief, Resource Management, BC Interior, DFO, told me that the major Aboriginal fisheries in that area are monitored with programs that provide a "fairly reliable catch estimate under the current funding levels."[123]

The authors of Technical Report 7, Fisheries Management, also provided a qualitative assessment of the accuracy, precision, and reliability of catch estimates in the commercial, recreational, and Aboriginal fisheries. They report that the accuracy of Aboriginal FSC and economic opportunity fishery catch estimates are "good," whereas the accuracy of the commercial and recreational fishery catch estimates are "fair." The authors consider the reliability of these estimates to range from "medium" to "good."[124]

In contrast, Randy Nelson, regional director of DFO's Conservation and Protection Branch, testified that he believes there are large gaps in the accuracy of catch estimates in all fisheries. He told me that, over the years when his officers provided evidence of illegal harvest to resource managers, they sometimes did not know what to do with it.[125] Mr. Parslow confirmed that DFO does not have any system in place to estimate illegal or unauthorized catch, and that the catch information obtained from the Conservation and Protection Branch is not used in the management of the fishery.[126]

Based on the evidence, I am satisfied that accurate catch estimates are an essential component of DFO's management of the Fraser River sockeye fishery. I accept the testimony of Colin Masson, element lead, Pacific Integrated Commercial Fisheries

Initiative (PICFI), DFO, that there has been a "crisis of confidence" among harvesters and the general public as to the accuracy and reliability of catch estimates,[127] a problem that the Integrated Salmon Dialogue Forum (ISDF) publication, *Charting Our Course*, also raises.[128] The use of qualitative terms such as "good" or "fair," rather than more quantitative and precise measurements, to describe the accuracy of catch estimates is, in my view, unsatisfactory, given the importance of catch monitoring and the public's lack of confidence in DFO's catch estimation. I am also concerned that DFO does not estimate illegal or unauthorized catch to use in its management of the fishery. This information could be helpful to fisheries managers in a variety of ways – for example, in directing enforcement activities, allocating fishing access, and providing post-season accounting of returns.

In developing recommendations in this area, I am cognizant that fisheries monitoring and catch reporting are complex exercises requiring consideration of the unique aspects of each fishery. As described above, catch-estimation methods differ among the commercial, recreational, and Aboriginal fisheries and among the gear types and areas within those fisheries. I accept that there may be valid reasons for the different methods used. The monitoring methods required to achieve conservation objectives in a mixed-stock seine boat fishery may well differ from those required in a small terminal dip net fishery.

Though different monitoring and reporting methods may be applied to each fishery, there is a reasonable expectation that the statistical quality and reliability of the catch estimates produced will be consistent and satisfactory in meeting conservation objectives. In other words, the methods used may differ, but the quality of catch estimation results ought to be comparable.

DFO, First Nations and stakeholders, through consultation and the efforts of the ISDF, have worked toward articulating the quality of catch estimates required. As described in the section on catch monitoring in Volume 1, Chapter 5, Sockeye fishery management, DFO and the ISDF have created tables setting out monitoring standards of "basic," "moderate," and "enhanced," depending on the degree of conservation risk, the type of fishery operations, the catch information required, and the ecosystem or habitat considerations at play. For example, an enhanced level of monitoring applies to fisheries where there is a high conservation risk, a potential for bycatch of sensitive Conservation Units, a high relative fishing capacity, or a high-value species being caught, thereby creating an incentive to under-report the catch. An enhanced level of monitoring also applies if the fishery is managed by defined shares or allocations, the fishery is subject to eco-certification requirements, fisheries managers require accurate and timely records of the operational details of the fishery (e.g., effort, location, gear), or future fishing opportunities (i.e., openings and closings) are dependent on precise and timely catch information.[129] With an enhanced level of monitoring, catch estimates are to achieve a statistical quality of precision within 5 percent, with greater than 20 percent of the catch validated (counted) by an independent party.[130]

I am satisfied that, applying the factors articulated by DFO and the ISDF, the Fraser River sockeye salmon fishery should be monitored at an enhanced level and should achieve catch estimates that fall within 5 percent of actual catch as determined by greater than 20 percent independent validation. In order to achieve this outcome, it is my view that certain aspects of DFO's catch-estimation practices must change.

First, in order to improve the completeness and accuracy of fisher-dependent catch reports, DFO should enforce penalties for non-compliance with catch-reporting requirements. Dr. Houtman described one example in which DFO required commercial fishers to return their harvest logbooks before being issued the subsequent year's annual fishing licence. This requirement led to a dramatic improvement in the percentage of logbooks returned.[131] Where non-compliance with reporting requirements exists, DFO must take persuasive action to address it.

Second, DFO should confirm the role of fishery officers in reporting illegal harvest numbers. Fishery officers on the water lend a valuable set of eyes and ears that should be considered by fishery managers in estimating catch. To be complete and accurate, catch estimates must also consider credible observations of illegal harvest, in addition to reports of legal harvests.

Third, DFO must provide sufficient and stable resources to support an enhanced level of fisheries

monitoring, including funds for independent validation of catch.* I heard that aspects of recreational, commercial, and Aboriginal fisheries monitoring rely on Pacific Integrated Commercial Fisheries Initiative program funding, set to expire in 2012.[132] Mr. Jantz expressed concern that, with the loss of these funds, the quality of catch estimates in the BC Interior area will be compromised.[133] Mr. Parslow expressed similar concerns for the Lower Fraser area, stating that, without PICFI funds, DFO would be limited to core staff with no seasonal technical support for field surveys or boat patrols associated with catch monitoring.[134] As an essential aspect of DFO's fisheries management function, catch estimation programs must be provided with the resources necessary to maintain an enhanced quality of catch estimates and to rebuild public confidence.

Dr. Houtman told me that commercial fishers pay for a portion of the fisheries monitoring and catch reporting in the commercial fishery, in particular for the logbook program.[135] Mr. Masson explained that it is DFO's stated intention to move costs associated with enhanced monitoring onto commercial fishers and that this transfer has already been done in the context of demonstration fisheries using individual transferable quotas.[136] (Individual transferable quotas are described in the section below on share-based management.) However, I also heard from commercial fishing witnesses that they were not content to bear the increased expense of enhanced fisheries monitoring and that doing so may cause significant hardship to them.[137]

In contrast, DFO funds the monitoring of Aboriginal economic opportunity fisheries, and Mr. Masson testified that DFO has no plans to transfer monitoring costs to First Nations at this point, although it might in the future.[138] If DFO decides that those engaged in commercial fisheries should bear some or all of the costs associated with catch monitoring, then in principle mainstream commercial fishers and those engaged in Aboriginal economic opportunity fisheries, where not based on an Aboriginal right to fish for economic purposes, should be treated equally.

Fisheries monitoring and catch reporting

31 The Department of Fisheries and Oceans should ensure that all Fraser River sockeye salmon fisheries are monitored at an enhanced level (achieving catch estimates within 5 percent of actual harvest, with greater than 20 percent independent validation). To meet this objective, DFO should

- **enforce penalties for non-compliance with catch-reporting requirements;**
- **confirm the role of fishery officers in reporting illegal harvest numbers to fisheries managers and establish a system to incorporate such numbers into official catch estimates;**
- **establish a program for independent catch validation;**
- **provide sufficient and stable funding to support enhanced catch-monitoring programs; and**
- **treat commercial and Aboriginal economic opportunity fishers equally regarding any requirement of fishers to contribute toward the cost of catch monitoring, subject to any accommodation required in support of an exercise of an Aboriginal right.**

Stock assessment

There are several components to DFO's stock assessment program which, collectively, are important for two main reasons: first, to help understand population dynamics and the production of different stocks; and second to assist in forecasting run sizes, generating escapement targets, and developing post-season estimates of total return.

Escapement enumeration at spawning grounds involves calculating the number of adult salmon returning to their spawning grounds. Enumeration is done using a combination of low- and high-precision assessments, one of which in particular – mark-recapture – is a precise yet costly method. Mark-recapture involves sampling a portion of the returning Fraser River sockeye population downstream

* I note that in the budget tabled in Parliament on March 29, 2012, the government proposes to provide $33.5 million in 2012–13 to extend the Atlantic Integrated Commercial Fisheries Initiative and the Pacific Integrated Commercial Fisheries Initiative.

of spawning areas, marking them, and then releasing them. At the spawning grounds, another portion is captured. After the number of marked individuals within the sample is counted, an estimate of the total population size can be obtained by dividing the number of marked individuals by the proportion of marked individuals in the second sample.

Mark-recapture used to be applied to returning Fraser River sockeye populations anticipated to be larger than 25,000. In 2005, as a result of funding pressures, DFO raised the threshold for the use of mark-recapture to returning populations greater than 75,000. The evidence indicates that this change has not had a detrimental effect on Fraser River sockeye stock assessment. However, Timber Whitehouse, area chief, Fraser River Salmon Stock Assessment, DFO, acknowledged that, because DFO Science has not been able to complete the research on this issue, there is an unresolved issue regarding the appropriate calibration of low-precision enumeration methods now used for spawning populations in the 25,000–75,000 range.[139]

DFO also conducts an assessment of post-incubation fry (juvenile) production in sockeye nursery lakes and some rivers. I was told that DFO's survey work of nursery lakes is not as extensive as it was in the 1980s and 1990s. In Technical Report 10, Production Dynamics, authors Dr. Randall Peterman and Dr. Brigitte Dorner recommend that DFO strategically increase the number of sockeye stocks for which it annually estimates juvenile abundance (i.e., beyond Shuswap and Quesnel lakes). In their view, it is important to have a time series of abundance data on at least one juvenile stage (in addition to spawners and adults) so it will be possible to identify the portion of the total life cycle in which major changes in survival have occurred.I agree with their analysis.

DFO also conducts nursery lake productivity assessments (i.e., the chemical, physical, and biological properties of the lake) to determine the ability of lakes to support juvenile sockeye. Finally, DFO monitors smolt output at Chilko and Cultus lakes.

I was told that the cutbacks to stock assessment of other salmon species such as coho and chinook may have an adverse effect on the sockeye fishery. According to Mr. Whitehouse, if we lose the capacity to be able to inform management about the status of coho or chinook stocks, we may have to constrain sockeye fisheries to deal with the uncertainty around the status of co-migrating species.[140] Not considering other salmon species is also contrary to the Wild Salmon Policy and to ecosystem-based management.

Finally, because escapement enumeration and other stock assessment activities require hands-on participation and occur in the traditional territories of many First Nations that have a historical connection to the Fraser River sockeye salmon fishery, I support the suggestion that DFO encourage the involvement of members of such First Nations in these activities.

Stock assessment

32 With respect to escapement enumeration for Fraser River sockeye salmon returning to their spawning grounds, the Department of Fisheries and Oceans should

- **continue enumeration at not less than the level of precision recommended by DFO Stock Assessment staff for Fraser River sockeye spawning populations in 2010; and**
- **determine the calibration (or expansion index) for spawning populations in the 25,000–75,000 range.**

33 The Department of Fisheries and Oceans should double, from two to four, the number of lakes in the Fraser River basin in which it conducts annual lake stock assessments as well as annual monitoring programs to estimate fall fry populations.

34 The Department of Fisheries and Oceans should allocate funding for stock assessment of other salmon species that share the Fraser River with sockeye salmon.

35 The Department of Fisheries and Oceans should support the involvement of members of First Nations in escapement enumeration and other stock assessment activities in their traditional territories.

Definition of food, social, and ceremonial fishing

Following the Supreme Court of Canada's 1990 decision in *R. v. Sparrow*, it has been DFO's policy

to provide First Nations with priority access (after conservation) to Fraser River sockeye salmon for food, social, and ceremonial purposes. DFO has no specific definition for this term (except that fish harvested for FSC purposes cannot be sold), and, as I discuss in the section on Aboriginal fishing policies and programs in Volume 1, Chapter 5, Sockeye fishery management, there is no common understanding within DFO or among First Nations as to what is encompassed within the term "food, social, and ceremonial."*

Barry Rosenberger, area director, BC Interior, DFO, told me that the department tries to arrive at FSC allocations that reflect the genuine food, social, and ceremonial needs of Aboriginal communities.[141] It attempts to do so through negotiations between its resource managers and representatives from Aboriginal groups.[142] To inform these negotiations, DFO considers a number of factors, including the group's population, recent FSC harvests, harvest preferences, and the availability of fish species in the area. Ms. McGivney testified that a First Nation's preference in a fish species, the breadth of species available, access of other First Nations to the species, and the status of fish resources are further considerations.[143] When negotiations fail to produce an agreement on the quantity of fish to be taken and the conditions under which a group may fish for FSC purposes, DFO's policy is to issue a communal licence to the group in any event, with an FSC allocation as determined by DFO.

Based on the evidence I heard, it will be challenging for DFO and First Nations to reach a common understanding on what is included, and what is not, in "food, social, and ceremonial purposes." However, those who negotiate on DFO's behalf with Aboriginal groups would, in my view, benefit from a clear understanding of how DFO itself interprets these words. That would, I think, lead to greater consistency in how FSC allocations are made and, in the long term, to allocations that are in keeping with Aboriginal FSC needs.

To the extent that any FSC fishing allocations may be less than what is needed by Aboriginal groups to sustain the fisheries practices, customs, and traditions integral to their distinctive cultures, this paucity may put at risk the sustainability of the traditional Aboriginal FSC fishery as well as the Aboriginal cultural connection to that fishery. Conversely, FSC allocations that exceed actual FSC need may negatively affect other First Nations and general commercial access to the fishery, particularly in years of low abundance.

It is, in my view, equally important that First Nations actively assist DFO in reaching appropriate FSC allocations by providing DFO with information on the unique aspects of their culture that are relevant in determining their FSC needs.

Definition of food, social, and ceremonial (FSC) fishing

36 Following consultation with First Nations, the Department of Fisheries and Oceans should

- **articulate a clear working definition for food, social, and ceremonial (FSC) fishing; and**
- **assess, and adjust if necessary, all existing FSC allocations in accordance with that definition.**

37 In the context of negotiating an agreement with a specific First Nation, the Department of Fisheries and Oceans should encourage the First Nation to provide DFO with information on its practices, customs, and traditions that is relevant in determining its food, social, and ceremonial needs.

Share-based management

Traditionally, the Pacific salmon commercial fishery has operated as a "derby" fishery, meaning that, with each commercial fishery opening, licensed fishers catch as much of the target species as they can while the fishery is open. Beginning with the 2005 Pacific Fisheries Reform, DFO has indicated an

* I note that on June 29, 2012, Bill C-38, *An Act to implement certain provisions of the budget tabled in Parliament on March 29, 2012 and other measures*, received royal assent. It amends the *Fisheries Act* to define "Aboriginal" as follows: "'Aboriginal,' in relation to a fishery, means that fish is harvested by an Aboriginal organization or any of its members for the purpose of using the fish as food or for subsistence or for social or ceremonial purposes" (Bill C-38, section 133).

interest in moving the commercial salmon fishery away from derby fisheries and toward share-based management, which assigns catch shares to specific user groups or individuals. Having been told their assigned catch share, users know in advance how many fish they are allowed to catch and retain.

Under the umbrella term "share-based management," there are different management structures or approaches that can be used. When catch shares are assigned to individual licences or vessels, they are often called "individual quotas," or IQs. Share-based management systems can also be designed so that shares or quotas are transferable. When a licence holder is permitted to transfer his or her quota to another licence holder, the quotas are referred to as "individual transferable quotas," or ITQs. A share-based management system may restrict or prohibit transfers of shares within a particular licence area or gear type, or it may allow transfers among gear types or even fishing sectors (e.g., a transfer of total allowable catch from the commercial to the recreational or First Nations sectors).

Not all commercial fishers support share-based management, and for that reason, DFO has elected to rely on demonstration fishing projects with those fleets that are willing to engage in a share-based management model. During the hearings, the First Nations Coalition, the Stó:lō Tribal Council, and the Cheam Indian Band expressed concern about moving to an ITQ system for salmon fisheries because they say the move to ITQ in other fisheries had led to permanent change without adequate consultation or consideration of First Nations' rights and interests. They want to discuss overall allocation policy before DFO makes decisions on share-based management.[144]

I heard evidence of the benefits of share-based management over a derby-style management model. I am satisfied that share-based management serves conservation objectives and that DFO has properly committed to moving to share-based management for this legitimate reason. DFO recognizes that managing the entire commercial salmon fishery as a purely competitive derby model is not responsible or sustainable, and, as such, it has committed to move to share-based management.[145]

However, I accept the evidence of Jeff Grout, salmon resource manager, Salmon Team, DFO, that there are complexities affecting DFO's implementation of share-based management in the salmon fishery – factors such as changing total allowable catch through the season, and the manner in which shares can be transferred among different fleets and sectors.[146] These alternatives to the present system have not yet been thoroughly examined.

Although I support in principle DFO's commitment to moving to share-based management, it is not realistic for the department to do so without first completing its analysis of the socio-economic implications of implementing the various management models, such as IQs and ITQs. It should, without further delay, complete that analysis in a manner that accords with Action Step 4.2 of the Wild Salmon Policy, decide which model of share-based management is preferable, and then implement that model.

Share-based management

38 The Department of Fisheries and Oceans should, by September 30, 2013, complete its analysis of the socio-economic implications of implementing the various share-based management models for the Fraser River sockeye fishery, decide which model is preferable, and, promptly thereafter, implement that model.

In-river demonstration fisheries

In 1992, DFO initiated the Pilot Sales Program to provide certain First Nations with commercial salmon fishing allocations in the Lower Fraser River, the Skeena River, and the Alberni Inlet–Somass River areas. The Pilot Sales Program was suspended in 2003 and replaced the following year with communal "economic opportunity fisheries" in marine and Lower Fraser River fishing areas. Since about 2007, DFO has also provided some First Nations with allocations for economic fishing farther upstream on the Fraser River mainstem and at near-terminal and terminal fishing areas (that is, near or at salmon spawning grounds). These in-river economic fisheries are sometimes referred to as "in-river demonstration fisheries."

According to DFO, the economic fishing allocations provided to First Nations for in-river demonstration fisheries are made available through the purchase of equivalent fishing allocations from

the general commercial fishery. These purchases are accomplished using funds from DFO programs such as the Allocation Transfer Program (ATP), the Aboriginal Aquatic Resources and Oceans Management (AAROM) program, and PICFI. Between 2007 and 2011, DFO spent approximately $15 million to acquire salmon licences from the general commercial fishery to support in-river demonstration fisheries. DFO has also funded the acquisition of vessels and gear and the development and capacity building of organizations carrying out in-river demonstration fisheries.

I heard that DFO supports in-river demonstration fisheries for two reasons: to address conservation concerns associated with marine mixed-stock fisheries and to provide economic benefits to First Nations.[147] However, the evidence before me leaves doubt as to whether these two objectives are being met.

During the hearings on harvest management, I heard that the general commercial fishery in marine and Lower Fraser River areas encounters both strong and weak sockeye stocks co-migrating toward their spawning areas in the Fraser River. These stocks eventually separate as they leave the Fraser River mainstem and enter into the various tributaries and streams that make up their respective spawning grounds. Because of this separation, several witnesses suggested that fishing in-river (particularly at near-terminal and terminal areas) provides conservation benefits by allowing fishers to avoid the harvest of weak stocks. By selectively fishing only strong fish stocks, I was told, in-river demonstration fisheries may assist fisheries managers in meeting conservation and escapement targets for weak stocks.[148]

In theory, the potential conservation benefits of in-river demonstration fisheries look promising. However, it is not clear on the evidence that fishing in-river necessarily allows fishers to avoid weak stocks in many situations. Many weak Fraser River sockeye salmon stocks remain "mixed" with other stronger stocks throughout much of their in-river migration. For in-river demonstration fisheries to select only for strong stocks, most of these fisheries would have to be limited to very near-terminal or terminal fishing areas. That has not been the case for all in-river demonstration fisheries, which have also been located along the Fraser River mainstem in areas that still contain mixed stocks.

I was not directed to any detailed analysis of whether in-river demonstration fisheries, particularly those along the Fraser River mainstem, were in fact successful in avoiding weak stocks. Rather, as I describe in Volume 1, Chapter 5, Sockeye fishery management, the evidence before me is clear that the current in-season management of the marine mixed-stock fishery has been conducted in a way that allows DFO to respond to conservation concerns for returning stocks. DFO has been relatively successful in managing commercial harvests in such a way that they largely meet in-season escapement targets set for returning fish stocks.

I also heard that the use and timing of in-river fisheries ought to be carefully considered in light of the potential cumulative effects of water flow and high temperatures on fish as they migrate in-river.[149] Although Karl English, former president, LGL Research Associates Ltd. and lead author of Technical Report 7, Fisheries Management, stated that marine fisheries also stress migrating sockeye, he told me that water temperatures in-river are of particular concern because they are much higher than in the ocean. As a result, he suggested that, in years with extreme water temperatures, different harvest methods may be required.[150] As described in Volume 2, Chapter 4, Decline-related evidence, the temperature of the Fraser River has increased in past decades and is expected to continue to increase. I was not directed to any analysis of whether or how the predicted conservation benefits of in-river demonstration fisheries may be affected by this changing in-river environment.

Based on the foregoing, it is not apparent to me that in-river demonstration fisheries are providing the conservation benefits intended of them. DFO simply has not done the work necessary to assess or quantify any tangible conservation benefits from a shift of commercial harvest to in-river demonstration fisheries, to consider whether changing environmental conditions may counter such benefits, or to evaluate the degree to which any benefit improves on existing mixed-stock management strategies in achieving in-season escapement targets.

Having considered whether in-river demonstration fisheries have been shown to provide a tangible conservation benefit, I now consider whether these fisheries provide economic benefits to First Nations.

I heard that in-river demonstration fisheries provide some First Nations with employment, training, and economic opportunities that may not otherwise be available to them. For example, Chief Fred Sampson of the Siska First Nation told me that in-river demonstration fisheries in his area provide "opportunities to those who are often the poorest of the poor in this province" and that benefits from such fisheries are significant.[151] However, other evidence before me leaves doubt as to whether in-river demonstration fisheries can be economically viable or self-sustainable.

In-river demonstration fisheries experience significant challenges with regard to their economic viability. As fish return to spawning grounds, the quality of their flesh changes. Traits commonly valued in the commercial marketplace, such as the firmness and colour of flesh, may be lost. As a result, some witnesses raised serious concerns about the quality, marketability, and economic value of Fraser River sockeye caught in in-river demonstration fisheries, particularly those in near-terminal and terminal areas.[152] Although efforts are under way to develop markets for in-river and terminally caught sockeye, it appears to me that it will be challenging to achieve this goal in viable quantities, given the limited product range that can be produced from terminally caught Fraser River sockeye salmon.

Many near-terminal and terminal demonstration fisheries also face challenges associated with the cyclical nature of stock returns. As described in Volume 1, Chapter 2, Life cycle, Fraser River sockeye stocks return in varying abundance depending on whether it is a dominant, subdominant, or low-abundance year for that stock. Cyclical fluctuations in abundance affect the profitability of both marine mixed-stock and in-river fisheries. However, whereas a marine mixed-stock fishery may be able to rely on the abundances of multiple stocks, a near-terminal or terminal fishery would rely on the few stocks returning to that terminal area.

There was little evidence before me to suggest that in-river demonstration fisheries are economically viable or self-sustainable or that DFO has done the research and analysis necessary to conclude that they will be in the future. Other than a preliminary study conducted in 1994 on the quality and financial viability of terminal fisheries targeting Late Stuart and Horsefly River sockeye, it does not appear that DFO has conducted systematic research to assess the viability of in-river demonstration fisheries. Rather, the evidence before me indicates that the in-river demonstration sockeye salmon fisheries in the Fraser River have generally not achieved profitability.

Based on the foregoing, valid questions as to the economic viability and sustainability of in-river demonstration fisheries remain to be addressed. It is not clear that DFO has gathered the information or conducted the analysis necessary to show that in-river demonstration fisheries are, or are capable of being, economically viable or sustainable.

In summary, DFO has invested significant funds toward the development of in-river demonstration fisheries. However, there is insufficient evidence for me to conclude that such fisheries offer tangible conservation benefits or that they provide economic benefits to First Nations in a viable or self-sustainable way. Rather, the evidence before me suggests that conservation benefits may not always be achieved through in-river demonstration fisheries and that these fisheries have not been economically viable or sustainable over the several years they have operated. In my view, these issues ought to be carefully researched and analyzed before DFO advances further in acquiring commercial fishing allocations from the marine mixed-stock fishery to expand in-river demonstration fisheries. To clarify, however, this recommendation does not pertain to fishing for food, social, and ceremonial purposes in-river.

Any expansion of in-river demonstration fisheries will also affect a broad array of First Nations and fisheries stakeholders. As discussed in the next section, decisions such as the transfer of fishing allocations between areas and among the various fishing sectors ought to be informed by the strategic planning process set out in Action Step 4.2 of the Wild Salmon Policy.

In-river demonstration fisheries

39 The Department of Fisheries and Oceans should conduct the research and analysis necessary to determine whether in-river demonstration fisheries are, or are capable of, achieving tangible conservation benefits or providing economic benefits to First Nations in an economically viable or sustainable way before it takes further action in expanding in-river demonstration fisheries.

Transparency in the reallocation of the commercial Fraser River sockeye salmon fishery

Participants in the Aboriginal, commercial, and recreational fisheries, together with other members of the public, may all be affected by potential changes to the allocation of the commercial Fraser River sockeye salmon fishery. For example, increasing the number of sockeye allocated to in-river demonstration fisheries along the Fraser River may bring opportunities to communities along the river and in the interior, but may reduce economic fishing opportunities in marine and coastal areas.

Reallocation of the commercial Fraser River sockeye salmon fishery among fishing sectors may also affect the size and composition of the fishing fleets. Current DFO practice is to offset increases in First Nations access to the commercial salmon fishery by purchasing voluntarily relinquished salmon licences from individual participants in the general commercial fishery. The effect of this transfer is that the general commercial fishing fleet is made smaller, and fewer opportunities may be available for the public at large to enter into the commercial fishing industry.

As described earlier in this chapter, the Wild Salmon Policy envisions an inclusive planning process where "all parties that are affected by a planning outcome should have the opportunity to provide input to the articulation of objectives, the identification of management options, and the evaluation and selection of management alternatives." The WSP also states that transparency is a key attribute of an effective planning process, whereby "[i]nformation considered in making recommendations should be publicly available and communicated in a timely manner," and that "[r]ecommendations and decisions should be carefully described and the reasons for them clearly explained."[153]

In my view, the reallocation of the commercial Fraser River sockeye salmon fishery, whether geographically or among fishing sectors, is exactly the type of "planning outcome" that is expected to affect multiple parties and that ought to be developed in an inclusive and transparent manner. The evidence before me suggests, however, that DFO has not always developed its policies and practices for the reallocation of the commercial Fraser River sockeye salmon fishery inclusively or transparently.

During the hearings, I was presented with a document known as the Aboriginal Fisheries Framework (AFF), which purportedly articulates the government's target for the overall percentage of the available salmon harvest to be allocated to First Nations for both FSC and economic fisheries.[154] I say "purportedly" because, although the AFF was entered as an exhibit, the portion of this document setting out the percentage of the salmon fishery to be allocated to First Nations was redacted and remains confidential.

In testimony, Ms. McGivney agreed that DFO had not consulted with First Nations or others specifically on the development of the AFF, on the concept of an overall salmon allocation for First Nations, or on the actual salmon allocation itself.[155] When participants to this Inquiry learned that such a target reallocation existed, several of them sought access to this information. After considering applications from participants, I ordered that Canada disclose the overall salmon allocation percentage contained in the AFF. In response, Canada provided me with a letter from the clerk of the privy council certifying the allocation percentage and related information as a cabinet confidence and, on that basis, did not provide me with the ordered information.

The AFF is one example where DFO has not developed its policies and practices for the reallocation of the commercial Fraser River sockeye salmon fishery in an inclusive or transparent manner. DFO has not disclosed the reallocation decision contained in the AFF, nor has it shared with the public how this reallocation was arrived at or what information was considered in doing so.

Although the specific allocation percentage and related information contained in the AFF have been certified as a cabinet confidence, I understand that the approach reflected in the AFF has not been finalized. Rather, I was told that further development of this and related "Coastwide Framework" documents were deferred pending the outcome of this Inquiry.[156] Given the impact that the reallocation of the commercial Fraser River sockeye salmon fishery has on a broad range of groups, I recommend that DFO's continued and future development of its policies and practices in this area, including further revision of the AFF, be conducted in an inclusive and transparent manner.

This objective could be carried out following a strategic and integrated planning process such as Action Step 4.2 of the WSP.

Transparency in the reallocation of the commercial Fraser River sockeye salmon fishery

40 The Department of Fisheries and Oceans should develop its future policies and practices on the reallocation of the commercial Fraser River sockeye salmon fishery (including allocations for marine and in-river fisheries) in an inclusive and transparent manner, following a strategic and integrated planning process such as Action Step 4.2 of the Wild Salmon Policy.

Habitat

As discussed in Volume 2, Chapter 4, Decline-related evidence, I accept the evidence of DFO and expert witnesses that habitat degradation and loss pose risks to Fraser River sockeye and that, if current trends persist, there will be a significant decline in the productive capacity of Fraser River sockeye habitat. This decline could have a negative impact on Fraser River sockeye productivity, affecting the long-term sustainability of the fishery. It is not possible at present to quantify the risk that many habitat stressors (e.g., contaminants, alteration or destruction of habitat) pose to Fraser River sockeye, but I heard evidence about possible negative consequences to these fish and about shortcomings in DFO's management of habitat.

Implementation of the 1986 Habitat Policy

The 1986 Habitat Policy is a key national policy intended to guide DFO's protection of fish habitat.[157] It recognizes that fish habitat is required to sustain fisheries resources and aims in the long term to achieve net gain in the productive capacity of fish habitat. To support this objective, the policy has three goals:

- active conservation of the existing productive capacity of habitats;
- restoration of damaged habitats; and
- development of new habitats.

The 1986 Habitat Policy and the Wild Salmon Policy are distinct but complementary. Implementation of one policy will advance implementation of the other policy – with their ultimate goal of maintaining and restoring fish populations, including Fraser River sockeye.

Based on the evidence I heard, DFO is not achieving its goal of net gain of productive fish habitat. Nor is it achieving No Net Loss – the guiding principle of the first goal of the 1986 Habitat Policy. Further, DFO measures neither habitat loss nor gain. Measuring requires habitat indicators, such as those contemplated by Strategy 2 of the Wild Salmon Policy, but, as discussed earlier, almost nothing has been done to implement this strategy. Past reports by the Auditor General and the Commissioner of the Environment and Sustainable Development also found that DFO has met neither the net gain objective nor the No Net Loss principle.[158] Similarly, I conclude that the 1986 Habitat Policy has not been fully implemented. Moreover, DFO has not developed a plan to do so. In my view, implementation of Strategy 2 of the Wild Salmon Policy would advance implementation of the 1986 Habitat Policy by providing DFO with a method to assess Fraser River sockeye habitat loss or gain. The habitat inventory information needed to estimate gains and losses in Fraser River sockeye habitat is, in effect, the same information required under Strategy 2 of the Wild Salmon Policy.

Notwithstanding repeated findings that DFO has not met the objectives of its 1986 Habitat Policy, the evidence before me is that the department has not yet undertaken to complete the policy's implementation. Instead, I heard that DFO aims to develop a new habitat policy.[159] Based on the evidence I heard, the 1986 Habitat Policy is a valuable tool for the protection of productive Fraser River sockeye habitat. In my view, DFO does not need a new habitat policy; rather, it needs to complete implementation of the 1986 Habitat Policy. Although the policy may need updating to address changes in case law and legislation, including the changes to the *Fisheries Act* contained in Bill C-38 (see discussion in Chapter 3, Legislative amendments), its goals and No Net Loss principle are sound and should be retained.

The 1986 Habitat Policy recognizes that the cumulative impact of development projects (due to the collective effect of habitat degradation and loss arising from multiple projects in an area) is a serious concern, but DFO considers proposed projects only on a project-by-project basis. On the evidence, I find that cumulative impact is one of the key factors that negatively affect fish habitat. DFO needs to manage this cumulative incremental harm, which, over time, could have a substantial effect on Fraser River sockeye habitat. The habitat management system DFO has in place does not address these harms adequately.

Implementation of the 1986 Habitat Policy

41 The Department of Fisheries and Oceans should complete implementation of the 1986 Habitat Policy. By March 31, 2013, DFO should, for the benefit of Fraser River sockeye salmon, set out a detailed plan addressing these points:

- **how DFO will work toward a net gain in productive capacity of Fraser River sockeye habitat by conserving existing habitat, restoring damaged habitat, and developing new habitats;**
- **how DFO will measure the amount of productive capacity of Fraser River sockeye habitat in order to assess whether the net gain objective is being achieved on an ongoing basis;**
- **how DFO will take into account the cumulative impact on Fraser River sockeye habitat potentially arising from individual projects that are currently considered only on a project-by-project basis, if at all;**
- **how the tasks will be performed, and by whom;**
- **when the tasks will be completed; and**
- **how much implementation will cost, as set out in a detailed itemization of costs.**

The Habitat Management Program should coordinate with the new associate regional director general (proposed in Recommendation 4) to ensure consistency in implementing this Recommendation and Recommendation 8.

DFO's Habitat Management Program

Under the regulatory process in place at the time of the hearings, when DFO receives notice of a proposed project, it must assess the project information and, if necessary, visit the site. DFO must decide whether the project is likely to result in a net loss of productive habitat capacity. It may decide to permit the project to proceed as proposed, reject the proposal, or permit the project to proceed with mitigation or compensation conditions aimed at achieving No Net Loss.

In practice, many proposed projects cannot proceed without harming fish habitat. Consequently, since 1986, DFO has authorized many harmful effects on fish habitat on the condition, set out in the permit, that the proponents of the project create or improve other habitat to compensate for loss in habitat productivity. DFO's Habitat Management Program is largely focused on ensuring compliance with the prohibition of harmful alteration, disruption, or destruction of fish habitat in subsection 35(1) of the *Fisheries Act* and other statutory provisions. Developers are not required to seek approval from DFO for their projects, but if they do not and the project results in a harmful alteration, disruption, or destruction of habitat, then they run the risk of prosecution under the *Fisheries Act*.*

Downsizing within DFO and at the provincial level – and the disengagement of British Columbia in many joint habitat management activities with DFO – have resulted in the department placing greater reliance on streamlining processes to manage impact on fish habitat. I heard convincing evidence from several DFO Habitat Management Program staff that these streamlining processes and budget reductions have had a negative impact on DFO's ability to protect Fraser River sockeye freshwater habitat.[160]

* I note that, on June 29, 2012, Bill C-38, *An Act to implement certain provisions of the budget tabled in Parliament on March 29, 2012 and other measures*, received royal assent. As discussed in Chapter 3, Legislative amendments, Bill C-38 amends section 35 of the *Fisheries Act*, changing the prohibition (without authorization) on harmful alteration, disruption, or destruction of fish habitat.

If a proposed project falls within a category of activity to which operational statements or best-management practices apply, then notification to DFO is voluntary. According to David Bevan, associate deputy minister, DFO, because not all proposed projects are reviewed, more monitoring is required to ensure compliance with the *Fisheries Act*.[161] However, at the time of the hearings, if a project proponent did not file a proposed project with DFO, the department was unable to monitor the project because it might not even know that the project exists. This shift away from a project-by-project review and toward a proponent or professional-reliance model demands a strong emphasis on monitoring. Although DFO acknowledges that monitoring for compliance, effectiveness, and fish habitat health are all important for ensuring the sustainability of Fraser River sockeye, at the time of the hearings, DFO was doing only some compliance monitoring, and no monitoring of effectiveness or fish habitat health.[162]

Compliance monitoring involves DFO staff in ensuring two things: (1) that project proponents comply with any conditions of authorizations or orders; and (2) that developments conform to any advice aimed at avoiding negative effects on fish and fish habitat. Identifying areas for improvement in management systems or areas of risk is another part of compliance monitoring. *Effectiveness monitoring* involves verifying that habitat mitigation and compensation measures effectively achieve their intended outcomes. *Fish habitat health monitoring* involves "ecosystem-level" monitoring to measure the effects of development activities on fish habitat in order to establish baseline conditions within a watershed and to determine the cumulative effects of multiple works or undertakings on the productive capacity of fish habitat and the health of the aquatic system. One Habitat Monitoring Unit witness spoke of the need for baseline habitat inventory information in order to conduct fish habitat health monitoring.[163] As far as I can discern on the limited evidence available, this information appears equivalent to what is required by strategies 2 and 3 of the Wild Salmon Policy (see Recommendation 8).

DFO's Habitat Management Program

42 The Department of Fisheries and Oceans should strengthen the monitoring component of DFO's Habitat Management Program as follows:

- **Require that project proponents relying on operational statements and best management practices notify DFO before beginning work on their proposed projects.**
- **Fully implement compliance monitoring of projects whether or not the projects are reviewed in advance by DFO, including those falling under the *Riparian Areas Regulation*.**
- **Implement effectiveness monitoring, including for activities under the *Riparian Areas Regulation*.**
- **Give Habitat Management Program staff discretion to require, on a project-by-project basis, measures that are additional to those set out in operational statements and best management practices.**

Freshwater habitat

Riparian Areas Regulation

Riparian areas are vegetated shorelines of a stream or lake that are critical components of the water body and can affect fish habitat. Loss or degradation of riparian habitats poses risks to Fraser River sockeye sustainability. It is not possible to maintain a healthy fish-bearing stream without a healthy riparian zone. Shortcomings in the current management regime for riparian areas may affect Fraser River sockeye.

In 2006, the Province of British Columbia brought into force the *Riparian Areas Regulation* (RAR), which provided local governments with direction to improve the protection of fish and fish habitat. The regulation applies only to municipalities and regional districts in the Lower Mainland, much of Vancouver Island, the Islands Trust areas, and parts of the southern interior area. It applies only to new residential, commercial, and industrial development on land under local government jurisdiction.

I heard evidence of a regulatory gap between the provincial *Water Act* and the RAR. Lands adjacent to water courses may be privately owned, but in the case of lakes, private ownership applies only above the high-water mark. The provincial *Water*

Act controls works "in and around streams," but I understand that the province interprets this phrase to extend only up to the high-water mark.[164] Thus, works above the high-water mark are not regulated under the *Water Act*, and the landowner is not required to obtain approval for works above that level.

At the same time, the RAR applies only above the one-in-five-year flood elevation, which is higher than the high-water mark. Thus, there is a physical gap between the high-water level (the *Water Act* limit) and the one-in-five-year level (the RAR limit), and works undertaken in this area are subject to no provincial regulatory control. The construction of works on riparian areas may detrimentally affect Fraser River sockeye salmon, and, for that reason, I invite DFO to encourage the Province of British Columbia to resolve this legal anomaly.

Under the RAR, a proponent must have an assessment report completed by a qualified environmental professional (QEP) before development may be approved or allowed by local governments. Proponents must submit completed assessment reports to the provincial Ministry of Environment, which then notifies the appropriate local government of the report. The local government makes the final decision to approve or reject the development project. If the proponent complies with the RAR, DFO accepts that there will be no harmful alteration, disruption, or destruction of fish habitat.

The provincial Ministry of Environment started compliance monitoring for the RAR and is developing an effectiveness monitoring plan. At the time of the hearings in June 2011, the time frame for developing this plan was uncertain. DFO is not engaged formally in RAR monitoring. Provincial compliance monitoring in relation to the RAR is targeted at three different groups: qualified environmental professionals, local governments, and developers. DFO and the ministry agreed on a RAR compliance target of 90 percent, with a 90 percent confidence level.

During the first three years after the Regulation came into force, the ministry assessed the degree of compliance with the regulation-reporting requirements by reviewing every report submitted by QEPs. More recently, the ministry audited every fifth report unless it had particular concerns about a QEP. The initial assessment found that 48 percent of non-compliance with the RAR was attributable to errors by the QEPs.[165] The ministry notified the QEPs of its review and, if errors were serious, the ministry had further discussions with the QEP and with his or her professional association. Also, changes were made to the non-mandatory QEP training course based on the compliance information collected.

Local government and developer compliance with the Regulation is also low. Only 60 percent of local governments were found to be compliant, meaning that 40 percent did not have the appropriate bylaws in place to trigger regulatory action under the RAR. Developer compliance was 38 percent on Vancouver Island and 48 percent in the Lower Mainland.[166]

At the time of the hearings, no compliance reports had been completed since 2009 and no changes to the RAR were made on the basis of compliance reporting results. I heard no evidence that anything other than the compliance assessments and the actions taken by the ministry in relation to QEP reports has been done to ensure achievement of the RAR compliance target of 90 percent with a 90 percent confidence level. Given the high incidence of non-compliance with the RAR, I invite DFO to encourage the Province of British Columbia to continue to monitor compliance with the RAR and work with the province to achieve the RAR compliance target. DFO should also encourage the province to conduct effectiveness monitoring of projects completed under the Regulation.

As well, until recently, if a proponent sought to vary the streamside protection and enhancement area recommended in a QEP's assessment report, the provincial Ministry of Environment would notify DFO, and DFO would be responsible for approving the application for a variance. However, as a result of a decision of the BC Court of Appeal in *Yanke v. Salmon Arm (City)*, developments that require variances to the streamside protection and enhancement area, but do not result in a harmful alteration, disruption, or destruction of fish habitat, do not require approval by DFO or the Ministry of Environment.[167] The court ruled that there is nothing in section 4 of the RAR that allows DFO to veto a development proposal that is before a local government where the qualified environmental professional has given an opinion that the proposed development will not result in harmful alteration, disruption, or destruction of fish habitat.

This decision means that DFO has no proactive input into the development process, even though it is responsible for the protection of fish habitat

and has extensive experience in this issue. It is left with only the reactive, and rather blunt, instrument of section 35 of the *Fisheries Act*. In my view, DFO should encourage the Province of British Columbia to amend the RAR to require provincial approval of such setback variances. The province should also, in my view, consider DFO's input into the impact of these variances on fish and fish habitat.

Riparian Areas Regulation

43 The Department of Fisheries and Oceans should encourage the Province of British Columbia to resolve differences of interpretation on the application of section 9 of the provincial *Water Act* and the provincial *Riparian Areas Regulation* to ensure that there are no physical gaps in coverage of the *Water Act* and the *Riparian Areas Regulation*.

44 The Department of Fisheries and Oceans should encourage the Province of British Columbia

- **to continue to monitor compliance with the provincial *Riparian Areas Regulation*;**
- **to conduct effectiveness monitoring of projects completed in compliance with the *Riparian Areas Regulation*; and**
- **to consider DFO's input into the impact of *Riparian Areas Regulation* setback variances on fish and fish habitat.**

45 The Department of Fisheries and Oceans should work with the Province of British Columbia to achieve the *Riparian Areas Regulation* target of 90 percent compliance with 90 percent confidence levels.

46 The Department of Fisheries and Oceans should encourage the Province of British Columbia to amend the *Riparian Areas Regulation*

- **to require provincial approval of setback variances; and**
- **to require local governments to enforce compliance with the assessment reports on which development proposals are approved.**

Water use in the Fraser River watershed

As I discuss in Volume 2, Chapter 4, Decline-related evidence, alterations in water flows and temperatures may have a negative impact on Fraser River sockeye salmon. Surface water use can reduce instream flows that constrain access to spawning habitats or, in extreme cases, remove water from redds. Extraction of groundwater for irrigation can reduce flows into streams, thereby increasing surface water temperatures and affecting sockeye salmon adults and eggs. Although I heard that impact from water withdrawals may be less of a concern for sockeye than for other species of salmon, Jason Hwang, area manager, BC Interior, Oceans, Habitat and Enhancement Branch, DFO, said that water withdrawals could become a concern in the future as demand for water increases.[168] Dr. Michael Bradford, research scientist, DFO, agreed that population growth, particularly in the drier Okanagan and Cariboo areas, could have a future impact on sockeye. He also indicated that groundwater extraction is potentially a concern for Cultus Lake sockeye.[169] Dr. Craig Orr, executive director of the Watershed Watch Salmon Society, said that, to maintain the Early Stuart sockeye stocks, something has to be done to protect groundwater. He also said that groundwater is the "key to resilience of the salmon habitat."[170] The evidence revealed some aspects of water use management that need to be improved in order to ensure sustainability of Fraser River sockeye.

I heard evidence that the *Fisheries Act* is generally not enforced against water users because federal regulatory tools are limited and not particularly well suited to managing water use for the benefit of fish.[171]

The Province of British Columbia holds property and usage rights to surface water and groundwater, except insofar as private rights are granted to other persons. Thus, British Columbia is responsible for the licensing of surface water use and groundwater extraction under the provincial *Water Act*.

In 2010, the BC Auditor General released a report that was critical of the province's management of groundwater resources.[172] I was told that the province is responding to the report primarily through changes contemplated under the *Water Act* modernization process.[173] DFO has been engaged in this renewal process. I was told that the department supports the overall goals and objectives set

out in the 2010 discussion paper produced by the provincial Ministry of Environment. DFO offered a number of specific recommendations relating to protecting fish and fish habitat and to harmonizing the proposed legislation with federal legislation.[174]

I commend the Province of British Columbia for its work on modernizing the *Water Act*. Based on the evidence I heard, I invite DFO to encourage the province to complete that process and to address the three matters specified in the following recommendation.

Water use in the Fraser River watershed

47 The Department of Fisheries and Oceans should encourage the Province of British Columbia to complete modernization of the *Water Act*, which would include the following points:

- **regulation of groundwater extraction in a manner that addresses the needs of Fraser River sockeye;**
- **increased reporting and monitoring of water use; and**
- **allocation of sufficient resources to complete the modernization process.**

Forestry

Dr. Peter Tschaplinski, a research scientist with the BC Ministry of Environment, testified about the impact of several potential forestry-related factors on Fraser River sockeye habitat; these include changes to watershed hydrology that can influence stream flow and processes, channel form, and erosional processes, as well as changes to riparian environments that might affect water temperature, nutrient provision, channel structure, and stream microclimates. I accept Dr. Tschaplinski's evidence that forestry practices have improved greatly during the recent 20-year decline in Fraser River sockeye and are thus unlikely to have caused the decrease in productivity. However, he noted the importance of watershed baseline research in ensuring that forestry practices do not harm sockeye habitat.[175] As set out above, I found that habitat degradation and loss are a risk to Fraser River sockeye. I also accept the evidence of Dr. Peter Ross, research scientist, Marine Environmental Quality Section, Institute of Ocean Sciences, Science Branch, and Don MacDonald, lead author of Technical Report 2, Contaminants, that forestry pesticides are of concern with respect to Fraser River sockeye.[176]

Although DFO is responsible for protecting fish and fish habitat, the Province of British Columbia has the exclusive authority to make laws for the development, conservation, and management of forestry resources, which it does under the *Forest and Range Practices Act* (FRPA) and the *Forests Act.* FRPA is a results-based model, whereas the earlier *Forest Practices Code* was a prescriptive model. The province's introduction of FRPA in 2004 coincided with DFO's transition toward its national Environmental Process Modernization Plan (EPMP). Under FRPA, the provincial ministry no longer refers the main operational plans it requires from forest licensees to DFO for review.

I heard that DFO's role in forestry issues and fish-forestry interactions has decreased in recent years. Since the early 2000s, DFO has not had a fish-forestry person working out of its regional headquarters, and in about 2006 its Fish-Forestry Technical Working Group (a regional forum to communicate and discuss fish-forestry interaction issues, make recommendations to senior management, and facilitate communication between area Habitat Management Program staff and regional headquarters) fell apart. There is no viable referral system or standard way for DFO to communicate with forest licensees or the province.

According to Peter Delaney, former senior program advisor, Oceans, Habitat and Enhancement Branch, DFO, the department is not doing work on forestry because logging plans are not referred to it and/or they are not a priority for field staff given other demands on their time. DFO has also become less involved on the research and monitoring side of fish-forestry interactions, although some close connections remain between DFO and provincial scientists, and DFO Habitat Management Program staff have done some monitoring of stream crossings. DFO has no active fish-forestry research under way, and DFO research funds in this area have dried up. DFO does not undertake any of its own field assessments on streamside retention zones.[177]

Mr. Delaney said there are several reasons for DFO's disengagement on fish-forestry issues: DFO's move to a results-based professional-reliance model,

the EPMP streamlining processes, reductions in staff, and an increase in development activities.[178]

Given the importance of fish habitat to the health of Fraser River sockeye salmon and other species, DFO needs to re-engage with the Province of British Columbia and to identify a person with regional responsibility to serve as forestry contact person for the entire Pacific Region. DFO also needs to become involved again in reviewing proposed forestry activities that may harm fish habitat.

Forestry

48 The Department of Fisheries and Oceans should re-engage in managing the impact of forestry activities on Fraser River sockeye by

- **reviewing proposed forestry activities that may cause harmful alteration, disruption, or destruction of fish habitat under section 35 of the *Fisheries Act*, protocols for receiving operational plans / referrals, riparian standards for small streams and their tributaries, and the circumstances in which watershed assessments are required; and**
- **identifying an individual in DFO with regional responsibility to serve as forestry contact person for the Pacific Region to provide support to Habitat Management Program area offices, to provide a consistent approach throughout the region with respect to forestry activities and referrals, and to select policy issues and make recommendations to senior management.**

Marine habitat spill response

As I discuss in Volume 2, Chapter 4, Decline-related evidence, the long-term productivity decline in Fraser River sockeye salmon appears to be primarily due to conditions experienced during the time that Fraser River sockeye are in the marine environment. Technical reports 4 (Marine Ecology), 9 (Climate Change), and 12 (Lower Fraser Habitat), as well as four expert reports tendered by the Government of Canada, point to marine conditions and climate change during the coastal migration life-history stage as the most likely causes for the decline.[179] The marine habitat spill-response process is therefore potentially critical to ensuring long-term sustainability of Fraser River sockeye. However, I have some concerns regarding the ability of that process to adequately protect the health of these fish.

The Canadian Coast Guard (within DFO) is the lead federal agency responsible for ship-source and mystery-source pollution incidents in Canadian waters. The role of the Coast Guard is twofold: to oversee a polluter's response to a marine pollution incident or, if the polluter is unknown or unable to respond, to manage the response to the incident. The Coast Guard does not see the evaluation of habitat impact as within its mandate – it relies on Environment Canada and DFO's Oceans, Habitat and Enhancement and Science branches to deal with long-term habitat impact.[180]

On receiving a call about a marine pollution incident, the Coast Guard will do an assessment, and if it determines that further information is required, it calls Environment Canada to activate the Regional Environmental Emergency Team (REET). This team develops post-emergency monitoring plans for habitat issues and conducts long-term monitoring of a particular site. It is a body of experts that provides technical, scientific, and environmental advice to the Coast Guard, and it is co-chaired by Environment Canada and the provincial Ministry of Environment.

The Coast Guard relies on the REET for advice on the impact of various factors on anadromous fish and fish habitat in the marine environment. If a spill is marine in origin, the Environment Canada co-chair of the REET determines what agencies should be brought into the REET to assess any impact.

The REET is only an advisory organization, and the Coast Guard can choose to ignore the REET's advice.[181] I was told that, in deciding whether to follow the advice of the REET, the Coast Guard considers factors such as worker and public safety issues, the nature of the product spilled, weather and forecast conditions, tide information, and cost and reasonableness of the effort or the monitoring. The Coast Guard can prefer the approach to cleanup and monitoring proposed by the polluter or the cleanup company over the REET's recommendations. With respect to cost and reasonableness, I was told that the Coast Guard always tries to recover its costs for marine spill response from the polluter, the

polluter's insurance company, or the Ship Source Oil Pollution Fund. When a claim is submitted to one of these three sources of funds, the Coast Guard must demonstrate reasonableness or it will not recover its monitoring or response costs.[182]

On the evidence, I am satisfied that the Coast Guard has the organizational structure; staffing; response equipment; liaison experience; and vessel, logistical, and air support to make it an appropriate first responder for marine spills. Similarly, the REET is the appropriate body to provide advice on monitoring plans and habitat issues.

However, I have several concerns about post-emergency mitigation and long-term monitoring of the impact of marine spills. In my view, responsibility for these matters should be transferred from the Coast Guard to Environment Canada and assigned to the Environment Canada co-chair of the REET. At the same time, the membership of the REET should always include DFO's Oceans, Habitat and Enhancement and Science staff, who would bring specialized expertise on contaminant, fish, and fish habitat issues.

When the Environment Canada co-chair of the REET decides whether to follow the REET's advice regarding post-emergency mitigation and long-term monitoring, the co-chair should consider a number of the specific matters, as enumerated in my recommendation below. Finally, DFO should identify an individual within DFO who has regional responsibilities to act as a liaison with the Coast Guard, Environment Canada, and the Province of British Columbia on marine habitat spill response.

Marine habitat spill response

49 Responsibility for decision making about post-emergency mitigation and long-term monitoring of the impact of marine spills should be moved from the Canadian Coast Guard to the Environment Canada co-chair of the Regional Environmental Emergency Team.

50 Membership of the Regional Environmental Emergency Team should always include the Department of Fisheries and Oceans' Habitat Management Program (Ecosystem Management Branch)* and Science staff.

51 The Environment Canada co-chair of the Regional Environmental Emergency Team should, when considering whether to follow the team's advice regarding post-emergency mitigation and long-term monitoring, take account of the impact of the marine spill on fish and fish habitat, logistics, ecosystem values, cost recovery, and socio-economic effects.

52 The Department of Fisheries and Oceans should identify an individual in DFO who has regional responsibility to act as a liaison with the Canadian Coast Guard, Environment Canada, and the Province of British Columbia on marine habitat spill response.

Contaminants monitoring

DFO takes the position that it is not responsible for research or monitoring of contaminant fate and transport within the environment, even in relation to anadromous fish such as Fraser River sockeye salmon.[183] It is Environment Canada's view that population-level effects of contaminants, in particular on anadromous fish and the marine environment, is the purview of DFO.[184] In addition, although DFO agrees that the toxicological effects of contaminants on fish are still within its mandate, around 2005, it took away the dedicated funding for such research on contaminants.[185]

In Volume 1, Chapter 6, Habitat management, I found that Environment Canada's water quality monitoring in the Fraser River system does not provide information about most contaminants of concern to Fraser River sockeye (because this kind of reporting is not the purpose of Environment Canada's monitoring program), and that Environment Canada does not do any marine water-quality monitoring in relation to anadromous fish. At the same time, DFO takes no responsibility for water quality monitoring as it relates to sockeye in either the freshwater or the marine environment.

Several witnesses agreed that, with respect to monitoring of contaminants, the respective responsibilities of DFO and Environment Canada should be clarified. They said that both departments

* The Ecosystem Management Branch was formerly the Oceans, Habitat and Enhancement Branch.

should probably be involved, but added that it was not clear which department should take the lead.[186] Ms. Dansereau testified that she and the deputy minister of Environment Canada are working on recommendations to clarify the mandates for their respective departments.[187]

Monitoring of contaminants as it relates to the health of Fraser River sockeye salmon has, for jurisdictional reasons, been neglected by DFO and Environment Canada. It matters little whether Environment Canada considers its jurisdiction to cease at the end of an outfall pipe, or that DFO's decision to cut its Toxic Chemicals Research Program nearly a decade ago and to disband its Pacific Region Water Quality Unit was done without consultation. The effect is that neither department is currently monitoring contaminants that may negatively affect Fraser River sockeye productivity in either the freshwater or the marine habitat.

Technical Report 2, Contaminants, developed an inventory of more than 200 substances that may be released into aquatic ecosystems in the Fraser River basin from the various land uses identified. Of these, the researchers identified 23 chemicals of potential concern measured in surface water, and 11 substances in sediment, at concentrations sufficient to pose potential risks to sockeye salmon eggs, alevins, fry, smolts, or adults. Many of these substances in surface water and sediment occur at concentrations sufficient to cause or substantially contribute to adverse effects on the survival, growth, or reproduction of sockeye salmon in the Fraser River basin. Technical Report 2 dealt only with contaminants in freshwater; much less is known about contaminants in the marine environment, where Fraser River sockeye spend more than half their life.

The findings of Technical Report 2, Contaminants, satisfy me that contaminants, singly or cumulatively, may have a serious negative impact on Fraser River sockeye salmon. It is for that reason that, later in this chapter, I recommend directed science research into contaminants, especially contaminants of emerging concern, endocrine-disrupting chemicals, and complex mixtures. In anticipation of such research, it is important that DFO and Environment Canada co-operate in regularly monitoring fresh and marine water for contaminants affecting Fraser River sockeye salmon.

Given the evidence and my findings about the importance of contaminant research and monitoring to ensure the future sustainability of Fraser River sockeye, I note with concern that, in May 2012, the media reported that DFO is closing its Marine Environmental Quality section at its Institute of Ocean Sciences. If this section is closed, I question whether DFO will still have the ability to fulfill its responsibility for research and monitoring toxicological effects on Fraser River sockeye.

Contaminants monitoring

53 The Department of Fisheries and Oceans and Environment Canada should co-operate in regularly testing and monitoring fresh and marine water for contaminants of emerging concern and for endocrine-disrupting chemicals affecting Fraser River sockeye salmon.

Pesticides

The broad application of pesticides to crops, lawns, and forests results in non–point source pollution of Fraser River sockeye habitat, which can have lethal and sublethal effects on these fish. Pesticides can pollute surface waters through overspraying, erosion of contaminated soils, and seepage from contaminated groundwater. Mr. MacDonald testified that the use of pesticides by the forestry sector might be one of the greatest concerns for Fraser River sockeye salmon productivity.[188] Dr. Ross told me that agriculture and forestry pesticides are of concern with respect to Fraser River sockeye health.[189] Technical Report 2, Contaminants, describes a number of water quality concerns associated with agriculture. An Environment Canada study reported that several active ingredients in pesticides in British Columbia were used exclusively in the agriculture sector and accounted for 63 percent of total sales in 2003.[190]

All pesticides imported into, sold, or used in Canada are regulated federally, while the Province of British Columbia regulates the transportation, sale, use, storage, and disposal of pesticides, as well as the certification and licensing of applicators and vendors. Generally speaking, pesticide use on private property by someone who is not acting on a fee-for-service basis does not require a licence.

The Province of British Columbia does not keep comprehensive information on the quantities and types of pesticides used in different areas of the province. Information regarding pesticide application to residential properties and the agricultural sector is not collected, nor is the applicator required to keep it. Although pesticide vendors must keep a record of their sales, I was told that sales data for pesticides are extremely unreliable as information on pesticide use in a region for any given year.[191] I am satisfied that better data on pesticide use are important for understanding the impact of pesticides on the Fraser River watershed.

Pesticides

54 The Department of Fisheries and Oceans should encourage the Province of British Columbia

- **to require users of pesticides in forestry and agriculture to record, and report annually to the province, the areas where pesticides were applied and the amounts used; and**
- **to develop and maintain a pesticide-use database that includes information on location, volume / concentration, and timing of use, and make that information publicly available.**

Pulp and paper, metal mining, and municipal wastewater effluents

In recent years there have been improvements in effluent discharges from pulp and paper mills along the Fraser River sockeye salmon migratory route. However, Janice Boyd, program scientist, Natural Resources Sector Unit, Environmental Protection Operations, Environment Canada, and Robert Grace, environmental impact assessment biologist, Thompson-Nicola sub-region, Environmental Protection Division, BC Ministry of Environment, told me that current monitoring of pulp and paper and metal mining effluents does not evaluate the impact on the health of Fraser River sockeye.[192] Also, Environment Canada does not assess the cumulative sublethal effects of mining effluent on migratory fish. This risk of harm is not at present being assessed.

Effluents from wastewater treatment plants are known to contain a variety of substances of concern to Fraser River sockeye salmon health, including metals, polychlorinated biphenyls (PCBs), pharmaceuticals, fire retardants, steroids, personal-care products, and disinfectants. Mr. MacDonald testified that the volume of discharges from wastewater treatment plants has increased over the past 20 years. The data to evaluate them are not available, but it is assumed that the concentrations of these contaminants are increasing in the Fraser River watershed and Strait of Georgia.[193]

The authors of Technical Report 2, Contaminants, concluded that, for incubating sockeye eggs, alevins, and rearing sockeye, exposure to wastewater treatment–plant effluent is likely to be negligible for most Conservation Units. Two exceptions may be Harrison River sockeye spawning downstream of the treatment plant located at Harrison Hot Springs and Salmon River sockeye in the Shuswap River area, both of which may be exposed to diluted wastewater treatment–plant effluent during incubation. Also, contaminant research shows that Pacific salmon accumulate persistent and toxic contaminants in their marine life stage and transport these into the spawning and lake environments.[194] At the municipal wastewater treatment hearings, the expert witnesses agreed that municipal wastewater potentially has harmful effects on Fraser River sockeye, in particular sublethal effects, and that it cannot be ruled out as a contributing factor to the long-term decline.[195] According to Dr. Ross, there are 90 wastewater treatment plants in the Fraser River valley. He expressed particular concern about the impact of persistent chemicals that do not break down (e.g., dioxins, PCBs, organic chlorine pesticides, and polybrominated diphenyl ethers [PBDEs]) on Fraser River sockeye throughout their early life and on their return migration.[196]

Federal, provincial, and municipal levels of government share responsibility for managing the collection and treatment of municipal wastewater, administering the performance of wastewater facilities, and controlling the environmental and health impact of municipal effluents. Operators of

wastewater systems must comply with applicable federal legislation and with provincial or territorial legislation, permits, and licences.

In the Pacific Region, DFO is not involved in monitoring or researching the impact of municipal wastewater on Fraser River sockeye or other salmon, nor is anyone from Environment Canada tasked with assessing the impact of municipal wastewater on salmon.

Municipal wastewater is not currently governed by a specific regulation under section 36 of the *Fisheries Act*. However, in March 2010, Environment Canada proposed draft Wastewater Systems Effluent Regulations (WSER) that, if enacted, will apply nationwide.

The WSER specify conditions that must be met by any wastewater system with a capacity to deposit 10 cubic metres or more of effluent daily from its final discharge point into fish-bearing waters. Standards are created for effluent toxicity, effluent monitoring, receiving environment monitoring, record keeping, and reporting. The effluent standards represent a secondary level of wastewater treatment or equivalent, but under transitional provisions, municipal sewage facilities will have different timelines to meet the minimum effluent standard, depending on the level of risk assessed.

Under the WSER, in addition to monitoring to ensure effluent quality standards, some wastewater treatment facilities will be required to undertake environmental effects monitoring to evaluate the effect of the effluent quality standards for protecting fish and fish habitat. Monitoring will include assessing the effects of some emerging chemicals of concern on endocrine function and the effects of nutrient inputs on the benthos and, in some cases, on fish populations.

As noted, the WSER have not yet been enacted. Dr. Ross expressed concern that Environment Canada appears not to have incorporated the issues raised by DFO contaminant scientists and that the WSER do not impose limits or require testing of emerging contaminants of concern such as pharmaceuticals, surfactants, and some persistent organic pollutants and PBDEs.[197] Also, the WSER do not at present address biosolids, which are not broken down by treatment and can be transferred to land – and thereby re-enter Fraser River sockeye salmon habitats.[198]

Although I commend Environment Canada for developing its Wastewater Systems Effluent Regulations, it ought, in my view, also to include in the final version the matters set out below.

Pulp and paper, metal mining, and municipal wastewater effluents

55 The Department of Fisheries and Oceans and Environment Canada should co-operatively

- **ensure that environmental quality monitoring and environmental effects monitoring related to pulp and paper, metal mining, and municipal wastewater discharges include consideration of Fraser River sockeye salmon, and the two federal departments should work with the Province of British Columbia and with regional and municipal governments to that end;**
- **work with BC municipalities on a public education campaign aimed at reducing toxicants in municipal wastewater, especially pharmaceuticals and personal-care products; and**
- **immediately recommence their participation in the Metro Vancouver Environmental Monitoring Committee.**

56 Canada should promptly finalize the Wastewater Systems Effluent Regulations to include

- **public reporting on environmental effects monitoring results;**
- **ongoing environmental effects monitoring requirements similar to those found in the *Pulp and Paper Effluent Regulations* and in the *Metal Mining Effluent Regulations*; and**
- **environmental effects monitoring of contaminants of emerging concern and endocrine-disrupting chemicals discharging from large wastewater treatment facilities.**

57 Canada should finalize a regulatory strategy to limit the impact of wastewater biosolids on fisheries resources.

Fisheries and habitat enforcement

Enforcement priorities and funding

In an era of shrinking resources, difficult decisions must be made on how to allocate enforcement funds to achieve the best results.

I heard evidence that the purpose of DFO's 2007 National Compliance Framework is to provide a solid foundation for the activities the department undertakes to achieve and maintain compliance. It articulates three pillars of compliance management:

- Pillar One (Education and shared stewardship) focuses on informal and formal education of the public, co-management, and partnerships.
- Pillar Two (Monitoring, control, and surveillance) focuses on patrols, inspections, third-party monitoring, inter-agency partnerships, and fishery officer responses to non-compliance.
- Pillar Three (Major cases and special investigations) focuses on formal intelligence gathering and analysis, retroactive offence detection and investigation, and the use of specialized skills and technology.[199]

I observe that these three pillars offer an informative categorization of enforcement activities but do not purport to identify which activities should have relative priority.

Two DFO witnesses offered very different perspectives on how to prioritize enforcement expenditures. Mr. Bevan testified that DFO is focusing its compliance and enforcement efforts on Pillar One and Pillar Three, and away from Pillar Two. He said that the department has tried to bring people along to understand the need for conservation and compliance (Pillar One). At the same time, major case investigations (Pillar Three) are required when DFO identifies a systemic problem in a location or in a particular component of fish harvesting and processing.[200] In contrast, Mr. Nelson, regional director of the Conservation and Protection Branch, emphasized the importance of Pillar Two activities, saying that fishery officer field presence is the primary deterrent in any enforcement.[201]

I heard evidence that some Pillar One activities, such as attending community events and organizing once-a-year canoe trips with local Aboriginal youth, help build strong community relationships (and, ultimately, compliance) at relatively low cost. Mr. Nelson persuasively argued that there is no substitute for personnel on the ground and on the water. At the same time, I question whether it is possible to establish, by departmental directive, what priority should be given to Pillar Three activities. If systemic problems are identified, they must be investigated and, in appropriate cases, prosecuted.

When it comes to prioritizing enforcement expenditures, I do not find it helpful to engage in a debate over the relative merits of the three pillars; all three have value. In my view, the overarching principle that should direct allocation of enforcement resources should be to fund the activities that will best support conservation. I accept the evidence of those witnesses who said that conservation is best served by proactively preventing fish from being taken illegally from the water. Preventing the illegal taking of fish will likely involve a combination of community education and stewardship and on-the-ground enforcement activities. Effective catch monitoring of all sectors is an important component of this plan, as is the realistic allocation and identification of FSC fish to Aboriginal groups. I do not want to suggest that after-the-fact investigations are not also important; they are. Indeed, enforcement activities aimed at illegal sales may provide an effective deterrent to taking fish illegally out of the water. In my view, preventing the illegal taking of fish should be the priority consideration when DFO is faced with focusing its resource expenditure within any of the three pillars.

Two previous reports were especially critical of DFO's capacity to enforce compliance: the Honourable John Fraser's *Fraser River Sockeye 1994: Problems and Discrepancies* (Fraser Report) and the Honourable Bryan Williams's *2004 Southern Salmon Fishery Post-Season Review* (Williams Report).[202]

The Williams Report recommended that DFO properly enforce the *Fisheries Act* and Regulations through measures including adequate presence to deter the concealment of overharvesting of fish

by all sectors; enforcement of the laws against the illegal sale of fish; and a system to record illegal nets in the Fraser River accurately through the use of overflights and night patrols, particularly in areas where illegal fishing has been reported.

Following the Williams Report, there was an influx of approximately $1.8 million per year to bolster the work of the Conservation and Protection Directorate (C&P) in the Pacific Region, primarily to address compliance issues with closed-time patrols on the Fraser River. Approximately $1.2 million of this funding was rolled into the Pacific Integrated Commercial Fisheries Initiative program for 2007. According to Mr. Nelson, the new post-Williams funding led to a dramatic increase in C&P's patrol capability. He believes that, at present, C&P has a credible enforcement presence on the Fraser River and that his staff are able to do an adequate job on closed-time fishing activity. He did, however, voice concern that funds for these enforcement activities may be cut back, as occurred before the release of the Fraser and Williams reports.[203]

Mr. Nelson's testimony was clear that it is only due to increased funding following the Williams Report that C&P has recently been capable of providing adequate enforcement services in the Fraser River.[204] In my view, there is no substitute for overflight, on-the-ground, and on-the-water enforcement activity, and the Pacific Region's C&P needs to continue to receive funding that will allow it to provide these services at its post–Williams Report level.

Fisheries enforcement priorities and funding

58 The Department of Fisheries and Oceans should, at a minimum, fund its enforcement activities, including overflight, on-the-ground, and on-the-water fishery officer presence, to ensure the same level of enforcement that was achieved in response to the Honourable Bryan Williams's *2004 Southern Salmon Fishery Post-Season Review*, plus amounts necessary for aquaculture-related enforcement.

Responsibility for administration of section 36 of the *Fisheries Act*

Section 36(3) of the *Fisheries Act* states:

> Subject to subsection (4), no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water.

As I discuss in Volume 1, Chapter 7, Enforcement, administrative responsibility for section 36 was, in 1978, delegated to Environment Canada, although, ultimately, DFO remains responsible for ensuring that section 36 is enforced. The delegation took place in part because of Environment Canada's responsibility for pollution prevention and its expertise in chemical-based pollutants and spills.*

DFO and Environment Canada witnesses testified that, at the field level, delegation of responsibility for enforcement of section 36 to Environment Canada appears to be working.[205] However, witnesses and public submitters agreed that, in the eyes of the public (and even within government), it can be confusing as to who is responsible in certain circumstances. For example, over the past decade more than half of the convictions pursuant to section 36 arose from prosecutions by DFO. I accept the evidence that there is room for improvement in terms of communication, sharing of information, and joint planning of *Fisheries Act* activities at the national level. Based on the evidence, I am satisfied that DFO and Environment Canada could improve the ability of their on-the-ground staff to co-operate and respond to occurrences by conducting joint training and investigation post-mortems and, where feasible, by sharing resources and expenses in remote locations.

In 2009, the office of the Commissioner of the Environment and Sustainable Development recommended that DFO and Environment Canada clearly establish the expectations for Environment

* I note that on June 29, 2012, Bill C-38, *An Act to implement certain provisions of the budget tabled in Parliament on March 29, 2012 and other measures*, received royal assent. It amends the *Fisheries Act* to state: "The Governor in Council may, on the recommendation of the Minister and any other federal minister, by order, designate that other minister as the minister responsible for the administration and enforcement of subsections 36(3) to (6) [of the *Fisheries Act*] for the purposes and in relation to the subject-matters set out in the order" (see section 43.2(1)).

Canada's administration of the pollution prevention provisions of the *Fisheries Act*.[206] Ms. Dansereau testified that significant progress has been made to clarify the roles of the two departments, and that they are working at many levels to update the 1985 Memorandum of Understanding, which sets out the agreement between DFO and Environment Canada in relation to section 36.[207]

Several witnesses and participants recommended that DFO should resume administration of section 36 of the *Fisheries Act*. While I conclude that a good case could be made for repatriation to DFO, I am mindful that the focus of our hearings was on the Pacific Region, and I am not aware of the national context and implications that may arise from repatriation.

Although I am not in a position to recommend repatriation, I am satisfied that DFO and Environment Canada should complete the renegotiation of their relationship without further delay. At the national level, communication, sharing of information, and joint planning of *Fisheries Act* activities must be improved.

Responsibility for administration of section 36 of the *Fisheries Act*

59 The Department of Fisheries and Oceans and Environment Canada should, by September 30, 2013, renegotiate their relationship in regard to Environment Canada's responsibility to enforce section 36 of the *Fisheries Act* in the Pacific Region in accordance with the 2009 report from the office of the Commissioner of the Environment and Sustainable Development. Clarification should include each department's respective roles and responsibilities with respect to communication, sharing of information, and joint planning of *Fisheries Act* activities.

60 The Department of Fisheries and Oceans and Environment Canada should improve the ability of their on-the-ground staff to co-operate and respond to occurrences by conducting joint training and joint investigation post-mortems and by sharing resources and expenses in remote locations where feasible.

Powers of inspection

In the past, Habitat Management Program staff were designated as inspectors, which gave them the authority, for example, to issue an inspector's direction for a stop-work order to avoid the deposition of a deleterious substance. I was told that the removal of inspector powers came about in response to health and safety concerns raised by Habitat Management Program staff as a result of one incident in another region of the country.[208] The result is that Habitat Management Program staff must now call on a C&P fishery officer, who does have inspector powers, to attend the scene and issue a direction for a stop-work order.

Mr. Nelson testified that, in some cases, a fishery officer may be hours away and, in the meantime, the violation could continue. Even if the fishery officer is nearby, the result is that C&P staff wind up performing habitat compliance work that Habitat Management Program staff are supposed to be doing under the Environmental Process Modernization Plan. He also observed that taking inspector powers away does not eliminate the health and safety concern, as Habitat Management Program staff are already on site when the alleged violation arises.[209] If their inspector powers were returned, presumably they would call for assistance from C&P fishery officers when there is a security concern, but in other circumstances would issue the direction themselves. On balance, I am satisfied that inspection powers ought to be returned to Habitat Management Program staff.

Powers of inspection

61 The Department of Fisheries and Oceans should restore powers of inspection to Habitat Management Program staff.

Specialized habitat fishery officer

Over the years there have been changes in how habitat-related work is distributed among C&P's fishery officers. From 1999 to 2003, Pacific Region C&P identified a need for additional specialized habitat officers and had some dedicated habitat fishery officers funded under the now defunct Habitat Conservation and Stewardship Program.

They specialized in the investigation of harmful alteration, disruption, or destruction of fish habitat. Currently, no C&P fishery officers work exclusively on habitat. I accept Mr. Nelson's testimony that specialized habitat fishery officers were very effective.[210] In my view, at least one fishery officer within the Pacific Region ought to be designated as a specialized habitat fishery officer, with the responsibilities set out in the following recommendation.

Specialized habitat fishery officer

62 The Department of Fisheries and Oceans should re-establish within the Conservation and Protection Branch in the Pacific Region at least one specialized habitat fishery officer whose duties would include

- **acting as the go-to person for habitat occurrences and investigations throughout the region;**
- **working closely with the Habitat Management Program with access to its Program Activity Tracking for Habitat database;**
- **overseeing the training and mentoring of fishery officers for habitat investigations; and**
- **recording habitat occurrences and ensuring that there are responses to them.**

The "mortally wounded" clause

The general rule is that fishers may retain only the species of fish they are licensed to catch and for which there is a fishery opening. If they incidentally catch another species of fish that they are either not licensed to catch or for which there is no opening (unauthorized bycatch), they must return that fish to water, even if it is dead when brought on board. However, some Aboriginal communal fishing licences in the Fraser River include an exception to this rule – the "mortally wounded" clause. This clause provides that certain species of fish that would otherwise be considered unauthorized bycatch may nevertheless be retained if the fish was mortally wounded when caught.

I was told that it is difficult to enforce the "mortally wounded" clause because it is difficult in all circumstances to determine whether a fish is mortally wounded. Two DFO witnesses testified that they had observed Fraser River sockeye being caught during a chinook opening, with no attempt being made to revive or release them.[211] However, Ernie Crey, fisheries and policy advisor for the Stó:lō Tribal Council, testified that retaining and consuming mortally wounded bycatch is consistent with First Nations perspectives and that First Nations are working to determine if a ceiling on such mortalities could be implemented.[212]

In my view, the retention of mortally wounded bycatch should not be permitted because retention could have a negative impact on the conservation of Fraser River sockeye salmon and on the long-term sustainability of the fishery. I also accept the testimony of DFO witnesses that the "mortally wounded" clause is unenforceable. Requiring bycatch to be returned to the ocean or river is consistent with ecosystem-based management.

The "mortally wounded" clause

63 The Department of Fisheries and Oceans should not include in fishing licences a clause that allows for retention of "mortally wounded" Fraser River sockeye salmon.

Science research

Throughout the hearings I heard from many expert witnesses who have spent much or all of their professional careers studying Fraser River sockeye salmon. It is the most studied of all Pacific salmon species, and for many years DFO has invested much time and energy in learning more about this iconic species. I commend DFO and the many individual researchers who have participated in this quest for a better understanding of Fraser River sockeye salmon and the habitat in which they live.

Despite this work, much remains to be done. As Volume 2, Causes of the Decline, documents, there are still many aspects of the Fraser River sockeye life cycle about which little is known. Many stressors have been identified, including predators, climate change, infectious diseases, human development, contaminants, municipal wastewater, pesticides, harmful algal blooms, salmon farms, hydroelectric projects, interaction

between wild and enhanced salmon, and the effects of agriculture, forestry, and metal mining. We still have much to learn about the detrimental impact these stressors actually have on sockeye and their habitat.

This lack of understanding about actual effects not only applies to individual stressors at a single point in time but also extends to cumulative effects (e.g., the combined effect of contaminants, disease, and warmer waters on the health of a fish) and delayed effects (e.g., a contaminant or pathogen picked up during the outmigration, leading to mortality during the return migration).

In Volume 2, Chapter 5, Findings, I summarized the current situation as follows:

> Based on the evidence led during this Commission's hearings, very few (if any) of the potential stressors discussed in this Report can be safely taken off the table with a confident assurance that they have not contributed in some way to the Fraser River sockeye decline. Given the plausible mechanisms that abound, I am satisfied that there is a risk that some of these stressors have a negative impact on sockeye and may have contributed to the long-term decline. However, I accept the testimony of numerous witnesses that a lack of research has resulted in knowledge gaps which have impeded the ability of researchers to move beyond the identification of plausible mechanisms toward the establishment of cause-effect relationships.

Many stressors pose a risk to Fraser River sockeye and, although it is not possible at present to quantify that risk, I did hear evidence that the negative consequences to sockeye may be profound – they may have contributed to a 20-year decline in productivity of Fraser River and other Pacific sockeye salmon stocks. Unless the impact of these stressors is addressed, it is reasonable to conclude that they will have at least as serious a negative impact on these sockeye stocks in the future.

In the following pages I will recommend several focused scientific research projects that should yield much-needed information about the abundance, health, condition, and rates of mortality of Fraser River sockeye salmon during their freshwater and marine life stages and about the impact of contaminants and other stressors on them. I also think it is important that DFO undertake or commission research into the interactive effects of multiple stressors across all stages of sockeye life history and, thinking more broadly, that it work with Oregon, Washington, and Alaska to coordinate the collection and analysis of data on the productivity of their sockeye salmon populations.

Mortality of Fraser River sockeye salmon during downstream migration

During the evidentiary hearings, many witnesses regretted the lack of long-term time-series data sets for crucial milestones in the life history of Fraser River sockeye. Apart from monitoring programs currently under way at Shuswap and Quesnel lakes for fry and at Chilko and Cultus lakes for smolts, there is incomplete information, at a stock or Conservation Unit level, about abundance levels during the juvenile life history stages.

From the time smolts leave their nursery lakes until they are caught in the test fisheries as adults returning to spawn, very little is known about when and where they die. One of the important life stages about which there is incomplete information is stage 2, the smolt outmigration. Between the time smolts leave their nursery lakes and enter the ocean, they are exposed to a wide range of stressors, including predators, infectious diseases, freshwater contaminants, municipal wastewater treatment facilities, pathogens from enhancement facilities, physical alteration of habitat, and the effects of agriculture, forestry, and metal mining.

I heard evidence about these various stressors, from which I was able to conclude that there are plausible mechanisms by which some or all of them might have a negative impact on Fraser River sockeye health and survival. However, little is known about what impact these stressors actually have on outmigrating smolts and on how many die before reaching the ocean.

I agree with the authors of Technical Report 6, Data Synthesis, that it is technically feasible to determine stock or Conservation Unit abundance,

health, condition, and rates of mortality of Fraser River sockeye at the mouth of the estuary, and that such research would yield valuable information to identify specific life stages in which dramatic population changes are occurring.[213]

Mortality of Fraser River sockeye salmon during downstream migration

64 The Department of Fisheries and Oceans should undertake or commission research on Fraser River sockeye salmon smolts at the mouth of the Fraser River estuary, before they enter the Strait of Georgia, to determine stock / Conservation Unit abundance, health, condition, and rates of mortality.

Marine survival of Fraser River sockeye salmon

Given my conclusion in Volume 2 that the causes of the long-term decline may be found in the nearshore marine areas (such as Queen Charlotte Sound) and deep North Pacific Ocean areas where stocks from the Fraser River and from many other Canadian and US river systems grow and mature, more needs to be learned about these productivity patterns and about the processes that may explain the long-term decline, such as climate change, predators, pathogens, and competition among species.

I am also satisfied that marine conditions in both the Strait of Georgia and Queen Charlotte Sound in 2007 were likely to be the primary factors responsible for the poor returns in 2009. Abnormally high freshwater discharge, warmer-than-usual sea surface temperatures, strong winds, and lower-than-normal salinity may have resulted in abnormally low phytoplankton and nitrate concentrations that could have led to poor zooplankton (food for sockeye) production.

These conditions may also have conspired to increase the growth of harmful algal blooms in the Strait of Georgia, which can potentially cause mortality in salmon through altered ability to uptake oxygen and diminished respiratory function. For example, marine survival of Chilko sockeye average 2.7 percent in years when juvenile sockeye migration through the Strait of Georgia coincides with major blooms, as opposed to 10.9 percent in years with no or minor blooms.

Warmer sea surface temperatures can attract non-resident predators and make sockeye salmon smolts weaker and thus more vulnerable to predators. Concurrently, because of higher metabolic rate, these predators have increased appetite.

A better understanding is needed of Fraser River sockeye salmon migratory and feeding patterns in all these marine areas; the biological, chemical, and physical oceanographic variables that they currently experience and will experience in the future; and the impact of various natural and human-caused stressors such as warming waters, predators, pathogens, and contaminants. Earlier in this chapter, I dealt with the specific risks posed by salmon farms.

I heard evidence that increasing fish densities in the North Pacific may have a negative impact on wild stocks, including Fraser River sockeye, yet there are no studies by DFO's Salmonid Enhancement Program or Science Branch looking at the effects of competition between wild and hatchery salmon in the marine environment. Two DFO witnesses acknowledged that, if DFO understood interactions between wild and enhanced salmon, the Salmonid Enhancement Program would be able to improve the way it manages enhancement.[214]

Many of the variables that I recommend be studied are consistent with the marine habitat research that DFO has yet to undertake under strategies 2 and 3 of the Wild Salmon Policy. In addition, it would be logical to broaden the scope of this fundamental research on the marine survival of sockeye salmon to include other salmon stocks, both Canadian and US, and to share responsibility for the research between our countries.

Marine survival of Fraser River sockeye salmon

65 The Department of Fisheries and Oceans should undertake or commission research, in collaboration with academic researchers and, if possible, the Pacific Salmon Commission or another appropriate organization, into where and when significant mortality occurs in the nearshore marine environment, through studies of the outmigration from the mouth of the Fraser River

through to the coastal Gulf of Alaska, including the Strait of Georgia, Juan de Fuca Strait, the west coast of Vancouver Island, Johnstone Strait, Queen Charlotte Sound, and Hecate Strait. Studies should examine

- **abundance, health, condition, and rates of mortality of Fraser River sockeye salmon;**
- **biological, chemical, and physical oceanographic variables, including water temperature, the presence or absence of harmful algal blooms, and disease;**
- **predators, pathogens, competition, and interactions with enhanced salmon affecting Fraser River sockeye salmon; and**
- **contaminants, especially contaminants of emerging concern, endocrine-disrupting chemicals, and complex mixtures.**

66 In furtherance of Canada's understanding about what regulates Fraser River sockeye abundance and distribution, Canada should propose an international, integrated ecosystem research program to measure biological, chemical, and physical oceanographic variables in the offshore Gulf of Alaska. Some or all of the research would be conducted in collaboration with academic researchers, the North Pacific Marine Science Organization (PICES), and/or the North Pacific Anadromous Fish Commission.

Fish health

Surprisingly little research on population health has been conducted on Fraser River sockeye. I heard evidence about why there has been this gap in research:

- Salmon are difficult to track in the ocean.[215]
- When a wild fish dies, it disappears. It drops to the bottom of the ocean, never to be seen again. Diseased wild fish may not be detected.[216]
- Most laboratory studies focus on single pathogens, whereas most wild fish carry multiple pathogens.[217]
- Sockeye are very difficult to keep in a laboratory.[218]
- The focus of fish health research has been on cultured fish.[219]

Dr. Kent, author of Technical Report 1, Infectious Diseases, ably described the state of science about diseases in wild populations in his report to this Inquiry:

> [T]here are various well-accepted approaches that have been used to evaluate impacts of diseases in wild animal populations, including fishes. These approaches require evaluation of both prevalence and severity of infection in large numbers of samples. In recent years, this type of research has not been well supported as it is considered by some funding agencies to be merely survey work and not hypothesis driven. These types of investigations have not been applied to Fraser River sockeye salmon, but there are a few scientific reports that have documented outbreaks of infectious disease in sockeye salmon in British Columbia.[220]

With so little known about the health of Fraser River sockeye, it is difficult to assess the impact of some activities, such as salmon farms or salmon enhancement facilities, on these wild stocks. Researchers hired by this Inquiry were unanimous in their views that more research into the health of wild fish stocks is critical in order to make these sorts of assessments.[221] I heard evidence that, in 2010, in response to the poor 2009 returns, DFO began a three-year survey of sockeye salmon health in the Strait of Georgia.[222] Because of the short-term nature of this survey, it will provide a snapshot of sockeye health in one area of the sockeye's migratory range; it will not provide trend data.

A large component of the sockeye health survey in the Strait of Georgia is assessing sockeye for sea lice infection.[223] The sources of sea lice infecting migrating Fraser River sockeye juveniles include both wild fish (herring, stickleback) and farmed salmon.[224] I accept the evidence I heard that Atlantic salmon farms may be a significant source of *Lepeophtheirus salmonis* (*Leps*) infection for outmigrating smolts. The evidence is less clear for *Caligus clemensi* (*Caligus*). I accept the evidence of Michael Price, biologist, Raincoast Conservation Foundation, one of the expert witnesses testifying about sea lice, that Fraser River sockeye juveniles

downstream of salmon farms have a greater *Caligus* lice load than upstream;[225] however, the whole of the evidence before me presents different explanations for why that is so (e.g., increased time spent in sea water, exposure to salmon farms, or exposure to other natural sources of *Caligus* infection).[226] I accept the evidence that salmon farms are one of many sources of *Caligus* infection.

The evidence led during the hearings indicated that there is little scientific information about the effect of *Caligus* infection on sockeye. There was a consensus among the scientists who testified that *Caligus* infection presumably has some negative effect on sockeye hosts, but that effect is likely to be of lesser magnitude than *Leps* infection.[227] I accept the evidence of Dr. Simon Jones, research scientist, DFO, and Dr. Orr, both expert witnesses on sea lice, that more work is needed into the thresholds of sea lice infection and resilience in sockeye generally, and into the patterns of sea lice (especially *Caligus*) distribution and infection on juvenile sockeye.[228]

Senior DFO Science staff testified that there is a gap in research on wild fish health and that, although DFO is attempting to address it, research priorities are "very much weighted" by the need for DFO Science to provide advice to its "clients," such as the Canadian Food Inspection Agency (CFIA) or to the Fisheries and Aquaculture Management Branch.[229] Also, as described above in the section on salmon farm management, DFO has conducted little research into the effects of pathogens from salmon farms on Fraser River sockeye.

I see a difficulty in having DFO Science's research priorities for fish health directed by "clients," such as CFIA, whose mandate is not the conservation of wild fish but trade and economic concerns, or by aquaculture management, whose focus is sustainability of the aquaculture industry. When DFO's research is set by other agencies, there is the risk that the department does not give the priority it should to the conservation and protection of wild salmon. DFO Science should not be a follower on issues of wild fish health; it should be the leader. And it should be an advocate for research and innovation on wild fish health.

Evidence I heard in December 2011 concerning the possibility of infectious salmon anemia virus (ISAv) in BC waters heightened my concern about DFO's approach to wild fish health. DFO as an organization has not taken a proactive approach to researching whether ISAv exists in wild salmon. Instead, it has worked – under CFIA's direction – in a reactive manner, assisting in the investigation into whether presumptive positive tests for ISAv found by non-government labs were false positives. DFO discouraged one of its own leading scientists from conducting research outside the CFIA-led regulatory program. And it followed communication practices that left the impression that all was well, when at a minimum there was a strong case for further research. (See the case study on ISAv in Volume 1, Chapter 9, Fish health management.)

Fish health

67 The fish health research priorities of the Department of Fisheries and Oceans should reflect its responsibility for the conservation of wild fish. To that end, DFO's science managers should encourage innovation and new research into novel diseases and other conditions affecting wild fish, beyond the interests of specific "clients" such as the Canadian Food Inspection Agency or aquaculture management.

68 The Department of Fisheries and Oceans should undertake or commission research into the health of Fraser River sockeye salmon, including the following issues:

- **determining, in conjunction with the research proposed in Recommendations 64 and 65, what pathogens are encountered by Fraser River sockeye salmon along their entire migratory route, and the cumulative effects of these pathogens on Fraser River sockeye salmon;**
- **the hypothesis that diseases are transmitted from farmed salmon to wild sockeye;**
- **the hypothesis that diseases are transmitted from salmonid enhancement facility salmon to wild sockeye; and**
- **the thresholds of sea lice infection and resilience in sockeye and the patterns of sea lice distribution and infection on juvenile sockeye.**

Harrison River sockeye population

Contrary to most Fraser River sockeye stocks, the Harrison River population has been increasing in productivity and abundance since the 1990s and, in 2010 and 2011, returned in record numbers. Compared with other Fraser River sockeye, these salmon exhibit unique freshwater and marine life history patterns, and they may follow migration routes that are distinct from most other Fraser River sockeye populations.

In several respects the Harrison sockeye present a confounding picture. For example, there is concern that other sockeye stocks, which spend only a few days in the contaminated Lower Fraser River, may be adversely affected by contaminants. Yet Harrison River sockeye, which migrate downstream almost immediately after emerging from the gravel and spend several months as fry in river sloughs and estuaries where they would have much greater exposure to contaminants and compromised habitat, are increasing in productivity. Similarly, although there is concern that most other Fraser River sockeye smolts are exposed to numerous stressors during their brief migration through the Strait of Georgia, it appears that the Harrison River population has, at least in recent years, suffered no ill effects, even though it is believed that they spend most of their ocean-entry year in the Strait of Georgia.

Although numerous witnesses commented on these different life history patterns, the reasons underlying the Harrison River population's recent increases in productivity and abundance are not clear. In my view, this population would be a fruitful area of research because it may provide important insights into Fraser River sockeye production processes.

There is also uncertainty about the migratory route the Harrison River population takes after it leaves the Strait of Georgia. It is hypothesized that some or all migrate through Juan de Fuca Strait to the west coast of Vancouver Island, but the evidence is incomplete. Neither is it known how far north the fish migrate and where they reside during their marine life history. Improving our understanding of these migratory patterns may provide additional insight into Fraser River sockeye production processes.

Harrison River sockeye population

69 The Department of Fisheries and Oceans should undertake or commission research into the life history of the Harrison River sockeye population.

Research into regional production dynamics

The findings of Dr. Peterman and Dr. Dorner in Technical Report 10, Production Dynamics, show that recent sockeye salmon declines have occurred over a much larger geographical area than just the Fraser River system and are not unique to it. This conclusion suggests that there may be a shared causal mechanism at play that is operating on a larger regional spatial scale, most likely in the marine environment shared by these stocks. This important new research finding has potential application to fisheries management in Oregon, Washington, and Alaska, as well as British Columbia.

However, Dr. Peterman and Dr. Dorner describe only the extent to which time-series trends in productivity are similar across sockeye salmon stocks. The causes of that similarity are not investigated, although they hypothesize that "large-scale phenomena such as climate-driven oceanographic changes, or widespread predation or pathogen-induced mortality, might be major drivers of the observed decreases in productivity throughout the region through effects on freshwater and/or marine conditions."[230] They report that the current limited informal contacts among scientists and managers through conferences or other meetings reduce opportunities for sharing research – information that is needed to learn about large-scale processes that cut across jurisdictional boundaries. They recommend that a formal working group could coordinate data collection and sharing of methods of analysis, and facilitate the communication of results in a timely manner. This kind of collaboration, they state, will help to increase the rate of learning about the causes of these widespread trends and to identify what might be done about them.

Research into regional production dynamics

70 The Department of Fisheries and Oceans should initiate, along with the appropriate

state agencies in Oregon, Washington, and Alaska, a long-term working group devoted to coordinating the collection and analysis of data on the productivity of their sockeye salmon populations. The working group should invite a knowledgeable and independent entity, such as the Pacific Salmon Commission, to act as coordinator for the working group.

Cumulative effects

Throughout the hearings, I heard that Fraser River sockeye salmon experience multiple stressors that may affect their health and their habitats. Several witnesses emphasized the importance of considering the cumulative effects of these stressors, rather than considering stressors in isolation. Cumulative effects can arise from multiple exposures to an individual stressor within an area or life stage, from exposure to an individual stressor over the life cycle of Fraser River sockeye, or from exposure to multiple types of stressors interacting in a cumulative manner.

The impact of an individual stressor may increase where that stressor appears multiple times within an area. For example, Dr. Orr told me that the accumulation of wells near sensitive streams may result in water flow problems;[231] Dr. Ross told me that having multiple point sources of chemical discharge in the Fraser River estuary increases the potential for harm from chemical exposure;[232] and Michael Crowe, head, Habitat Management Program, Oceans, Habitat and Enhancement Branch, BC Interior, spoke of the cumulative impact of many small developments leading to an incremental loss of riparian function in a given area.[233]

Where Fraser River sockeye experience a stressor over the course of their lives, the negative impact of the stressor may have a cumulative effect. For example, Dr. John Ford, program head, Cetacean Research Program, Pacific Biological Station, DFO, spoke of the cumulative predator effects caused by "multiple potential different predatory species" encountered by Fraser River sockeye at various stages in their life cycle.[234] Don MacDonald, aquatic biologist, MacDonald Environmental Sciences Ltd., and lead author of Technical Report 2, Contaminants, and Dr. Mark Johannes, senior environmental specialist, Golder Associates Ltd., and lead author of Technical Report 12, Lower Fraser Habitat, told me about the potential risks associated with contaminants accumulating in the tissues of Fraser River sockeye across all stages in their life history.[235]

When Fraser River sockeye are exposed to multiple types of stressors during their lives, this contact can also affect their productivity. For example, Dr. Jack Rensel, consultant, Rensel Associates Aquatic Science Consultants, told me that harmful algae and pathogens could act cumulatively to impair fish;[236] Dr. Scott Hinch, professor, Department of Forest Sciences and Institute for Resources, Environment and Sustainability, University of British Columbia, and lead author of Technical Report 9, Climate Change, told me that climate change may interact with other stressors, causing harm to Fraser River sockeye;[237] and David Patterson, habitat research biologist, DFO, told me that migration mortality may be influenced by water temperatures, flows, sediment, general water quality, predation, disease, and other environmental factors.[238] With regard to the low returns of Fraser River sockeye in 2009, I heard from Dr. Jim Irvine, research scientist, Pacific Biological Station, DFO, that cumulative, multiple stressors may have played a role;[239] Mr. Marmorek went further, telling me that cumulative stressors in the marine environment may have been a primary cause for low returns that year.[240]

Dr. Siddika Mithani, assistant deputy minister, Oceans and Science, DFO, testified that the department considers "ecosystem science" and the investigation of cumulative effects as a priority for the Science Branch. She said it is "absolutely something that we need to do."[241] However, DFO witnesses told me that the department does not have a defined approach to considering or researching cumulative effects generally.[242]

Although I heard that DFO and other organizations have conducted some research on cumulative effects in specific contexts, the cumulative effects of many other stressors have not been considered.[243] For example, Mr. Bevan told me that in DFO's management of the "impacts on habitat … the cumulative impact is not being looked at."[244] Dr. Laura Richards, regional director, Science, Pacific Region, testified that she was not aware of

any work DFO was doing to assess the cumulative impact of the number of salmon farms on the Fraser River sockeye migration route.[245] Dr. Robie Macdonald, section head, Marine Environmental Quality, DFO, said that the department's toxicology work does not address the effect of multiple contaminants on fish at one life stage or the effect of contaminants on fish over various stages of the life cycle.[246] As a further example, Ms. Boyd of Environment Canada testified that federal environmental effects monitoring does not address the cumulative effects of the introduction of mining and pulp effluents into freshwater systems.[247]

I accept that research into cumulative effects is difficult. Robin Brown, head, Ocean Sciences Division, Institute of Ocean Sciences, Science Branch, told me that there has been a "very modest movement" in the assessment of cumulative impact in the marine area, but that it is very difficult research to carry out.[248] With respect to the cumulative effects of habitat loss, Patrice LeBlanc, director, Habitat Management Policy Branch, Program Policy sector, DFO, said that researchers "lack approaches and methodologies for assessing accumulative impacts" and that no such methodologies are currently available.[249] With respect to stress on fish health, Mr. Marmorek expressed the challenge this way: "[I]t gets tricky, because we don't have a cumulative stress meter that we can stick into sockeye and determine how overall stress is going up, or what the contributors are to that overall stress."[250]

However, I also heard from many witnesses that more cumulative effects research could and should be done. Dr. Ross told me that an improved understanding of the cumulative effects of endocrine-disrupting pollutants could be achieved by expanding research beyond laboratory settings and into the real world.[251] Ms. Boyd told me that, although researchers might have "shied away" from cumulative effects research in the past, "we've got to move in that direction," and she proposed bringing different groups together to formulate a cumulative effects monitoring strategy.[252] Dr. Villy Christensen, one of the authors of Technical Report 8, Predation, told me that an ecosystem model to assess the cumulative role of predation on sockeye could be built "certainly within a year."[253]

Several technical reports also recommended that cumulative effects research be done:

- *Technical Report 2, Contaminants:* Studies should be conducted to evaluate the interactive effects of contaminants (such as endocrine-disrupting compounds), disease agents, and/or water temperatures on sockeye salmon during outmigration of smolts and upstream migration of adults. Such studies should be conducted under a regional cumulative effects assessment program that is explicitly designed to evaluate the impact of multiple disturbance activities within the river basin.
- *Technical Report 8, Predators:* A conceptual ecosystem model should be built to assess the cumulative role that predators and other factors (e.g., food limitation) have on sockeye salmon as they leave the rivers and migrate to the North Pacific.
- *Technical Report 9, Climate Change:* Research is needed that examines cumulative impact across multiple stressors, such as the warming potential of multiple effluents (e.g., wastewater treatment plant discharges, industrial water discharges) to determine if they could have a cumulative effect on water temperature of the Fraser River; the impact of multiple environmental stressors (e.g., temperature, flow, water quality, and water chemistry); and the impact of fishery interactions.

Mr. English told me that research into cumulative effects will not only help scientists understand what is happening to Fraser River sockeye but may also inform fisheries managers about the way fisheries could be adjusted accordingly. Although little may be done about certain stressors, such as annual water temperatures, he said that "it is possible to minimize cumulative environmental effects and fishery related factors by disassociating the timing and location of in-river fisheries from these other stressors" – meaning that there may be years when, with extreme temperature, different harvesting methods should be considered.[254] I take this suggestion as an example of the importance of understanding cumulative effects, not only to fulfill scientific curiosity but also to inform the proper management of Fraser River sockeye salmon and their habitats.

Cumulative effects

71 The Department of Fisheries and Oceans should develop and carry out a research strategy to assess the cumulative effects of stressors on Fraser River sockeye salmon and their habitats. Cumulative effects may include multiple sources of a stressor, exposure to stressors over the life cycle of Fraser River sockeye, or exposure to multiple types of stressors interacting in a cumulative manner.

72 The Department of Fisheries and Oceans should consider the cumulative effects of stressors on Fraser River sockeye health and habitat in its management of fisheries and fish habitat.

Inventory of Fraser River sockeye salmon research

Many of the researchers participating in the Commission's research program encountered difficulty in locating and obtaining access to relevant data. In some cases, different organizations had collected data on the same issue but used incompatible databases.

The scientific research proposed in the preceding recommendations will generate a wealth of information about Fraser River sockeye salmon and related species as well as salmon habitat and the various stressors that threaten sockeye and their habitat. These data will add to the data already collected within DFO. It is essential that DFO develop and maintain an accessible inventory of all its research – a central repository for information about existing and new research, who has custody of it, and where it can be located.

With respect to who should have access to this research, I repeat what I said when discussing fish health data from salmon farms: DFO needs to be transparent and to allow non-government scientific researchers access to the proposed Fraser River sockeye salmon data for the purpose of original research. The information will be collected to assist in the assessment of risks posed to wild stocks. Although DFO has a mandate to analyze these data, it does not hold an exclusive mandate to do so, and the information in the database should not be treated as proprietary. Making the fruits of this research available to non-DFO scientific researchers is consistent with Principle 4.5 of the 2003 document prepared by the Privy Council of Canada, *A Framework for the Application of Precaution in Science-Based Decision Making about Risk*, which states that a "high degree of transparency, clear accountability and meaningful public involvement are appropriate."[255]

DFO's conservation mandate may be advanced by the provision of existing and new research to non-government scientific researchers. These researchers may apply fresh perspectives and ideas to this information and, by doing so, prompt DFO to ask new questions that further scientific understanding. Ultimately, this understanding could, in turn, lead to regulatory advances to protect wild stocks.

Inventory of Fraser River sockeye salmon research

73 The Department of Fisheries and Oceans should develop and maintain a central inventory of information about existing and new Fraser River sockeye salmon research, including who has custody of it and where it can be located. DFO should make the inventory available to the public, and make the information in the inventory available to non-DFO scientific researchers.

Improving future sustainability by addressing warming waters

In this volume, I have called for scientific research on a wide range of issues. Some of that research is for the purpose of improving our understanding of Fraser River sockeye salmon and how they behave. Other research is intended to provide a knowledge base about how particular stressors have a negative impact on these salmon stocks and how serious this impact can be. That understanding in turn will allow decisions to be made aimed at lessening or eliminating the impact of those stressors on Fraser River sockeye. For example, research on pathogens, contaminants, and

interactions with enhanced salmon could lead to changes in fisheries and habitat management. In these cases, there may be specific remedial actions that DFO can take to improve the sustainability of Fraser River sockeye salmon.

Other stressors will be a much greater challenge. Foremost among them is climate change. I ended Volume 2, Causes of the Decline, with a disquieting focus on the future – the prospect of warming salt- and freshwaters, increased precipitation in the form of rain, and earlier melting of the snowpack. These factors will likely have a negative impact on Fraser River sockeye salmon during all their life stages. Indeed, DFO has recognized the likely negative impact that climate change poses to fisheries.[256] Climate change also makes it more difficult to predict what will happen in the future. We are into a new paradigm, with increased unpredictability leading the way.

The signs of climate change that we see, such as warming of the Fraser River, are felt locally but caused by forces operating on a much larger scale. British Columbians and other Canadians all contribute to global warming, but we cannot, by ourselves, reverse its effect on us. We can all do our part, but even our best efforts will not lead to a cooling of the Fraser River. Solutions will only be found at a national and international level.

It was well beyond the scope of this Commission of Inquiry to examine the underlying causes of climate change and how society can tackle it. However, I heard enough evidence about warming waters and their impact on Fraser River sockeye salmon to reach the uncomfortable conclusion that reducing deposits of contaminants and municipal wastewater into the Fraser River, or increasing productive sockeye habitat, will not make a big difference if climate change increases the temperature of those same waters to a level that is lethal to Fraser River sockeye. Although we must address the impact of contaminants and habitat loss, we cannot stop there. Warming waters is the elephant in the room that we cannot ignore.

I did not hear evidence on and do not profess to know what specific steps should be taken to address the causes of warming waters and climate change. If solutions are to be found, they will likely be at the national and international level. Canadians must look to the Government of Canada as a whole, not DFO, for domestic action and for Canadian support for international initiatives that will reduce the impact of warming waters and climate change on Fraser River sockeye salmon.

Improving future sustainability by addressing the causes of warming waters

74 To improve future sustainability of Fraser River sockeye, the Government of Canada should champion, within Canada and internationally, reasonable steps to address the causes of warming waters and climate change.

Implementation of this Commission's recommendations

In my October 2010 Interim Report, I summarized the many previous examinations, investigations, and reports that I considered relevant to my mandate, along with the more than 700 recommendations made in them regarding the Pacific salmon fishery. Most of those recommendations were directed at DFO, focusing on its management of the fishery and its legislative powers respecting harvesting, protection of habitat, protection of wild salmon stocks, and aquaculture.

Where the Government of Canada, DFO, or the minister of fisheries and oceans formally responded to those recommendations, I summarized those responses. In doing so, I relied primarily on a 289-page document prepared for the Commission by Canada entitled "Recommendations Related to Fraser River Sockeye Salmon and Responses by the Government of Canada, 1982–2010," which is included in the DVD accompanying this Report.[257]

A review of these materials reveals that, when the Government of Canada or DFO chose not to implement a recommendation, there was, in most cases, no follow-up by the recommending body, and there was no independent scrutiny of the merit or adequacy of the government response. The government entities under review (DFO and Environment Canada) decided what their response to the recommendations would be, and that was the end of it.

In my view, there should be a degree of accountability when an independent body,

such as a commission of inquiry, makes recommendations to a department of government in accordance with the mandate given to it by the Governor General in Council. I do not suggest that government is obligated to adopt and implement all of a commission's recommendations, but I think that the public would be better served if there were a form of independent oversight of the government's response.

More specifically, I conclude that an appropriate level of accountability could be achieved by having an independent and knowledgeable body review the extent to which and the manner in which the commission's recommendations have been implemented, and to make that review public. That would bring a needed measure of transparency to the government's response to the commission's work, while at the same time preserving the Executive Branch's independence of action.

The federal office of the Commissioner of the Environment and Sustainable Development has reported on matters relating to wild salmon stocks, habitat, and aquaculture for nearly a decade and would, in my view, be an appropriate body to undertake this type of review – if willing and able to do so. Given the ongoing interest of the Standing Committee on Fisheries and Oceans on the matters examined by this Commission, it would be appropriate for the Commissioner of the Environment and Sustainable Development to report to that committee as well as to the public.

Implementation of this Commission's recommendations

75 An independent body such as the office of the Commissioner of the Environment and Sustainable Development should report to the Standing Committee on Fisheries and Oceans and to the public as follows:

- **By March 31, 2014, and every two years thereafter during implementation of the Wild Salmon Policy, on progress in implementing the policy in relation to Fraser River sockeye salmon.**
- **By September 30, 2015, on the extent to which and the manner in which this Commission's recommendations have been implemented.**

Notes

Policy and practice reports were prepared by Commission counsel and entered into evidence to provide a contextual background to inform the hearings on the various topics, including:

- PPR 5, Harvest Management;
- PPR 8, Habitat Management;
- PPR 12, Catch Monitoring; and
- PPR 19, Marine Environment.

1 Exhibit 77, p. 66.
2 Exhibit 77, pp. 45, 66.
3 Exhibit 604, p. 33.
4 Exhibit 606, p. 47.
5 *R. v. Nikal*, [1996] 1 SCR 1013, para 102.
6 Al Cass, Rob Morley, and Ken Wilson, Transcript, February 7, 2011, pp. 77–81.
7 See, e.g., Western Central Coast Salish First Nation's written submissions, pp. 57–59; First Nations Coalition's written submissions, pp. 251, 255,
8 *R. v. Marshall,* [1999] 3 SCR 533 *(Marshall II)*, para 40.
9 *Comeau's Sea Foods Ltd. v. Canada (Minister of Fisheries and Oceans)*, [1997] 1 SCR 12, para 37.
10 Transcript, August 19, 2011, p. 45.
11 Canada's final submission, pp. 110, 149; Transcript, August 19, 2011, p. 45; Transcript, September 2, 2011, p. 75; Exhibit 1426.
12 Exhibit 8, p. 2.
13 Exhibit 480, pp. 11, 14.
14 Exhibit 1187, p. 13.
15 Exhibit 1187, p. 20.
16 *R. v. Marshall*, [1999] 3 SCR 533 *(Marshall II)*, para. 40.
17 Stewart Johnstone, Transcript, August 22, 2011, pp. 36, 69–70; Sylvain Paradis, Transcript, June 7, 2011, pp. 29, 48, 51–52; Exhibit 981, p. 9.
18 Robie Macdonald, Transcript, June 6, 2011, pp. 5–8; Sylvian Paradis, Transcript, June 7, 2011, pp. 29, 48, 51–52; Exhibit 981, p. 9.
19 Transcript, September 23, 2011, p. 3.
20 Exhibit 216, pp. 20–30.
21 Exhibit 1728, pp. 1–2.
22 Exhibit 102, p. 1.
23 Transcript, September 22, 2011, p. 44.
24 Susan Farlinger, Transcript, September 23, 2011, p. 55; David Bevan, Transcript, September 23, 2011, p. 65.
25 Exhibit 8, p. 8.
26 Exhibit 8, p. 35.
27 Susan Farlinger, Transcript, September 27, 2011, pp. 21–22.
28 Exhibit 244, p. 2; Transcript, December 9, 2010, pp. 40–41.
29 Claire Danserau, Transcript, September 22, 2011, pp. 45, 58–60. Susan Farlinger, Transcript, September 22, 2011, pp. 51–52; David Bevan, Transcript, September 23, 2011, p. 83.
30 Exhibit 8, p. 35.
31 Transcript, November 30, 2010, pp. 96–97; Exhibit 102.

32 Exhibit 238, p. 8; Exhibit 240, pp. 6, 8.
33 Transcript, November 29, 2010, pp. 72–73.
34 Pat Chamut, Transcript, November 29, 2010, pp. 72–73; Transcript, November 30, pp. 82–83; Jim Irvine, Transcript, December 8, 2010, pp. 58–59.
35 Kathy Scarfo, Transcript, March 1, 2011, p. 30; Rob Morley, Transcript, February 7, 2011, p. 83.
36 PPR 20, pp. 14–15.
37 Exhibit 1615.
38 Andrew Thomson, Transcript, September 1, 2011, pp. 7–8.
39 Gary Marty, Transcript, August 31, 2011, pp. 21–22.
40 Andrew Thomson, Transcript, August 30, 2011, pp. 16–18.
41 Andrew Thomson, Transcript, August 30, 2011, p. 25.
42 Exhibit 1615, p. 6.
43 Josh Korman, Transcript, August 25, 2011, pp. 82–83; Exhibit 1536, p. 34; Craig Stephen, Transcript, August 22, 2011, p. 93.
44 Josh Korman, Transcript, August 25, 2011, pp. 86–87; Exhibit 1543, p. 11; Larry Dill, Transcript, August 26, 2011, p. 79.
45 Craig Orr, Transcript, September 6, 2011, p. 22.
46 Clare Backman, Transcript, September 7, 2011, p. 89.
47 Trevor Swerdfager, Transcript, August 30, 2011, pp. 22–23.
48 Kristina Miller, Transcript, December 15, 2011, pp. 53, 102–3; Exhibit 2084.
49 Exhibit 51, p. 3.
50 Mia Parker, Transcript, September 7, 2011, p. 26.
51 Michael Kent, Transcript, August 22, 2011, pp. 11–12; Craig Stephen, Transcript, August 22, 2011, p. 15.
52 David Marmorek, Transcript, September 19, 2011, p. 76.
53 Exhibit 1540, p. 9.
54 Exhibit 1540, p. 9.
55 See, e.g., Aquaculture Coalition's written submissions, p. 1; Conservation Coalition's written submissions, pp. 14–17; written submissions of Area D Salmon Gillnet Association and Area B Harvest Committee (Seiners), pp. 64–65.
56 Catherine Stewart, Transcript, September 8, 2011, p. 5; Exhibit 1563.
57 For example, see Exhibit 1543.
58 Transcript, August 23, 2011, p. 42.
59 Exhibit 1540, p. 24; Lawrence Dill, Transcript, August 29, 2011, pp. 104–5.
60 Transcript, August 22, 2011, pp. 37–38.
61 Exhibit 8, p. 31.
62 Exhibit 1632, p. 1.
63 Andrew Thomson, Transcript, August 30, 2011, p. 18.
64 Susan Farlinger, Transcript, September 22, 2011, pp. 82–83; Trevor Swerdfager, Transcript, August 30, 2011, pp. 71–72.
65 Exhibits 1625, 1629, 1630.
66 Andrew Thomson, Transcript, September 1, 2011, pp. 87–88.
67 Rebecca Reid, Transcript, April 5, 2011, pp. 28–31; Exhibit 663.
68 Gavin Last, Transcript, August 30, 2011, p. 71.
69 Laura Richards, Transcript, September 22, 2011, p. 79.
70 Exhibit 1536, p. 25; Donald Noakes, Transcript, August 29, 2011, p. 23.
71 Susan Farlinger, Transcript, September 26, 2011, p. 74–75.
72 Andrew Thomson, Transcript, August 30, 2011, pp. 74, 108.
73 Kerra Hoyseth, Transcript, September 1, 2011, pp. 57–58.
74 Susan Farlinger, Transcript, September 22, 2011, p. 80.
75 Exhibit 51, pp. 4–5.
76 Josh Korman, Transcript, August 25, 2011, pp. 86–87; Exhibit 1543, p. 11.
77 Exhibit 1454, p. 3; Christine MacWilliams, Transcript, August 22, 2011, p. 48.
78 Christine MacWilliams, Transcript, August 22, 2011, p. 48.
79 Exhibit 1454, p. 2.
80 Christine MacWilliams, Transcript, August 22, 2011, pp. 77–78.
81 Craig Stephen, Transcript, August 23, 2011, pp. 77–80; Exhibit 1454, p. 105.
82 Exhibit 1454, pp. 3–4.
83 Exhibit 1593, pp. 4–6.
84 Christine MacWilliams, Transcript, August 22, 2011, pp. 47–48.
85 Exhibit 1454, pp. 3–4.
86 Exhibit 1454, pp. 87–88.
87 Transcript, May 2, 2011, p. 67; Exhibit 759A, p. 3.
88 Exhibit 759A, p. 3.
89 Randall Peterman, Transcript, May 2, 2011, pp. 37, 66–67; Exhibit 759A, p. 3.
90 Randall Peterman, Transcript, May 2, 2011, pp. 59–61; Exhibit 759A, p. 3.
91 Transcript, July 7, 2011, p. 83.
92 Transcript, May 2, 2011, pp. 86, 99.
93 Transcript, May 2, 2011, p. 46; Exhibit 757, p. 3 (Exhibit A, Question 8.c); Exhibit 758, p. 9 (Exhibit A, Question 19.c).
94 Exhibit 757, p. 3 (Exhibit A, Question 9).
95 Exhibit 757, p. 3 (Exhibit A, Question 10); Exhibit 758, p. 10 (Exhibit A, Question 21); Exhibit 766.
96 Exhibit 8, pp. 30, 36.
97 Annual Statistics 2008, online: NPAFC Statistical Yearbook www.npafc.org/new/publications/Statistical%20Yearbook/Data/2008/2008page.htm.
98 Canada's final submissions, p. 202.
99 Transcript, February 11, 2011, pp. 45–46, 66.
100 Exhibit 396, p. 1.
101 Al Cass, Transcript, February 7, 2011, pp. 15–17.
102 Transcript, February 8, 2011, p. 121; see also PPR 5, pp. 43–45.
103 Transcript, February 7, 2011, p. 70.
104 Rob Morley, Transcript, February 7, p. 83.
105 Paul Ryall, Transcript, March 16, 2011, p. 5.
106 Exhibit 371, p. 1.
107 Susan Farlinger, Transcript, September 23, 2011, p. 7.
108 *Larocque v. Canada (Minister of Fisheries and Oceans)*, (*Larocque*), 2006 FCA 237, FCA 237 270 DLR (4th) 552.
109 Exhibit 372; Exhibit 373; Jim Cave, Transcript, January 31, 2011, pp. 58–59.
110 Transcript, January 26, 2011, pp. 86–87.
111 Transcript, January 27, 2011, pp. 19–20.
112 Transcript, January 27, 2011, p. 23.
113 Mike Lapointe, Transcript, January 26, 2011, p. 83.
114 Exhibit 356, p. 3.
115 Exhibit 443, p. 2.
116 Exhibit 266, p. 7.
117 Transcript, February 21, 2011, p. 36.
118 Exhibit 718, p. 57 (Authority cited by authors of TR7 omitted).
119 Transcript, May 11, 2011, p. 13.
120 Transcript, May 11, 2011, p. 51.
121 Transcript, May 11, 2011, pp. 16–17.
122 Transcript, May 11, 2011, p. 52.
123 Transcript, May 11, 2011, pp. 15–16.
124 Exhibit 718, p. 21.
125 Transcript, May 17, 2011, p. 11. See also Transcript, May 18, pp. 1–2.
126 Transcript, May 11, 2011, p. 21.
127 Transcript, May 12, 2011, p. 12.
128 Exhibit 855, foreword.
129 Exhibit 855, p. 10; Exhibit 860, pp. 23–24.
130 PPR 12, p. 44; Exhibit 855, p. 10.
131 Transcripts, May 11, 2011, p. 6; Exhibit 840, p. 3.
132 Joe Tadey, Transcript, March 3, 2011, p. 15; Exhibit 270, p. 10; Lester Jantz, Transcript, May 11, 2011, pp. 20–21.
133 Transcript, May 11, 2011, p. 18.
134 Transcript, May 11, 2011, p. 19.

135 Transcript, May 11, 2011, p. 12.
136 Transcript, May 12, 2011, p. 19.
137 Peter Sakich, Transcript, May 12, 2011, p. 20; Kathy Scarfo, Transcript, March 1, 2011, pp. 51, 56.
138 Colin Masson, Transcript, May 12, 2011, p. 21; Julie Stewart, Transcript, August 19, 2011, p. 18.
139 Timber Whitehouse, Transcript, February 2, 2011, pp. 33–36; Transcript, February 3, 2011, pp. 24–25; Exhibit 380.
140 Timber Whitehouse, Transcript, February 2, 2011, pp. 61–62; Brian Riddell, Transcript, February 2, 2011, pp. 42, 59, 62–63.
141 Transcript, July 4, 2011, pp. 28–29.
142 Barry Huber, Transcript, June 30, 2011, pp. 36–37; Kaarina McGivney, Transcript, August 19, 2011, p. 3; Exhibit 1279, p. 5.
143 Transcript, August 19, 2011, p. 4.
144 First Nations Coalition's written submissions, p. 309; Stó:lō Tribal Council and Cheam Indian Band's written submissions, pp. 61–62, 101.
145 Susan Farlinger, Transcript, September 22, 2011, pp. 69–70; Jeff Grout, Transcript, February 23, 2011, pp. 18, 23, 29, 45, 88–89, 92.
146 Transcript, February 23, 2011, p. 50.
147 Canada's written submissions, p. 164, available at www.cohencommission.ca; Susan Farlinger, Transcripts, September 22, 2011, p. 63
148 Paul Sprout, December 16, 2010, p. 11.
149 Karl English, Transcript, April 14, pp. 21–22; Transcript, April 15, pp. 75–76.
150 Transcript, April 15, 2011, pp. 75–77.
151 Exhibit 291, pp. 1, 5.
152 Bill Duncan, Transcript, March 1, 2011, p. 42; Gordon Curry, Transcript, February 21, 2011, pp. 65–66; Rob Morley, Transcript, March 1, 2011, p. 43.
153 Wild Salmon Policy, Exhibit 8, p. 28.
154 Exhibit 1426.
155 Transcript, August 19, 2011, p. 31; Transcript, September 2, 2011, p. 97.
156 Exhibit 1279, p. 1; see also Ruling Re: Heiltsuk Tribal Council's Application for Production of FSC "Mandate Documents"; Coastwide Framework Documents, September 20, 2011, p. 15.
157 Exhibit 260.
158 Exhibit 730, pp. 20–29; Exhibit 88, p. 12; see also PPR 8, pp. 20–21.
159 Patrice LeBlanc, Transcript, April 4, 2011, p. 8; Transcript, April 5, 2011, p. 57; David Bevan, Transcript, November 2, 2010, pp. 36–37; Claire Dansereau, Transcript, September 22, 2011, pp. 29–30; Exhibit 665.
160 Exhibit 662; Jason Hwang, Transcript, April 4, 2011, p. 32; Jason Hwang, Transcript, April 5, 2011, p. 19; Michael Crowe, Transcript, June 8, 2011, pp. 5–7, 14, 16–18, 21–22, 25–27; Corino Salomi, Transcript, June 8, 2011, pp. 14–15, 21–22; Exhibit 1003.
161 Transcript, September 22, 2011, pp. 33–34.
162 David Carter, Transcript, April 6, 2011, pp. 3, 6, 9, 11, 20, 37; Exhibit 260, p. 21; Exhibit 678.
163 Dave Carter, Transcript, April 6, 2011, pp. 16–17.
164 Michael Crowe, Transcript, June 8, 2011, pp. 8–9; see also Exhibit 1018.
165 Exhibit 1010, pp. 13–15.
166 Stacey Wilkerson, Transcript, June 8, 2011, p. 44; Exhibit 1010, p. 15.
167 *Yanke v. Salmon Arm (City)*, 2011 BCCA 309.
168 Transcript, September 16, 2011, p. 8.
169 Transcript, September 15, 2011, p. 6.
170 Transcript, September 15, 2011, pp. 2–3, 9, 57; see also Exhibit 1760.
171 Jason Hwang, Transcript, September 16, 2011, pp. 9–11.
172 Exhibit 1871, p. 2.
173 Glen Davidson, Transcript, September 16, 2011, p. 13.
174 Jason Hwang, Transcript, September 16, 2011, p. 16; Exhibit 1874, pp. 4–32.
175 Transcript, June 17, 2011, pp. 6, 48–51, 57–58, 76.
176 Don MacDonald, Transcript, May 9, 2011, pp. 91–92; Exhibit 826, pp. 34–36; Peter Ross, Transcript, June 14, 2011, p. 30.
177 Transcript, June 17, 2011, pp. 19–20, 53–53, 57, 59, 72, 77.
178 Transcript, June 17, 2011, pp. 19, 52.
179 For Canada's reports, see Exhibits 1303, 1305, 1307 and 1309.
180 PPR 19, p. 29.
181 Peter Ross, Transcript, August 17, 2011, p. 61; Bruce Reid, Transcript, August 17, 2011, p. 62; Sergio Di Franco, Transcript, August 17, 2011, p. 63.
182 Sergio Di Franco, Transcript, August 17, 2011, pp. 64–65, 67–68, 72.
183 Sylvain Paradis, Transcript, June 7, 2011, pp. 24–25, 28, 64; Robie Macdonald, Transcript, June 6, 2011, pp. 5, 6, 12, 17, 37–38; Claire Dansereau, Transcript, September 22, 2011, p. 37.
184 John Carey, Transcript, June 7, 2011, pp. 41, 42.
185 Robie Macdonald, Transcript, June 6, 2011, pp. 5, 6; Peter Ross, Transcript, June 14, 2011, pp. 79–80.
186 Peter Ross, Transcript, June 14, 2011, p. 83; Transcript, August 17, 2011, pp. 86, 88; Transcript, August 18, 2011, p. 26; Graham van Aggelen, Transcript, June 14, 2011, pp. 83–84; Sylvain Paradis, Transcript, June 7, 2011, p. 84; Claire Dansereau, Transcript, September 22, 2011, p. 39; Exhibit 1377; Exhibit 1378, p. 1.
187 Transcript, September 22, 2011, p. 35.
188 Transcript, May 9, 2011, pp. 91–92.
189 Transcript, June 14, 2011, p. 30.
190 Exhibit 997, p. 7.
191 John Carey, Transcript, June 7, 2011, p. 39.
192 Janice Boyd, Transcript, June 13, 2011, p. 73; Robert Grace, Transcript, June 13, 2011, p. 62.
193 Transcript, May 9, 2011, p. 55.
194 Robie Macdonald, Transcript, June 6, 2011, pp. 4–5.
195 Peter Ross, Transcript, June 14, 2011, p. 62; Ken Ashley, Transcript, June 14, 2011, pp. 62–63; Graham van Aggelen, Transcript, June 14, 2011, p. 63.
196 Transcript, June 14, 2011, pp. 15–16, 41.
197 Transcript, June 14, 2011, pp. 23, 66; Exhibit 1048.
198 James Arnott, Transcript, June 15, 2011, p. 13; Peter Ross, Transcript, June 14, 2011, p. 25.
199 Exhibit 878.
200 Transcript, September 22, 2011, pp. 6–7.
201 Transcript, May 17, 2011, p. 65.
202 Exhibits 77 and 606.
203 Transcript, May 17, 2011, pp. 8, 19–20.
204 Transcript, May 17, 2011, pp. 18–19.
205 Paul Steele, Transcript, April 7, 2011, pp. 8–9; Randy Nelson and Manon Bombardier, Transcript, April 7, 2011, pp. 9–10.
206 Exhibit 35, pp. 34, 40.
207 Transcript, September 22, 2011, p. 44.
208 Paul Steele, Transcript, April 7, 2011, pp. 52–53; Patrice LeBlanc, Transcript, April 4, 2011, pp. 72–73; Randy Nelson, Transcript, April 7, 2011, p. 53.
209 Transcript, April 7, 2011, pp. 51, 53, 55.
210 Transcript, April 7, 2011, p. 64.
211 Randy Nelson, Transcript, May 17, 2011, pp. 40–41; Barry Rosenberger, Transcript, July 4, 2011, pp. 36–37, 40.
212 Transcript, July 4, 2011, p. 35.
213 Exhibit 1896, pp. 108–9; Stewart McKinnell, Transcript, July 6, 2011, pp. 28, 30; David Welch, Transcript, July 6, 2011, pp. 58–59; Richard Beamish, Transcript, July 6, 2011, pp. 82–83; Transcript, July 7, 2011, pp. 24–25; Transcript, July 8, 2011, p. 47; Exhibit 1294, p. 50; Jim Irvine, Transcript, July 8, 2011, p. 108.
214 Exhibit 757, p. 3 (Exhibit A, Question 12); Exhibit 758 p. 10 (Exhibit A, Question 23).
215 Michael Kent, Transcript, August 22, 2011, pp. 11–12; Craig Stephen, Transcript, August 22, 2011, p. 15.

216 Michael Kent, Transcript, August 22, 2011, pp. 37–38.
217 Stewart Johnson, Transcript, August 22, 2011, pp. 12–13.
218 Stewart Johnson, Transcript, August 22, 2011, p. 32.
219 Michael Kent, Transcript, August 22, 2011, p. 10; Exhibit 1449, p. 23.
220 Exhibit 1449, p. 23.
221 Donald Noakes and Lawrence Dill, Transcript, August 26, 2011, pp. 79–80; David Marmorek, Transcript, September 19, 2011, pp. 77–78.
222 Stewart Johnson, Transcript, August 22, 2011, pp. 52–53.
223 Exhibit 1461, p. 8.
224 Exhibit 1536, p. 15; Exhibit 1765; Exhibit 1766; Donald Noakes, Transcript, August 26, 2011, p. 69; Exhibit 1764, p. 4.
225 Transcript, September 6, 2011, p. 8.
226 Simon Jones, Transcript, September 6, 2011, pp. 10–12, 35.
227 Lawrence Dill, Transcript, August 26, 2011, p. 25; Simon Jones, Transcript, September 6, 2011, p. 51; Craig Orr, Transcript, September 6, 2011, pp. 19, 37.
228 Simon Jones, Transcript, September 6, 2011, p. 29; Exhibit 1780, p. 22; Craig Orr, Transcript, September 6, 2011, pp. 19, 37.
229 Laura Richards, Transcript, September 23, 2011, pp. 4–5.
230 Exhibit 748, p. 65.
231 Transcript, September 15, 2011, p. 59.
232 Transcript, June 14, 2011, p. 16.
233 Transcript, June 8, 2011, p. 6. **See also Jason Hwang,** Transcript, April 5, 2011, p. 67; Corino Salomi, Transcript, June 8, 2011, p. 70.
234 Transcript, May 4, 2011, p. 81.
235 Don MacDonald, Transcript, May 9, 2011, p. 37; Mark Johannes, Transcript, April 18, 2011, p. 97.
236 Transcript, August 17, 2011, p. 36.
237 Transcript, March 9, 2011, p. 74.
238 Transcript, January 27, 2011, p. 97.
239 Transcript, July 8, 2011, pp. 94–95.
240 Transcript, September 20, 2011, p. 20.
241 Transcript, November 3, 2010, pp. 56, 58.
242 Wendy Watson-Wright, Transcript, November 4, 2010, p. 21; Siddika Mithani, Transcript, November 4, 2010, pp. 99–100.
243 Exhibit 1415; Exhibit 1416; see also Robin Brown, Transcript, August 18, 2011, p. 89; Craig Orr, Transcript, September 15, 2011, p. 101; David Patterson, Transcript, January 27, 2011, p. 106.
244 Transcript, September 22, 2011, p. 34.
245 Transcript, September 22, 2011, p. 79.
246 Transcript, June 6, 2011, p. 18.
247 Transcript, June 13, 2011, p. 61.
248 Transcript, August 18, 2011, p. 59.
249 Transcript, April 4, 2011, p. 29.
250 Transcript, September 20, 2011, p. 69.
251 Transcript, June 14, 2011, p. 35.
252 Transcript, June 13, 2011, pp. 61, 63.
253 Transcript, May 4, 2011, p. 31.
254 Exhibit 718, p. 1; Transcript, April 14, 2011, pp. 21–22.
255 Exhibit 51, p. 9.
256 Exhibit 1400, pp. 2–4, 32; PPR 19, pp. 78–80.
257 Exhibit 14.