

Restoring Wild Salmon Habitat

When insufficient habitat protection provisions are in place or compliance with those provisions has not been enforced, restoration may be required. The need to turn to restoration highlights past deficiencies in the resource management system.

The restoration of wild salmon habitat involves repairing any physical damage done to the aquatic and biological conditions necessary for the fish to carry out their life functions. Activities to restore habitat quality and habitat availability include altering water flows and drainage patterns, minimizing erosion, restoring cover and shade along waterways and creating off-channel and side channel rearing areas. Appendix B provides a sample of best practices developed by provincial agencies for watershed restoration.

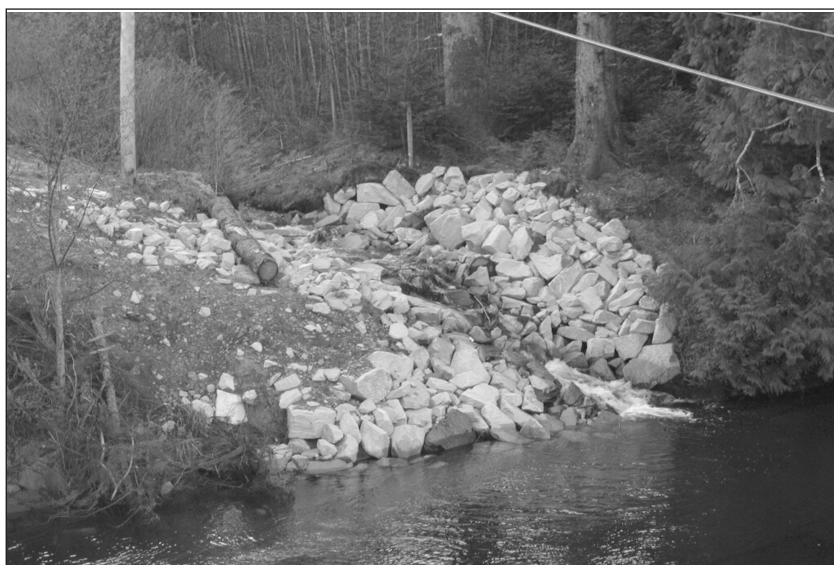
In this audit, we expected to find that ministries and agencies had programs and plans in place for restoring wild salmon habitat. We found that because government has significantly reduced its investment in restoration activities over the last few years, many of these programs and plans no longer exist.

Initiatives to restore salmon habitat have been significantly curtailed

Over the last decade, the Province made significant contributions to wild salmon and fish habitat restoration. Now, however, limited resources are being directed towards these areas. In the mid-1990s, the B.C. Salmon Habitat Conservation Plan (1995) and the B.C. Fisheries Strategy (1997) outlined how government would contribute to restoring fish habitat affected by historical land use practices while preventing further loss of salmon habitat. Forest Renewal B.C. and the former Ministry of Environment, Lands and Parks also coordinated provincial initiatives that aimed to benefit the freshwater habitat requirements for juvenile and returning spawners. These organizations set the foundation for programs such as the Watershed Restoration Program and the Urban Salmon Habitat Program that funded activities to restore streams and riparian areas damaged by past forest extraction practices, and to protect and restore salmon habitat in urban areas, particularly within the Georgia Basin.

Between 1994 and 2001, consecutive governments made significant investments in fish habitat restoration activities, mostly through Forest Renewal B.C., Fisheries Renewal B.C.

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Courtesy: Office of the Auditor General of British Columbia, 2004

A stream bank stabilization project on a tributary of the Salmon River

and the former Ministry of Environment, Lands and Parks. The Watershed Restoration Program provided over \$350 million with significant focus on salmon spawning and rearing habitat, while the Urban Salmon Habitat Program directed over \$7 million to deal with urban salmon habitat.

Under the current government, resource allocations have changed. In managing wild salmon, the major question facing decision-makers is how much restoration work can the Province engage in and support. The government, in its 2001 New Era commitments, stated it would support environmental stewardship action plans by passing a Living Rivers Act to protect the province's river systems, enhance fish habitat and develop a 10-year program to correct past damage. To date, however, no such Act is in place, nor has a ten-year program for habitat restoration been established. Indeed, at the time of our audit, the Living Rivers initiative was being refocused to apply ecosystem based principles together with \$2 million funding, which is now being managed through the Vancouver Foundation. Resource constraints and the shift to a results-based management model have reduced provincial involvement in direct habitat restoration activities considerably.

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The Province has streamlined its involvement in salmon habitat restoration down to four program areas: the Ministry of Forests' Forest Investment Account; the Ministry of Water, Land and Air Protection's Living Rivers Strategy and Habitat Conservation Trust Fund; and, BC Hydro's Fish and Wildlife Compensation Programs.

The Forest Investment Account is funded by a vote of the legislature. It was initiated upon the dissolution of Forest Renewal B.C. as a mechanism for funding forest management activities. One of its objectives is to improve the public forest asset base by restoring damaged ecosystems. Under this objective, the program includes projects for treating watersheds to restore ecosystem function and structure, including aquatic attributes.

At the time of our audit, the amount of provincial funding for fish and fish habitat related issues was approximately \$10 million. Most available funds are not targeted to wild salmon, though BC Hydro's Bridge-Coastal Fish and Wildlife Restoration Program is an exception. There is also considerable reliance on the federal government and non-profit organizations to fund restoration activities, although their resources are also constrained.

To make the best use of scarce resources, funds ought to be spent based on priority. Currently, information on restoration needs is incomplete and scattered throughout the province in various regional offices. There is no single inventory of the work previously completed or the ranking of watersheds and habitat requiring restoration. There is also limited information on, and monitoring of, the high risk watersheds that were initially

Addressing Salmon Management Issues for Hydroelectric Development

BC Hydro established the Bridge-Coastal Fish and Wildlife Restoration Program (BCRP) to restore fish and wildlife populations and habitat in areas affected by hydroelectric generation facilities in coastal British Columbia. The Bridge River/Coastal Generation Area includes the Fraser Valley, Vancouver Island, Coastal, Bridge River and Shuswap regions. BC Hydro contributes \$1.5 million in annual funding to support fish and wildlife projects. Approximately 50% of that is allocated for salmon compensation. Projects undertaken through the BRCRP include fish passage assessment, recovery planning, off-channel rehabilitation, spawning channel restoration and habitat inventories. Through the BCRP and the water use planning process, BC Hydro is also examining a variety of issues affecting wild salmon, including inventory data collection, rehabilitation, maintaining instream flow requirements and monitoring. BC Hydro will undertake research and monitoring activities for 10 years as part of new permitting requirements under its water licenses.

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identified for restoration work, or the watersheds that have been restored to gauge how they are responding to past restoration efforts. The absence of an existing restoration plan and program precludes us from commenting on the resource and capacity requirements to undertake these activities.

Restoration efforts have not been evaluated for their effectiveness

Effectiveness evaluations are necessary to ensure scarce resources have been allocated in an efficient and effective manner. Very few evaluation programs are currently in place to assess existing efforts in restoring salmon habitat.

Bringing Back the Salmon: BC Hydro at Work

Sockeye once teemed in the Coquitlam River. Sockeye require river systems that include lakes for spawning. In 1914, construction of a dam to provide electricity to the region ended the sockeye migration into Coquitlam Lake. The sockeye were thought to be extinct until recent DNA analysis of several fish from the lake suggested the possibility that the original strain of migratory sockeye might be re-established. Studies have been commissioned by the Bridge-Coastal Fish and Wildlife Restoration Program, which is funded by BC Hydro. It is believed that a run of about 40,000 sockeye could be restored. The estimated cost to achieve this is between \$1.5 million and \$7.5 million over 10 years.

We found that some evaluations have been carried out in the past, such as the one on the Urban Salmon Habitat Program done in 2000. That evaluation concluded that the program delivery had been effective and that program impacts appeared to be positive but were difficult to measure. We also found two evaluations of the Watershed Restoration Program. One focused on how to better deliver the program. The other evaluated projects funded by the program to determine whether site-level objectives were met. The conclusion of the latter was that while the objectives had generally been met, the early successes had declined over time. It called for routine inspections to ensure projected benefits are maintained.

The water use planning process that BC Hydro is engaged in with the Province and the Department of Fisheries and Oceans Canada incorporates processes to evaluate effectiveness in the future. A monitoring program for all water use plans will be undertaken based on 5, 10 and 15-year intervals to determine how successful each plan is working in individual systems. A variety of indicators will be monitored to determine how habitat characteristics are responding to restoration prescriptions.

It is important to note that successful restoration program outcomes require an effectiveness evaluation. The issues discussed in the sidebar below illustrate that many factors must be addressed to make restoration efforts successful, not just those directly tied to stream restoration. Seattle's experience is a case in point.

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Once restored, streams need effective protection including regulation by governments to ensure their quality is maintained. Efforts will be diminished if degradation through pollution or stream changes recurs. Restoration programs should therefore be considered in a more holistic manner than in the past.

Recommendation

We recommend that the Province institute a program to rank restoration priority, formulate a multi-year restoration program, and determine effectiveness of restoration programs.

Why Evaluations are Important

The City of Seattle has spent more than \$26 million restoring major salmon streams throughout its metropolitan area. Until recently, there was no focused efforts to determine the effectiveness of the restoration activities on salmon stocks. In 2002, a study was launched to see whether the restoration efforts were working. The study found that the water in many of the restored urban streams was dirty enough to kill coho salmon—most before they could spawn. The culprit was stormwater flushing quickly into the streams.

The study compared an urban stream to a rural one. In the urban stream, only 8 of 64 female coho survived to spawn. In the rural stream, 114 of 115 female fish survived. These findings suggest that urban restorations require more than making simply changing the streams themselves. Pollution flowing from the urban landscape has to be controlled if restoration efforts are to be effective in terms of fish production.



Information for Managing Wild Salmon

To make informed decisions about fish and fish habitat protection and restoration, decision-makers need ready access to basic inventory information about the physical and biological status of watersheds and related aquatic ecosystems. We looked at how the Province was undertaking information management activities related to data collection, coordination, quality control and accessibility.

The Province has considerable information about fish and fish habitat that is being consolidated

Through direct government programs and development activities permitted on Crown lands, the Province has collected a variety of land and resource information of value in the management of salmon. This includes information associated with forestry, hydroelectric development, agriculture, mining, oil and gas development, aquaculture, tourism and other land use activities. Such information is used for a range of purposes, from seeking provincial regulatory approvals and managing provincial freshwater recreational stocking programs, to planning provincially funded habitat rehabilitation or restoration projects.

Historically, without a central provincial agency to do it, individual government programs have themselves collected extensive information over the years on fish, including salmon, and their habitat. This information covers physical locations of lakes, streams, rivers, creeks and wetlands as well as their surface area, gradient and channel width, the condition of the riparian habitat and details of the aquatic environment (such as species present, size and weight of fish, and food supplies). However, less attention was given to organizing and capturing the data so it could be easily retrieved and analysed for decision-making.

Overall, the Province has a considerable amount of fish habitat and watershed management data at its disposal. With the creation of the Ministry of Sustainable Resource, the Province has begun to centralize and consolidate this information in one agency, but there is still a need to reduce the backlog in converting data into electronic format. For example, we were informed that some data collected by projects funded through the Forest Renewal B.C. watershed restoration program have not yet been properly catalogued in government databases. This, we believe compromises the information's completeness and accessibility.

Information for Managing Wild Salmon

Current data lacks wild salmon focus, but is still useful

We found that a number of databases developed over the last 30 years contain information pertinent to wild salmon. The principal tool used to manage fish inventory data today is the Fish Inventory Summary System. Administered by the Ministry of Sustainable Resource Management, this system collects information on freshwater fish and fish habitat from a variety of sources and integrates it into summary format. Topics summarized include: number of waterbodies, fish distribution, number of releases, enhancement and management, potential and constraints, obstructions, harvest and use, land use, life history and timing, resource use, angler access information, value and sensitivity.

In addition to the Fish Information Summary System, the government manages other fish information databases (Appendix C) including lakes, wetlands, watersheds and a number of physical, chemical and biological characteristics associated with their habitat. Few of these databases were developed with wild salmon or their habitat requirements as the focal point for data collection or analysis. Nevertheless, the information is useful for managing wild salmon issues.

Concerns over data accuracy and gaps are being addressed

Accurate, reliable information is needed if resource management decision-making is to be effective. Assessments by the Ministry of Sustainable Resource Management of some of these datasets raised concerns about their accuracy and timeliness and called for these problems to be cleared up.

Other government reports have identified a number of information gaps in the baseline knowledge of aquatic ecosystems. Key gaps include information on:

- freshwater needs of individual stream system such as flow and temperature requirements
- stream flow monitoring
- water use distribution of existing licences
- size, recharge time and current conditions of aquifers

We were informed that the data clean-up and completeness improvement process is underway.

Consistent application of data collection standards is needed

Standards for data collection helps ensure that datasets are easy to access and the information retrieved is of good quality for management decision-making.

Data sampling, collection and reporting methodologies and guidelines have been used by several provincial agencies for a number of years. With the establishment of the Resources Inventory Committee in 1991, the Province began to develop standard methodologies. Some of these documents (listed in Appendix D), provide sound criteria and procedures for collecting and analyzing information on a wide range of freshwater fish species, habitat types and conditions. However, there is still no one generally accepted best practice.

Because regions had significant autonomy in the past, adherence to guidelines and quality control standards varied. Some information was also collected by non-governmental groups or volunteers who might not have had sufficient training in applying these provincial standards. We learned that the Ministry of Sustainable Resource Management is working with a reconstituted standard development committee (the Resource Information Standards Committee) on improving standard methodologies and considering implementing a fish and fish habitat inventory auditing program to improve the quality of data being collected, and to monitor compliance with standards and best practices.

There is inadequate coordination between provincial ministries, agencies, industry and non-governmental organizations on the methodologies used to identify, measure and evaluate fish habitat. Data standards are largely voluntary and are often not integrated with their federal counterparts. As a result, the government has inadequate assurance about the accuracy of data. It also cannot provide assurances that the methods used to collect information by all parties are reliable or that the gathered data can be used to its full potential by all user groups. Considering the government's objectives for a results-based framework, and an increasing reliance on second and third party users to provide fish habitat data to provincial agencies, improvements are necessary to ensure data is standardized and coordinated if a comprehensive and current inventory is to be established and maintained.

Information for Managing Wild Salmon

The Ministry of Sustainable Resource Management has become the central agency to coordinate all land and resource management information in the province, of which freshwater fisheries data is one such type of information. The ministry chairs the Resource Information Standards Committee, the forum in which data standards are now identified, discussed and developed. The Resource Information Standards Committee currently manages over 200 standards, procedures, field guides, field forms and background documents, many of which have implications for freshwater fish and fish habitat issues.

The Province is moving towards operating as a standards setter, regulator and monitoring agent versus its historical role of data collector. There has been a significant reduction in the amount of fieldwork being conducted to collect fish habitat related information. The trend is to partner with stakeholders such as natural resource licensees and third parties to collect and share land and resource data. Instituting these changes will require consistent standards and procedures and long term commitment. The government in general and the Ministry of Sustainable Resource Management more specifically face many challenges over the collection and coordination of wild salmon information on an on-going basis.

Recommendation

We recommend that the Province, through the Ministry of Sustainable Resource Management:

- **determine, in conjunction with related provincial agencies and its federal partners, consistent data standards for collecting and storing information, including wild salmon data, and**
- **ensure that a program is in place to attest the accuracy, completeness of data and timely accessibility of information for decision makers and users**

Resource capacities need to be identified

Ministries and agencies accountable for freshwater fish issues rely on skilled staff and consultants to carry out government responsibilities and programs. Managing fish habitat is not a new area of administration, but as science contributes new information, government must have the resources to attract scientists into public service, as well as provide staff with the opportunities to upgrade and learn new skills.

We found that the Province has many world-class scientists working in various areas of fisheries biology and habitat management. Among these professionals are biologists, hydrologists, forest ecologists, fluvial geomorphologists, civil engineers, physical geographers, environmental planners, computer scientists and economists. Many are trained to the masters, doctorate and post-doctoral level.

We also were informed that training opportunities for staff were adequate and range from workshops and courses to conferences and technical seminars. However, current resources are stressed because of the shift to results-based regulations, competing operational demands, program downsizing and workforce adjustment. Many skilled people are leaving or have left government, which requires program managers to do more with less. We noted as well, some uncertainty over the longer term as to the future capacity needs to manage wild salmon sustainability issues. The changing nature of legislation and management approaches, the reliance on third parties for information, and the knowledge and data gaps for gathering, interpreting and managing fish and fish habitat information are all contributing to this uncertainty.

Where their budgets accommodate it, ministries and agencies hire outside consultants and contractors to carry out field research and analysis. The ministries and agencies we talked with acknowledged that more attention should be given to managing wild salmon issues, and there is a recognition that the Province has responsibilities to manage impacts to fish habitat from activities under provincial jurisdiction. Dealing with matters such as managing biodiversity and restoring lost habitat requires a long-term commitment of time and resources, including the allocation of dedicated staff. We concluded that most ministries and agencies

Information for Managing Wild Salmon

still need to determine the extent of the problem before long term staffing and fiscal requirements to address wild salmon sustainability issues can be addressed.

Recommendation

We recommend that the Province assess the resource requirements needed to deal with wild salmon issues.



Addressing the Impacts of Salmon Aquaculture

British Columbia's salmon farming industry started about 30 years ago and has grown substantially. Today the province is the fourth largest producer in the world after Norway, Chile and the United Kingdom. In 2002, according to provincial statistics, 12 companies produced 85,400 tonnes of salmon and generated 900 on-farm jobs from 121 tenured farms. The main species produced are Atlantic salmon (85%), Pacific Chinook (12%) and Pacific Coho (3%).

The Province has a goal of seeking "optimum economic benefits to British Columbia from fisheries and aquaculture while protecting the environment." It has been suggested that the controlled expansion of salmon aquaculture could generate over \$1 billion in economic activity over the next 10 years. The Province therefore advocates aquaculture with a vision of an economically competitive industry that develops in an environmentally and socially sustainable manner.

At the same time the salmon farming industry has faced substantial opposition. Many concerns over the effects of the industry on wild salmon and the marine environment have been raised and views on the risks on wild stock posed by farms have been conflicting. An incomplete understanding of the risks that salmon aquaculture poses to the environment and wild salmon has generated considerable and intense debates in British Columbia.

We expected to find that the Province had programs in place to identify the risks to wild salmon and to mitigate or offset those risks. We found that there are gaps and uncertainty in knowledge about the interactions between salmon aquaculture and wild salmon, particularly around topics such as disease transfer, the ability of farmed Pacific salmon to interbreed with wild Pacific salmon, the colonization capabilities of farmed Atlantic salmon, and the cumulative impacts of salmon aquaculture. Ongoing research is needed in these areas to ensure that salmon aquaculture does not pose an unacceptable risk to wild salmon and the environment.

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Courtesy: British Columbia Salmon Farmers Association

A net pen cage fish farm

Roles and responsibilities for managing salmon aquaculture

Both the federal and provincial governments have jurisdiction over, and therefore overlapping responsibilities for the regulation of salmon farming. To provide clarity for their respective authority, the Province and the Department of Fisheries and Oceans Canada came to an agreement on responsibilities and coordination of activities in their 1988 Memorandum of Understanding on Aquaculture Development. Under the Memorandum of Understanding, British Columbia has primary responsibility for day-to-day operational activities and is responsible for licensing, monitoring and managing sites once they are in production. The Department of Fisheries and Oceans Canada retains authority in the areas of conservation and protection of wild salmon, fish and fish habitat. The federal government retains responsibility for food safety outside the Memorandum of Understanding.

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The provincial organizations directly involved in managing salmon aquaculture in the province are the: Ministry of Agriculture, Food and Fisheries; Ministry of Water, Land and Air Protection; Ministry of Sustainable Resource Management, and Land and Water British Columbia Inc. The Ministry of Agriculture, Food and Fisheries is the provincial lead agency and is authorized under the provincial Fisheries Act to issue farm licenses. It has also taken on an advocacy role for the salmon farming industry. Land and Water British Columbia Inc. issues tenures for aquaculture operations and acts as the information and document collection and distribution coordinator for the finfish aquaculture facilities approval process. The Ministry of Sustainable Resource Management prepares high-level land and resource management plans, sub-regional coastal plans and aquaculture opportunities studies to identify suitable aquaculture areas. The Ministry of Water, Land and Air Protection regulates waste and monitors environmental impacts as a result of fish farm operations.

Services agreements are used to better define individual agency roles and responsibilities. For example, on compliance and enforcement issues, Ministry of Agriculture, Food and Fisheries is designated as the lead authority for compliance, while Ministry of Water, Land and Air Protection is the lead on enforcement. Coordinating committees have also been established at the project level (Project Review Team) and management level (Directors Aquaculture Committee) to guide policy discussions. We observed that attention is being devoted to wild salmon protection issues. However, tension and divergence of opinions between the two levels of government does occur as illustrated by policy differences surrounding siting criteria for salmon farms. In July 2003, the two governments established the Pacific Council of Fisheries and Aquaculture Ministers to provide a forum to discuss issues of concern regarding fisheries and aquaculture management in British Columbia.

Identifying and managing the risks of salmon aquaculture operations

The three main areas of risk in the salmon farming industry concern: health effects from the transfer of parasites and diseases (e.g. sea lice, bacterial like kidney disease, and viral disease like infectious hematopoietic necrosis); competition from escaped

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farmed fish (e.g. genetic diversity and food supply); and marine environmental impacts of aquaculture operations (e.g. on water quality and the seabed ecosystem).

The Province responded to public concerns over fish farms by placing a moratorium on salmon industry expansion in 1995. The British Columbia Environmental Assessment Office then conducted a comprehensive risk assessment of the industry. Completed in 1997, the “Salmon Aquaculture Review” concluded that salmon farming poses a low risk to wild salmon, but qualified that by adding “as currently practiced and at current production levels.” Production levels in 1995 were 23,800 tonnes. In 2002, they had increased to 85,400 tonnes, for the same number of farms.

The Salmon Aquaculture Review nevertheless provided suggestions to further mitigate the risks assessed during the review. These covered areas associated with: farm siting criteria, interaction between escaped farmed salmon and Pacific salmon, fish health and transfer of diseases between farmed and wild salmon, waste and environmental impacts and implementation.

The Province accepted the report’s conclusion of low risk and developed a risk management framework. In September 2002, after also taking into consideration similar studies in other jurisdictions, the Province decided it had a risk management regulatory framework in place and lifted the moratorium. The Salmon Aquaculture Policy Framework requires the relocation of poorly sited existing farms and implementation of new siting criteria. It also outlines improved fish escape prevention measures, waste management regulations and best management practices for maintaining fish health. The Aquaculture Regulation—the responsibility of the Ministry of Agriculture, Food and Fisheries, under the B.C. Fisheries Act—provides rules for farm operations and escape prevention. The Finfish Aquaculture Waste Control Regulation—the responsibility of the Ministry of Water, Land and Air Protection, under the Waste Management Act (replaced by the Environmental Management Act)—provides waste management standards and monitoring requirements for fish farms.

We found that although constructive measures for fish health, waste, best practices, and compliance and enforcement have been put into place, important issues remain unsolved.

Addressing the Impacts of Salmon Aquaculture

Disagreement on key farm siting issues persist

Properly sited salmon farms can reduce negative impacts on the marine environment, including impacts on wild salmon habitat. Having good siting criteria is therefore one of the best risk reduction approaches. The Province has drawn up 15 such criteria based on the Salmon Aquaculture Review recommendations (Appendix E). These criteria were developed mostly using professional judgement supported by risk management principles. The criteria set minimum distances to separate farms from certain areas such as shellfish beds and sensitive salmon-bearing streams.

These guidelines were developed using professional judgement and risk management principles, but federal and provincial agencies disagree over a number of key outstanding issues. Those key issues include: where the tenure boundary measurements for a farm should start; what the criteria should be to define values for wild salmon stream buffers, fish habitat buffers and seabed characterizations; and, whether existing farm sites should be “grandfathered” (allowed to remain because they existed before).

Over the last two years, 37 poorly sited salmon farms have been identified for relocation to more suitable areas. However, few of these sites have been relocated because environmental reviews are still proceeding.

Escape prevention measures have improved, but knowledge gaps remain

Farmed salmon can escape from aquaculture facilities and survive in the wild. Escapees have been known to reproduce and compete for spawning space and food with wild salmon. The Ministry of Agriculture, Food and Fisheries has suggested that escape prevention is a more cost-effective approach than dealing with the impacts of escaped fish. The Aquaculture Regulation requires farm operators to: improve net cage equipment design and maintenance; strengthen containment structures, net cage mesh and cage support systems; conduct inspections and establish record keeping programs; develop best management plans for facility operations, escape reporting and recovery.

The number of reported escapes has dropped in the last two years. However, knowledge gaps and disagreement remain about

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what happens to escaped salmon, particularly whether they have survived in large enough numbers to interbreed and compete with wild salmon for habitat. We noted the Province has contributed funding to the Atlantic Salmon Watch Program, operated by the Department of Fisheries and Oceans Canada, “to study the abundance, distribution and biology of Atlantic salmon in British Columbia and its adjacent waters.”

Fish health measures are improving detection of diseases

The potential for transfer of disease between farmed and wild salmon is a concern. The Salmon Aquaculture Review and other studies have pointed to the need for an aquatic animal disease program. While awaiting a national program to be established, the Ministry of Agriculture, Food and Fisheries has implemented a number of measures to deal with farmed salmon health issues. For example:

- In November 2000, the ministry started a fish health auditing and surveillance program. Under the program, fish health staff randomly audit 30% of active farms in an area or zone every quarter and collect specimens for health evaluation. The range of fish health issues tested for include bacteriology, virology and pathogens such as infectious hematopoietic necrosis. The ministry also audits fish health reports submitted by industry as a condition of licensing. These reports are maintained and managed by the ministry on a separate fish disease database.
- In 2001, the Fish Health Advisory Committee was formed to advise on health management issues and establish best practice guidelines. In November 2003, for example, guidelines were developed requiring every salmon farm site to have a Fish Health Management Plan in place. These plans are now a condition of licensing and must contain the key elements shown in Exhibit 8.

Monitoring of sea lice is now required by all fish farm operators

Sea lice in farmed salmon have been a problem in British Columbia since at least 1992 when the provincial Ministry of Agriculture and Fisheries sought federal approval to use pyrethrin, an insecticide, to control sea lice infestations.

Addressing the Impacts of Salmon Aquaculture

Exhibit 8

Required Elements of a Fish Health Management Plan

A. Characterizing the Health Status of Fish at a Culture Facility

1. Fish health records
2. Monitoring disease and infection

B. Identifying and Managing Risks to Fish Health

1. Water quality
2. Factors that predispose fish to disease
3. Vaccination
4. Broodstock health management

C. Reducing Exposure to, or Spread of, Disease Causing Agents

1. Outbreak investigation and management
2. Management of dead fish
3. Bio-Security
4. Release or escape of fish from a culture facility
5. Movement of fish

D. Use of Drugs and Chemicals in Fish Health Management

1. Diagnostic support
2. Drug, chemical and biological use of disease treatment and prevention

Source: B.C. Ministry of Agriculture, Food and Fisheries

Federal representatives noted that sea lice were a potential problem because control methods might not be compatible with the shellfish industry. In 2003, the Pacific Fisheries Resource Conservation Council concluded that sea lice are the most significant salmon aquaculture issue facing wild salmon.

In response to increasing concerns over the effects of sea lice on juvenile wild salmon, the Ministry of Agriculture, Food and Fisheries introduced a sea lice monitoring program in November 2003, now required as part of a facility's Fish Health Management Plan. The program applies to all companies and farms operating in the salmon farming industry. Operators are required to report monitoring results, and these are audited as part of the fish health auditing and surveillance program.

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The measures implemented by the ministry provide early detection and diagnosis for intervention and treatment. With the limited availability of treatment drugs, however, some experts suggest that more preventive measures are desirable. A joint federal-provincial sea lice monitoring project conducted in the Broughton Archipelago in 2003 recently reported that its findings on the impact of sea lice infestations on migrating pink salmon were inconclusive. More knowledge is necessary before long-term solutions can be identified.

Suitability of performance-based standards for determining the impact on marine habitat will be reviewed

Habitat impacts from salmon farms are generally of two types: water quality impairment and seabed contamination. Both are associated with waste discharges, feed not being consumed and chemical residues from farm operations polluting the water column. The affected areas are normally confined to the farm sites, but little is known about their wider impacts on wild salmon. To address these waste management issues, the Province enacted the Finfish Aquaculture Waste Control Regulation in September 2002.

The Ministry of Water, Land and Air Protection is responsible for enforcing the regulation, which sets a performance standard to limit the impact of farm sites on the seabed. The regulation is based on the sampling measurement of a chemical—sulphide concentrations—which are sampled below the farm site on the ocean floor at or beyond 30 meters from the edge of farms. Farm operators are also required to monitor their sites according to protocols set by the ministry and report results within set timetables. Debate still remains around the need to do more research to apply such values in British Columbia. The ministry recognizes this issue and will review the regulation in five years.

Compliance and enforcement can be improved

To foster better compliance with regulations, inspections are conducted at least once a year and cover essential areas required by both the Ministry of Agriculture, Food and Fisheries and the Ministry of Water, Land and Air Protection. The inspections involve comprehensive checklists that cover pertinent elements of

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the Aquaculture Regulation and best management practices associated with the Finfish Aquaculture Waste Control Regulation. The areas inspected include: conformance with management and best practice plans; fish health record keeping; stock inventory reports and record keeping; net maintenance, marking and record keeping; frequency of net inspections; escape prevention and response plans; and farm site operations.

Inspection results are reported annually and made publicly available on the Ministry of Agriculture, Food and Fisheries website. Non-compliances are enforced through written warnings, violation tickets with small fines and formal prosecution. We found that because the Finfish Aquaculture Waste Control Regulation regulatory regime is new and in transition, operators are still learning to meet the requirements, and hence their compliance rate could be improved. We also heard some concerns over the short statutory time period for initiating enforcement actions, and over the limited penalty provisions of the Aquaculture Regulation.

Further knowledge is needed

The Province's ability to manage the risks associated with the interaction between wild salmon and aquaculture is still hindered by significant gaps and uncertainty in knowledge. Recent analysis by several scientists has pointed to the need for more information in a number of high-risk areas:

- the source, extent and relationships of disease transfer between wild and farmed salmon, and particularly the potential link related to sea lice,
- the freshwater habitat behaviour of escaped Atlantic salmon and their ability to spawn and colonize,
- identification of escaped farmed Pacific salmon and their potential to breed with wild salmon, and
- the cumulative effects of aquaculture operations on the marine environment, including their impact on wild salmon.

We note that the Province has provided research funding of \$3.75 million to improve aquaculture practices and \$1.25 million to establish a chair in Aquaculture and the Environment at the University of British Columbia. The British Columbia Aquaculture

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Research and Development Committee, with administrative support from the Science Council of British Columbia, has also been set up to coordinate and prioritize research. These are positive measures. In our view, however, these projects are directed more towards improving farm operation technology and the identification and treatment of disease affecting farmed salmon rather than at assessing the potential impacts of farmed stock on wild salmon populations. The need to attend to issues surrounding disease transfer, escapes and cumulative impacts on wild salmon remain a concern. To fill these knowledge gaps during a time of reduced government financial resources, participation and cooperation of both levels of government and other stakeholders are needed.

Recommendation

We recommend that the Province:

- **take steps to resolve the aquaculture siting issues**
- **pool its research resources with those of relevant federal agencies to more efficiently and effectively address the priority knowledge gaps associated with wild and farm salmon interactions**
- **reassess the statutory time limit and strengthen the penalty provisions in its current aquaculture policy framework**



Reporting on Performance

Government's overall performance in managing sustainability issues is becoming a component of annual reporting practices in many jurisdictions. Public sector organizations are increasingly expected to report publicly on their performance in dealing with environmental issues.

In this audit, we looked at accountability reporting to the Legislature and the general public at two levels: corporate-wide addressing all of government's responsibilities for wild salmon and their habitat; and by ministry and agency, with each organization reporting on its individual responsibilities and activities.

We found limited accountability reporting on wild salmon, and although some program-specific output reports such as annual compliance and enforcement inspection reports are available, their timeliness needs improvement.

Government-level reporting is deficient

The Province does not produce on an annual basis any one document that examines how well it is managing its objectives to support wild salmon issues in British Columbia. Most program personnel frequently iterated their belief that the Province and their organization has no direct role or responsibilities to manage wild salmon and their habitat. As a result, they have paid limited attention to gather and report on information on managing wild salmon. The lack of recognizing a role for the Province and the absence of such information concerns us.

Reporting by ministries and agencies is deficient

We noted that no ministry or agency provides information to the Legislative Assembly on activities undertaken to support the sustainability of wild salmon. Some information is included in annual reports, but it tends to be very cursory, and often addresses freshwater fish species and not wild salmon. An exception is BC Hydro which refers in its Triple Bottom Line report to its water use planning process and power generation activity impacts on sensitive fish habitat. The Ministry of Forests' 2002/03 service plan report also shows that \$10 million was spent on restoration and rehabilitation. However, the report notes that this was spent

Reporting on Performance

on permanent road deactivation, landslide and gully rehabilitation and assessments. There is no indication that any stream restoration work was carried out under the program.

Several ministries provide reports on compliance and enforcement programs, but they are not reported on in a timely basis.

Recommendation

We recommend that the Province develop a monitoring system and indicators to measure and report overall progress for sustaining wild salmon in a timely basis.

