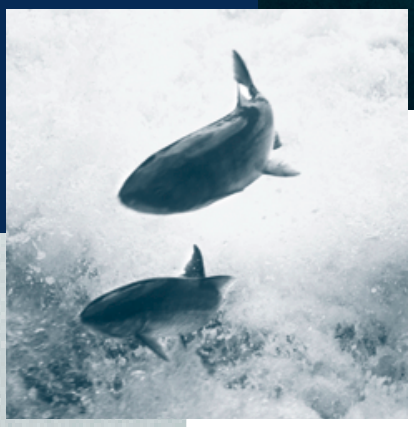
Fishy Business

The Economics of Salmon Farming in BC



by Dale Marshall

July 2003

CANADIAN CENTRE FOR POLICY ALTERNATIVES – BC OFFICE

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THE ECONOMIC CONTRIBUTION OF BC'S WILD FISHERIES—THROUGH THE commercial and sports fishery and the processing of wild fish—dwarfs that of salmon aquaculture and the processing of farmed salmon (Figure 1). It is clearly a misconception that BC's wild fisheries are dead, and that we need salmon aquaculture to economically replace them. In fact, there are far more British Columbians—many of whom live in rural regions of the province—who are benefiting from wild fish stocks compared to salmon farming.

Furthermore, expansion of the salmon farming industry will bring only modest economic benefits to the province. Considerable growth—a 200 per cent increase—in salmon production is predicted to:

- **Create no or few new jobs.** Both the Scottish and Norwegian salmon farming industries dramatically expanded production in the last decade while at the same time decreasing employment. In the 1990s, BC's salmon farming industry tripled production while adding no new jobs. Fish farms in BC are following the trend set in Norway by becoming increasingly mechanized and thus needing fewer workers.
- **Increase salmon aquaculture revenues and GDP by considerably less than production.** The industry is being squeezed between declining prices for salmon (due to aquaculture over-production) and increased costs for inputs such as fish feed (whose price continues to climb as wild fish stocks used for feed—for example anchovies, sardines, and pilchards—become depleted).
- **Increase government revenue, but not necessarily above government expenditures on the industry.** The salmon farming industry in Canada and BC continues to receive subsidies from senior levels of government. Provincial and federal government support (in subsidies, promotion of the industry, and research) to aquaculture exceeded $110 million between 1997 and 2002, in addition to governments' unrecovered regulatory costs. Recent data for tax revenue to government is not available, but 1993 and 1996 figures show that BC collected $5 million in taxes and fees in those two years.
- **Increase aquaculture exports to 1 per cent of total provincial exports.** This will arguably be the most significant economic benefit of expanding aquaculture in the province.

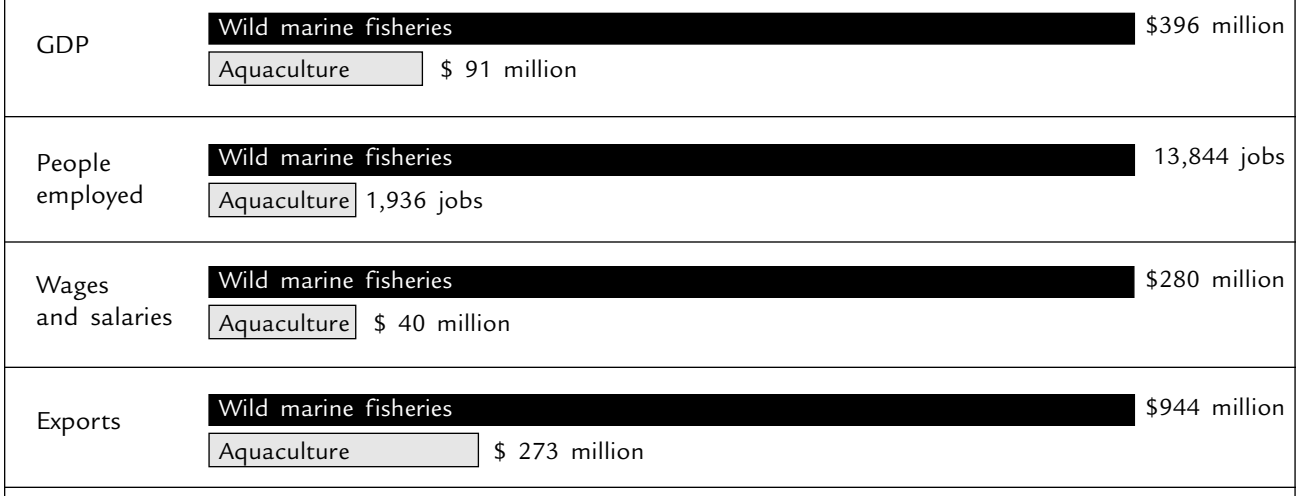
In contrast to *modest economic benefits*, the growth of BC's salmon aquaculture industry does pose *substantial ecological and economic risks*. Salmon farms have a long list of documented ecological problems, including:

- disease and parasite transfer to wild salmon;
- escaped Atlantic and Pacific salmon competing with wild stocks;
- release of feces, uneaten fish feed, fish blood, flesh and scales, as well as antibiotics, pesticides and other chemicals from open net cages; and
- impacts on marine animals attracted to salmon farms.

Salmon farming has already had negative economic impacts on other industries, some stemming from its ecological problems:

- The Pacific Fisheries Resource Conservation Council concluded that sea lice amplified by fish farms were the most likely cause for the pink salmon collapse in the Broughton Archipelago in 2002.
- Commercial salmon fishermen still able to fish have seen the price for their salmon decline by two-thirds over the last two decades due to a sharp increase in global salmon aquaculture production (only a small part of which was from BC).
- Bays and beaches that were once accessible to the guiding community and power/sail cruise boats are now inhabited by salmon farm operations.
- Tour guides have reported negative client reaction to the farms because ecotourists "have a low tolerance for industrial intrusions." The existence of fish farms is fundamentally at odds with the values that many of BC's tourists hold dear and with their reasons for traveling to this province.

Figure 1: Comparing the Economic Benefits of BC's Wild Fisheries to Salmon Aquaculture (2001)



Sources: BC Ministry of Finance and Corporate Relations (2002a); and Tourism BC.

Notes:

1. Wild marine fisheries include marine sports fishery, commercial fishing, and processing of wild fish. It does not include the value of First Nations food fishery.
2. Salmon aquaculture industry includes farmed salmon production, production of fishmeal and related products, and processing of farmed salmon.
3. Proportion of GDP, employment, wages and salaries, and exports of BC's fish processing sector allocated to aquaculture is assumed to be the same (4%) as the proportion of processing revenue that is derived from salmon aquaculture (Statistics Canada, 2002b, p. 27; and BC Ministry of Finance and Corporate Relations, 2002a, p. 85).
4. Employment and salaries/wages for salmon aquaculture were estimated from consolidated data for salmon and shellfish aquaculture, based on revenues in the two sub-sectors.

The scientific community repeatedly points to both the documented impacts of salmon farming and the remaining uncertainties surrounding its ecological risk. Even Stan Hagen, then BC's fisheries minister, when referring to the salmon aquaculture industry said that, "it was amazing to [him] to find out the lack of scientific information that we actually have in the year 2003."

Risks to the social well being of BC's remote rural communities from salmon aquaculture are also clearly present:

- Aboriginal people, whose cultures and histories are inextricably tied to the province's wild fisheries, are especially concerned about the health of the marine ecosystem.
- Fifteen BC communities—some predominantly aboriginal, some not—are particularly vulnerable because of their high dependence on fish harvesting and processing, their remoteness in the province, and the dearth of other economic opportunities.
- In contrast, BC's salmon farming industry is concentrated in only five BC communities (albeit rural ones).

There are alternatives. Technologies exist—in the form of closed containment salmon farms—that reduce (but don't eliminate) the ecological risks of salmon aquaculture. The fact that closed containment farms resolve the waste, nutrient, escape, and (to a certain extent) disease problems suggests that any decision to expand salmon farming should consider using this technology. Trials show that some closed containment technologies also have financial promise. However, outstanding issues remain, namely:

- risk of viral infections in farmed and wild salmon;
- higher energy costs, especially for land-based closed containment farms;
- pressure on wild fisheries for fishmeal;
- aesthetic impacts on tourism; and
- downward pressure on wild salmon prices.

Recommendations

1. **Place a moratorium on new net cage licences and sites.** The risks of salmon aquaculture contrast starkly with the modest economic benefits that salmon farming will bring. Until ecological issues are fully resolved, it would be foolhardy to risk the significantly greater economic benefits of other marine-based industries for the much smaller economic benefits of net cage salmon farming.
2. **Apply the precautionary principle to existing and proposed salmon farms—both net cage and closed containment—before allowing them to proceed.** Since the scientific community has repeatedly stated that conservation and management decisions are being based on uncertain or inadequate information, we need to err on the side of caution when making decisions about the salmon aquaculture industry. A whole variety of options must be considered—from making waste and escape regulations more stringent to increasing the buffer around salmon rivers to shutting down part of the industry.
3. **Properly consult First Nations people, in accordance with recent court rulings, regarding any decisions made about aquaculture in their traditional territories.** Until greater certainty is gained through the resolution of treaty negotiations, First Nations must be given the right to allow or refuse aquaculture activities in their stated traditional territories.
4. **Work with the international community—industry, governments, and scientists—to resolve issues that can be solved only with collective action.** The depletion of wild fish stocks to make fish oil and fishmeal is one of those issues. Another is labeling. There may be a place for salmon production through aquaculture, but consumers have the right to know whether they are eating a wild or farmed product.

Introduction

SALMON FARMING HAS BEEN DESCRIBED AS HAVING "TREMENDOUS economic potential" for BC,[1] especially for those communities whose other resource sectors have taken a downturn. The industry has grown tremendously for two decades, and proponents both hope for and foresee continued growth. For other British Columbians, continued escapes of Atlantic salmon, waste discharges from salmon net cages, and disease outbreaks with their impacts on wild Pacific salmon have cast a dark cloud over the industry.

The salmon farming industry and the provincial government would like to see a rapid expansion of fish farms in the province.[2] Growth in salmon farming in BC will likely amplify both potential risks and potential benefits. Before BC undertakes this major economic endeavor, however, it is important—even necessary—for our political leaders to think seriously about its consequences. What are the potential benefits of this economic activity? What are the risks involved, both ecological and economic, to the province? Are the potential benefits significant enough to make the risks worth taking? What are the risks and benefits of the aquaculture industry as it stands? Are there other courses of action that would decrease the risks while maintaining the benefits?

This report addresses these questions.

- Section 1 sets out the corporate profile of the salmon farming industry in BC.
- In Section 2, the economic benefits of salmon farming—GDP, employment, and exports—are compared to other marine-based industries, including sports fishing, commercial fishing, fish processing, and marine tourism. It also analyzes the economic prospects of an expanded industry for British Columbia.
- Section 3 assesses the sustainability of salmon farming in BC. The ecological risks it poses to the marine environment are discussed. There is a perception that aquaculture will reduce the pressure on wild fish stocks.[3] This claim is assessed for the specific case of salmon farming. Salmon farming is also compared to commercial salmon fishing with respect to its ecological footprint and energy use.
- In section 4, the ecological risks that salmon farming poses to the marine ecosystem are translated into economic risks to industries that depend on our oceans, including BC's marine tourism industry.
- Section 5 investigates alternative salmon farming technologies for their advantages and disadvantages, including financial viability.
- Section 6 makes recommendations on how to manage the salmon farming industry. These recommendations flow from the analysis undertaken in previous sections.

PART 1

The Multinationals that Control BC's Fish Farming Industry

BC'S AQUACULTURE INDUSTRY HAS GROWN DRAMATICALLY IN THE last two decades, from a GDP of $1.5 million in 1984 to a GDP of $99 million in 2001.[4] Salmon farming makes up the lion's share ($87 million) of that total. The salmon farming industry in 2001 produced 68,000 tonnes of fish, mostly Atlantic salmon.[5]

In 1984, there were fewer than five fish farm sites, located primarily along the Sunshine Coast.[6] The number of facilities and their production grew substantially in the early years. In the latter half of the 1980s fish farm companies from Norway, facing more stringent regulations and size restrictions in their own country, decided to expand where fish farm regulations were more lax.[7] These companies consequently set up operations in BC and started buying up smaller companies.

Around the same time, another significant change occurred in BC's salmon aquaculture industry: a shift from Pacific to Atlantic salmon.[8] Atlantic salmon were not only viewed as better suited to farming—they grew faster and survived intensive conditions better—but were also more familiar to Norwegian operators.

By 1990, farmed salmon production in BC had reached 15,500 tonnes, with a GDP of $24 million, and employing 1,700 people. The 1990s proved to be meteoric for the industry, which continued to grow even during the 1995-2002 period when a moratorium was placed on new fish farm licences. The salmon farming industry increased production despite the moratorium by transferring licences from unproductive or problem sites to new sites, and increasing production per site. Though production had more than quadrupled and GDP had more than tripled since 1990, the BC industry by 2001 had added a mere 200 workers.[9]

The provincial government had placed the moratorium on new fish farm licenses to allow its BC Environmental Assessment Office to undertake the Salmon Aquaculture Review, a two year process that investigated the environmental risks of the industry. Despite numerous environmental problems cited by the 1997 final report (and 49 recommendations made to improve the industry), its conclusion was that salmon aquaculture "presents a low overall risk to the environment."[10] When the moratorium was lifted in the fall of 2002, only six recommendations had been fully implemented and 17 partially implemented.[11]

The federal government's role with regard to salmon aquaculture has been as much about assisting the industry as regulating it. The Department of Fisheries and Oceans' mandate is to protect wild fish stocks from risks including those posed by salmon farming. Yet, since 1994, the federal Office of the Commissioner for Aquaculture Development has been tasked with "assisting the development of the aquaculture industry."[12]

Over its history, BC's salmon aquaculture industry has become increasingly concentrated in the hands of fewer corporations. In 1989, there were 50 fish farm companies in BC.[13] In 1997, there were 15.[14] Now, there are 11. Five multinational companies control 109 of 131 (83 per cent) fish farm licences[15] and generate 82 per cent of total production[16] in the province. Four of those companies (Stolt-Nielson, Pan Fish, Nutreco, and Cermaq) are based in Europe while one (George Weston) is Canadian, based in Toronto (see Appendix 1 for a list of BC aquaculture operations, their locations, and parent companies). Only nine salmon farming tenures (7 per cent of the total) are controlled by companies that are majority-owned by British Columbians.

Though displaying an impressive growth rate, production in Canada's salmon aquaculture industry (9 per cent of global market share in 2000) still trails the world's three major producers: Norway (43 per cent), Chile (24 per cent), and the UK (13 per cent), with Scotland being the primary UK producer.[17] BC's production of salmon from aquaculture dominates Canada's production.

Synergy in fish farming means that companies do more than just farm salmon. They also produce the required inputs that aquaculture operations require. Hatchery operations fertilize salmon eggs and rear the young until they are 6-12 month old smolts. Once in the net cages, the salmon consume fish feed prepared from other species of fish harvested elsewhere in the world. Once the salmon are mature, about 18 months later, they need to be processed, transported to market, and sold. These tasks are often undertaken by the same multinationals.

The fish farm companies that operate in BC, in descending order of the number of BC fish farm tenures, are as follows.

Stolt-Nielson

Stolt Sea Farms holds the greatest number (28) of salmon farm tenures in BC. Its parent company, Stolt-Nielson, is from Luxembourg and its shares trade on the Oslo stock exchange. Stolt-Nielson also manufactures offshore oil structures, provides transportation services, creates logistical software applications, and provides shipping companies with information on supplies and services. In 2001, it held assets worth U.S.$4 billion (CAN$5.7 billion), had revenues of U.S.$2.7 billion (CAN$3.9 billion)[18], and continued growing, in part by buying up international salmon farming and distribution companies. In the future, it will continue "looking for economies of scale."[19]

Stolt Sea Farms breeds, farms, processes, distributes, and sells Atlantic salmon. Besides the 28 fish farms and four smolt production facilities it operates in BC, it has operations in the U.S., Chile, Norway, Spain, and Japan. Its worldwide operations produced 63,000 tonnes of Atlantic salmon and trout in 2001.[20]

Pan Fish

Twenty-seven BC farm tenures are held by Omega Salmon Group,[21] whose parent company is Pan Fish. Pan Fish Group is based and traded in Norway and has three main arms: Pan Pelagic manufactures feed from wild fish stocks, Pan Fish operates salmon farms, and Pan Marine operates fish farms with species other than salmon. Pan Fish has operations in BC, Norway, the Faroe Islands (Denmark), Scotland, France, and Italy.

In 2001, Pan Fish had assets of NOK$8.3 billion (approximately CAN$1.7 billion) and revenues of NOK$5.6 billion (CAN$1.1 billion).[22] Twenty Norwegian investors own almost 90 per cent of Pan Fish, with the vast majority of these shares held by Norway's banks.[23]

Omega Salmon is wholly owned by Pan Fish. In addition to its 27 fish farms, it operates three hatcheries near Courtenay and a processing plant in Port Hardy, which recently suffered a devastating fire.

Nutreco

Globally, Nutreco is the mother of all salmon farmers. The Dutch company trades on the Amsterdam stock exchange, but owns fish farms in BC, Scotland, Chile, Australia, Ireland, and Norway and operates in 20 countries in all. It is the world's largest producer and processor of farmed salmon (with a 17 per cent market share) and produces 40 per cent of the world's fish feed.[24]

Including its agricultural division, Nutreco's assets total $2 billion Euro (approximately CAN$3.1 billion), with 2001 net sales of $3.8 billion Euro (CAN$6 billion).[25] The majority of its ordinary shares are held in the Netherlands, with only 1 per cent held outside the European Union or the U.S.

Nutreco's aquaculture subsidiary, Marine Harvest, holds 21 fish farm tenures in BC.[26] Like most other salmon farmers, Marine Harvest is also involved in smolt production (two BC operations), feed manufacturing (two BC operations), and retail sales. In BC, its fish processing is outsourced.

Cermaq

Cermaq's name comes from its two main activities: cereal production and marine aquaculture. In all, the Norwegian company has 11 subsidiaries and six associated companies. Its fish farms operate in Norway, Scotland, Chile, Ireland, the Faroe Islands (Denmark), as well as BC, producing 43,000 tonnes of farmed fish per year.[27]

In 2001, Cermaq had assets of NOK$7.9 billion (approximately CAN$1.6 billion) and income of NOK$7.1 billion (CAN$1.4 billion).[28] The Norwegian government owns 79 per cent of the company, with the remainder held by 100 private investors.[29]

In 2000, Cermaq bought EWOS, an aquaculture company that primarily manufactures fish feed, but also produces smolts, farms salmon and conducts aquaculture research. The next year, EWOS bought three BC fish farm operators, including Pacific National Group and Prime Pacific Seafarms. EWOS presently has 18 BC salmon farms (located near Tofino), a processing plant in Tofino, and a smolt production facility in Port Alberni.

George Weston

George Weston is a Canadian food processor and distributor that trades on the Toronto Stock Exchange, with total assets of $16.3 billion and 2001 sales of $24.7 billion.[30] Its operations span much of Canada and the eastern part of the U.S., with additional fish farms in Chile.

Heritage Aquaculture, a wholly owned subsidiary of Weston, operates 15 fish farms in BC, and others in New Brunswick, Chile, and Maine. Like other fish farm multinationals, it also produces fish feed and smolts, and processes its farmed salmon.

Others

- Target Marine Products a BC-based company located on the Sunshine Coast, operates one hatchery, eight fish farms, and one processing plant in Egmont, which receives the majority of its fish from its salmon farms.
- Creative Salmon holds licences for six fish farm operations that raise Chinook salmon. Its shares are evenly split between three Japanese and two BC owners.
- Greig Seafood is a Norwegian-based fish farm company that operates five fish farms in BC, two of which are partnerships.
- Salt Stream Engineering holds one license.
- Totem Oysters and Yellow Island Aquaculture each operate one salmon farm using closed containment technologies rather than open net cages.

PART 2

Economic Contributions of Salmon Farming vs. Other Marine-Based Industries

THE ECONOMIC IMPORTANCE OF COMMERCIAL OR INDUSTRIAL ACTIVITIES can be estimated by looking at a number of economic measures. Gross domestic product (GDP)—the amount of value added to the economy—is the measure generally used to estimate the size of a given industry. Equally, if not more, important is the number of jobs created by that economic activity. Economically, the level of wages and salaries earned by workers represents the amount of money that is injected into community economies. Finally, the value of exports is considered an important measure because it represents the amount of capital that is flowing into the province from outside, increasing people's standard of living.

Overall, the economic importance of salmon aquaculture to the province is fairly small when compared to other marine-based industries, and especially compared to the provincial economy as a whole. The province's sports fishing, commercial fishing, salmon processing, and marine tourism industries all surpass salmon farming in GDP, employment, and export revenue.

Size Matters: GDP of Marine-Based Industries

Based on 2001 figures, the GDP of the entire fisheries and aquaculture sector—$624 million[31]—makes up a small fraction (0.55 per cent) of the provincial GDP of $114 billion.[32]

The salmon aquaculture portion was one of the smallest, totaling $87 million (seeTable 1).[33] This figure (and those for employment and exports) includes economic activity for the full chain of production of farmed salmon: smolt production, feed production, salmon farming, and fish processing. One exception is the processing of salmon from Nutreco's operations, since it is outsourced to other processors and therefore not counted as part of the salmon aquaculture industry by BC Stats.[34]

The largest contributor to provincial GDP from the fisheries sector is the sports fishery: $259 million.[35] Almost all of this is directly related to angling activities such as marina use, boat rental or fuel, and anglers' spending on accommodations, travel, and food. A much smaller portion is generated from anglers spending money on other tourist attractions and services, such as purchasing souvenirs or visiting museums. The saltwater fishery generates just over half of the sports fisheries' economy.[36]

BC's commercial fisheries—wild salmon, herring, halibut, other finfish species, and wild shellfish—had a GDP of $164 million in 2001.[37] These fisheries are entirely marine-based.

The fish processing sector had a GDP of $102 million in 2001.[38] This industry is closely linked to the wild salmon fishery, since most of its value is derived from canned wild salmon.[39] The processing of fish and shellfish from BC's aquaculture industry contributes at most 4 per cent of the revenues that BC Stats assigns to the fish processing sector since data for the processing of farmed salmon is included in aquaculture statistics.[40] Salmon derived from the U.S. wild salmon fishery sometimes makes up a significant portion of BC's fish processing sector.

The contribution of the cruise ship industry to the provincial economy is fairly well documented. However, other marine tourism activities—power and sail cruising, wildlife viewing, scuba diving, and kayak guiding—are not well documented and can only be estimated. A government-funded study estimates that the GDP of these industries was $21.9 million in 1989[41]—no data has been compiled since. Tourism BC estimates that the GDP of the entire tourism industry was $5.6 billion in 2001, but does not break out marine tourism from the provincial total.[42] The present GDP of marine tourism falls somewhere between these two disparate figures.

Overall, the economic importance of salmon aquaculture to the province is fairly small when compared to other marine-based industries. Sports fishing, commercial fishing, salmon processing, and marine tourism all surpass salmon farming in GDP, employment, and export revenue.

The present GDP, employment, and export value of marine tourism can be estimated by using the 1989 figure as a base and assuming that growth in the industry matched the 3.1 per cent annual growth in BC's entire tourism industry over the 1990s. This is a very conservative estimate, given that the World Tourism Organization estimates that global tourism is growing at 4 per cent per year—in line with BC's 3.1 per cent growth—but that nature travel's growth rate is 10 per cent to 30 per cent.[43] The BC Wilderness Tourism Association asserts that wilderness tourism is growing by 11 per cent per year.[44]

All the economic indicators for marine tourism in BC also point to a higher rate of growth. For example, in 1989 there were 50 wildlife-viewing operators in BC,[45] only one of which involved whale watching.[46] In 2001, there were 47 whale watching operations in BC and the $9 million in revenue they generated was more than twice the revenue generated for all wildlife viewing in 1989.[47] Even if

Table 1: GDP of Marine-Based Industries and Provincial Total (2001)

Sector	Gross Domestic Product ($ million)
Salmon aquaculture[a]	87
Fish processing[a]	102
Sports fishery: marine component[a]	134
Commercial fisheries[a]	164
Marine tourism[b]	182
Total BC provincial GDP[c]	**113,849**

Sources:
a. BC Ministry of Finance and Corporate Relations (2002a).
b. Estimated from ARA Consulting Group; Tourism British Columbia; and InterVISTAS Consulting Inc.
c. Statistics Canada (2002a).

Notes:
1. At most, 4 per cent of these fish processing revenues come from the processing of farmed salmon.
2. Marine tourism does not include the sports fishery.

no other wildlife-viewing operators exist in BC today—and we know that is not true—this represents revenue growth of 6.7 per cent per annum.

In 1989, 20 scuba diving guides operated in BC;[48] there are now 30.[49] Revenue in the industry has gone from $3.4 million in 1989[50] to an estimated $4.8 million today.[51] Both of these figures imply an annual growth rate of at least 3.1 per cent.

Kayak guiding has also increased substantially. In 1989, 15 companies offered sea kayak tours.[52] WaveLength Magazine had 58 BC kayak tour companies advertise in its August/September 1997 edition and 91 advertisers in its August/September 2002 edition, with all but a handful operating on the coast.[53] The 1989 sea kayak guiding revenue of $4.4 million[54] has increased to an estimated $9 million today,[55] a 5.7 per cent annual growth rate.

To be conservative, growth of 3.1 per cent per year was applied to 1989 marine tourism figures. The estimated GDP of BC's marine tourism (excluding the sports fishery and cruise ship industry) was $32 million in 2001. Adding the BC portion of the GDP of the cruise ship industry, estimated at $150 million in 2001,[56] the GDP of marine tourism in BC was approximately $182 million in 2001.

Employing British Columbians

Job creation is one virtue of the salmon aquaculture industry often touted by its proponents and supporters. Again, however, other marine-based activities make bigger contributions to BC's employment rolls and income (Table 2). The entire aquaculture industry—including salmon and shellfish farming, feed and smolt production, and aquaculture product processing—employed 1,900 people in the province in 2001.[57] The smaller shellfish industry employs fewer people, but is much more labour intensive compared to salmon aquaculture.[58] Employees of fish farms and fish farm-related industries earned $37 million in wages and salaries.[59]

The sports fishery is by far the largest employer in BC's fisheries sector with 8,900 employees, just over half of which (4,700) are in the saltwater sports fishery.[60] Personal income is also fairly evenly split between the saltwater ($72 million) and freshwater ($66 million) sports fisheries.[61]

Comparing the above figures to employment in BC's commercial fishery is not straightforward, due to the seasonal nature of commercial fishing. For example, over 10,000 people drew a salary from

Table 2: Employment and Income of Marine-Based Industries and Provincial Totals (2001)

Sector	Number of people employed	Total wages and salaries ($ million)
Salmon and shellfish aquaculture[a]	1,900	37
Fish processing[a]	3,900	152
Marine tourism (2000)[b]	4,300	134
Sports fishery: marine component[a]	4,700	72
Commercial fisheries[a]	5,400	62
BC Total (year 2000)[a]	**1,942,400**	**60,776**

Sources:
a. BC Ministry of Finance and Corporate Relations (2002a).
b. Estimated from ARA Consulting Group; Tourism BC; and InterVISTAS Consulting Inc.

Notes:
1. Marine tourism employment totals represent full-time equivalents, but all other sub-sectors represent workers "who spend *most* of their time working in a given industry [emphasis in original]." (BC Ministry of Finance and Corporate Relations. 2002a. p. 23).
2. Employment data for salmon aquaculture alone was not available.
3. At most, 4 per cent of revenues assigned to fish processing comes from the processing of farmed salmon.
4. Marine tourism does not include the sports fishery.
5. Wages and salaries in commercial fishing include business income to independent owner-operators.

the wild salmon fishery in 1995, but since the fishery lasted only 11 weeks, this is the equivalent of 2,000 yearlong jobs.[62] If all commercial fishing is included and the number of British Columbians working in any given month of 2001 is averaged, the total becomes 5,400 yearlong jobs.[63] Incomes earned through commercial fishing totaled $62 million in 2001: $6 million through wages and salaries and $56 million in business income to independent owner-operators who are not included in wage and salary statistics.[64]

In 2001, the fish-processing sector employed 3,900 workers who earned an estimated $152 million in income.[65] The size of the commercial fleet is the most important factor in determining employment in processing, since commercial wild fish are the raw materials of the processing sector.[66] As noted previously, the processing of fish from aquaculture operations makes up only a tiny percentage of the revenues (4 per cent) and likely an equal percentage of employment (about 150 jobs) attributed to BC's fish processing sector.

The entire aquaculture industry—including salmon and shellfish farming, feed and smolt production, and aquaculture product processing—employed 1,900 people in 2001. By comparison, the sports fishery employed 8,900 people, over half in the saltwater sports fishery.

Marine tourism generated 965 person-years of employment in 1989.[67] Applying the 3.1 per cent estimated growth rate, employment in marine tourism was approximately 1,390 person-years in 2000. Adding the 2,970 person-years of employment generated by the cruise ship industry[68] yields a total employment of approximately 4,300 person-years in 2000. Wages and salaries in marine tourism are estimated at $134 million in 2000: $117 million in the cruise ship industry[69] and $17 million in other marine tourism.[70]

Bringing Money In: The Value of BC's Exports

Every jurisdiction wants to increase the value of its exports in order to bring in foreign capital. That is why trade surpluses (or deficits) are considered an important economic indicator for many jurisdictions. For example, BC's forest industry is considered important despite contributing only 6 per cent of GDP because forest products constitute over 50 per cent of exports.

BC exported $971 million worth of seafood products in 2001, up from $903 million in 2000 (Table 3).[71] This compared favourably to the $306 million value of seafood *imports* in 2001.[72] The U.S. (64 per cent) and Japan (21 per cent) are the main export markets for BC's seafood.[73]

The export of farmed salmon products in 2001 ($264 million) was exceeded by exports from the commercial fisheries ($694 million).[74] However, the overall value of exports from commercial operations masks a decline in exports of wild salmon from $352 million in 1991 to $128 million in 2001.[75] Growth in the production and export of halibut and the export of shellfish helped to maintain BC's export surplus.

Exports from the tourism sector—including the sports fishery, cruise ship industry and other marine tourism activities—involve people from other provinces and countries traveling to BC to partake in these activities, rather than the export of actual products. This calculation is more involved because one must estimate the expenditures made by out-of-province tourists as a proportion of all tourism expenditures. British Columbians made up 48 per cent of all those partaking in tourist activities in 2001, but only 27 per cent of the expenditures, since out-of-province visitors spend more on restaurants, hotels and other amenities.[76] Applying this proportion to saltwater sports fishing expenditures yields estimated exports of $249 million.[77] Applied to marine tourism exports yields an estimate of $283 million: $238 million for the cruise ship industry[78] and $45 million in other marine tourism.[79]

Table 3: Value of Seafood Exports and Total Exports from BC (2001)	
Sector	**Value ($ million)**
Sports fishery: marine component[a]	**250**
Salmon aquaculture[b]	**264**
Marine tourism[c]	**283**
Commercial fishing[b]	**694**
Wild Salmon	128
Herring	105
Halibut	72
Other	249
Shellfish	141
Other related fish products[b]	**9**
Total Exports from BC (2000)[d]	**33,241**

Sources:
a. Estimated from BC Ministry of Finance and Corporate Relations (2002a); and Tourism BC.
b. BC Ministry of Finance and Corporate Relations (2002a).
c. Estimated from ARA Consulting Group; Tourism BC; and InterVISTAS Consulting Inc.
d. BC Ministry of Finance and Corporate Relations (2002b).

Notes:
1. Marine tourism exports are estimated by assuming that 73 per cent of tourism expenditures were made by out-of-province tourists.
2. Marine tourism does not include the sports fishery.

Are Fish Farms Poised to Become BC's Economic Savior?

BC's aquaculture industry is presently a small player in terms of GDP and employment when compared to every other marine-based industry in the province (and larger only than the saltwater sports fishery in terms of exports). When compared to the provincial economy as a whole, its importance shrinks even further. But supporters of the industry argue that this is because the industry has been overly constrained in the past. They contend that the provincial moratorium in the last half of the 1990s kept it from growing even more than its three-fold expansion, and that it has future growth potential. It is therefore worth investigating what fish farm expansion will mean for the province's economy. Is the fish farm industry a stepping stone to prosperity in BC, particularly for struggling coastal communities?

The BC Salmon Farmers Association envisions BC's fish farm industry tripling in size in 10 years.[80] That would involve the number of sites growing from 130 to 200 over that period,[81] with almost twice the production at each site. What economic benefits would that entail for BC?

If this occurs, the GDP of the industry is unlikely to grow to the same degree, since the price farmers are getting for their salmon continues to drop as production expands around the world. In fact, three of BC's multinational salmon farmers have cited low prices due to global over-production to explain poor financial performance.[82] In addition, the industry is predicting a shortage of fish feed because oceans are running out of fish to feed to farmed salmon.[83] This is driving up the price of feed. The aquaculture industry has been able to decrease the quantity of feed per unit, but nonetheless feed costs in BC increased from 39 to 48 per cent of total industry expenses between 1997 and 2001.[84]

An increase in production would mean greater revenues and potentially greater profits for salmon farmers. But with the vast majority of aquaculture companies based outside of BC and owned by foreigners, profits are more likely to leave the province. Another disadvantage of having foreign multinationals control a domestic industry is that all the benefits of having a head office in BC—e.g. investment in city centres, high-level job opportunities for British Columbians, income tax returns from companies' highest income earners—go elsewhere.

Most importantly, benefits to British Columbia in the form of job creation will likely be very modest, and possibly non-existent. BC's fish farm industry (including the vast majority of processing) was 60 times larger in 1999 than it was in 1984, but employment merely doubled over that period.[85] During the 1990s, BC's industry tripled its production without any increase in employment.[86] This trend occurred elsewhere as well. Norway's industry more than doubled finfish aquaculture production between 1994 and 2000, while decreasing employment by 4 per cent.[87] Norway's industry expanded production tenfold between 1985 and 2000, and the number of jobs declined by 20 per cent.[88] Between 1989 and 1997 (the earliest and latest years cited) the Scottish salmon farming industry more than tripled its production while decreasing employment.[89]

Claims of job creation from fish farm proponents seem impressive because they often use person-years of employment (multiplying the actual number of full-time jobs by the number of years they exist) and include direct, indirect, and induced jobs created. For example, Coopers & Lybrand Consulting, a corporate consulting firm, predicts that an expanded salmon aquaculture industry will create 10,000-20,000 additional person-years of employment over 10 years.[90] Converted to real jobs, however, this would mean 400 to 800 new permanent jobs in aquaculture.[91]

Even this estimate is wildly optimistic. Coopers & Lybrand states that an increase of farmed salmon production from 34,888 tonnes to 87,500 tonnes (a 251 per cent increase) would increase employment by 300 per cent.[92] Employment growing faster than production would go against the historical trend in just about every industry, including aquaculture. Since that projection (in 1997), salmon aquaculture production has increased by 94 per cent while employment in the industry has increased by 5.6 per cent or 100 people.[93] The British Columbian, Norwegian, and Scottish experiences show that zero job growth across the industry is more likely, even if the salmon aquaculture industry continues to expand production.

Labour productivity is, economically, a good thing. Increasing the output (salmon) per unit of input (labour) decreases unit costs, increases profits, and potentially increases wages. It is one of the

Table 4: Comparing the Economic Benefits of BC's Wild Fisheries and Salmon Aquaculture (2001)

	Wild marine fisheries	Salmon aquaculture
GDP ($ million)[a]	396	91
Number of people employed[a]	13,844	1,936
Wages and salaries ($ million)[a]	280	40
Exports ($ million)[b]	944	273

Sources:

a. BC Ministry of Finance and Corporate Relations (2002a).

b. BC Ministry of Finance and Corporate Relations (2002a); and Tourism BC.

Notes:

1. Wild marine fisheries include marine sports fishery, commercial fishing, and processing of wild fish. It does not include the value of First Nations food fishery.
2. Salmon aquaculture industry includes farmed salmon production, production of fishmeal and related products, and processing of farmed salmon.
3. Proportion of GDP, employment, wages and salaries, and exports of BC's fish processing sector allocated to aquaculture is assumed to be the same (4 per cent) as the proportion of processing revenue that is derived from salmon aquaculture (Statistics Canada, 2002b, p. 27; and BC Ministry of Finance and Corporate Relations, 2002a, p. 85).
4. Employment and salaries/wages for salmon aquaculture were estimated from consolidated data for salmon and shellfish aquaculture, based on revenues in the two sub-sectors.

most important contributing factors to economic growth.[94] But it means smaller or negative job creation, and that is what is happening in aquaculture around the world.

A tripling of fish farm production by 2012 may triple exports, since industry analysts seem to agree that the U.S. market—where BC sends the majority of its farmed salmon exports—is growing.[95] However, BC's global share of the market has been declining since 1990.[96] A tripling of exports would likely be the most important economic advantage of expanded salmon production. If this happens, aquaculture exports will still represent only 1.3 per cent of BC's projected total exports in 2012.[97] A significant portion of the increased revenue will accrue to international owners and shareholders.

So, the economic contribution of BC's wild fisheries—through the commercial and sports fishery and the processing of wild fish—dwarfs that of salmon aquaculture and the processing of farmed salmon (Table 4). It is clear from this comparison that the demise of BC's wild fisheries is exaggerated. There are far more British Columbians—many of whom live in rural regions of the province—benefiting from wild fish stocks than those who benefit from salmon farming. Even a tripling of farmed salmon production would leave salmon aquaculture well behind the wild fisheries in economic importance to British Columbia.

There are far more British Columbians —many of whom live in rural regions of the province—benefiting from wild fish stocks than those who benefit from salmon farming.

It is possible that the BC government is interested in expanding fish farms to increase provincial revenue. In 2001/02, the industry paid $46,286 to the government in aquaculture licences.[98] A larger source of revenue no doubt comes from corporate income taxes and other taxes paid by the industry. These taxes and fees increased from less than $1 million in 1993 to $4 million in 1996, but this increase was in large part due to corporate income taxes that were not paid in 1993 and carried forward.[99] The BC government would also benefit from taxes paid by employees of aquaculture operations.

It is questionable, however, whether the aquaculture industry is contributing positively to government revenue, since subsidies, tax credits, and indirect government expenditures related to the industry are substantial. For example, between 1997 and 2001, the Canadian aquaculture industry received $15.7 million in direct federal government subsidies, $2.2 million of it for BC.[100] Investments in the aquaculture industry are subject to a tax credit under the federal government's Venture Capital Corporation. This totaled $750,000 in 1996 for BC salmon farmers.[101] Provincial governments also subsidize salmon aquaculture. For example, when disease devastated New Brunswick salmon farms in 1998, the provincial government compensated the industry to the tune of $18.3 million.[102]

Governments also provide economic support to the aquaculture industry through research and development, promotion, contributions to industry associations, and unrecovered regulatory costs, including the cost of monitoring fish farms, enforcing regulations, and issuing fish farm licences. These federal and provincial contributions were $3.65 million in 1996,[103] but have since increased substantially. In August 2000, the Department of Fisheries and Oceans committed $75 million over five years, "directed at enhancing the sustainable development of Canada's aquaculture industry."[104] In September 2002, the BC government created a $5.1 million fund "to support independent research into aquaculture and the environment."[105] The DFO is spending $700,000 in the spring and summer of 2003 for the pink salmon action plan.[106] As outlined in the next section, there is a need for more research on the environmental impacts of aquaculture. However, since governments, not the industry, are funding this research, net government revenue generated by the industry is substantially lower, and potentially non-existent.

Overall, it is clear that the economic benefits of expanding the industry are modest. An impartial estimate of new job creation—arguably the benefit most cited by the fish farm industry—would reveal non-existent to marginal benefits. Government net revenue also appears modest if positive at all. On the other hand, the growth of the industry does pose substantial ecological and economic risks. These are elaborated upon in the next section.

PART 3

Sustainability of the Fish Farm Industry

THE SALMON FARMING INDUSTRY POSES RISKS TO THE MARINE environment, has significant impacts on the world's wild fisheries resources, and uses considerable materials and energy in its operations. These issues must be considered when determining the economic risks that the fish farming industry presents for other marine-based industries.

Ecological Risks to Other Marine-Based Industries

The potential ecological problems associated with salmon aquaculture are well documented in peer-reviewed journals; studies conducted by government, non-governmental organizations and other interested parties; and even industry literature. These problems include disease and parasite transfer from farmed to wild fish; ecological impacts of Atlantic salmon escapes; feed, antibiotics, and other waste discharged from open pens; and impacts on marine mammals.

The most credible sources that have assimilated and published this information, with a particular emphasis on the BC context, include: the Leggatt Inquiry,[107] the Standing Senate Committee on Fisheries,[108] the Auditor General of Canada,[109] the Salmon Aquaculture Review, [110] and Simon Fraser University's continuing studies in science department.[111] Each of these publications emphasized that not enough is known about the salmon farming industry to precisely estimate what the magnitude of environmental impacts will be.

Disease and Parasite Transfer to Wild Stock

Disease and parasite transfers from farmed fish to wild salmon represent two separate but related risks to wild Pacific salmon. The number and prevalence of parasites such as sea lice can increase in wild salmon due to interaction with farmed salmon. In the same way, diseases can be amplified in wild salmon.

Sea lice infestations—and their impact on wild salmon—have recently received a considerable amount of press and attention in BC. Mostly, this is because of the significant decline (96 per cent fewer) in pink salmon returns between 2000 and 2002 in streams adjacent to the Broughton Archipelago.[112] The Broughton Archipelago was the only region in the province that experienced declines in pink salmon returns last year.[113] The Archipelago also holds the greatest concentration of fish farms in BC. The Pacific Fisheries Resource Conservation Council, an independent advisory body

funded by the Department of Fisheries and Oceans, believes that sea lice were the most likely cause for the salmon declines and recommends that fish farms in the archipelago be fallowed during the pink salmon migration.[114]

Disease outbreaks in wild fish have been linked to the existence of fish farms in many locations (Norway, Scotland, Ireland, New Brunswick, and BC) and throughout the history of intensive aquaculture.[115] Like sea lice, other diseases occur naturally in wild populations but become magnified by interaction between farmed and wild fish. The high density of salmon in farms increases disease transfer within farmed fish populations, which may eventually spread to wild populations. These diseases are more threatening when they infect wild fish populations that are already depressed,[116] as are many West Coast salmon runs. Wild Pacific salmon populations on the West Coast may also be at greater risk than wild Atlantic salmon on the East Coast because Pacific salmon are less able to deal with new diseases, for example diseases specific to Atlantic salmon.[117]

One disease that impacts farmed Atlantic salmon is a virus called infectious hematopoietic necrosis, or IHN. Nineteen of BC's salmon farms experienced IHN outbreaks between August 2001 and May 2002, 13 of them in the Campbell River area.[118] The impact of this disease outbreak on the salmon farming industry was estimated in the millions of dollars.[119] Another multi-million dollar loss due to IHN occurred last year at five Clayoquot Sound salmon farms operated by Pacific National Aquaculture, a Cermaq subsidiary, forcing the company to cull 2.4 million fish.[120] While Pacific salmon are less susceptible to death from the disease than Atlantics, the impact of multiple disease outbreaks on farms with Atlantic salmon has not been studied enough to discount the risk of harm to wild Pacific stocks and the coastal ecosystem.[121]

Escaped Salmon

Farmed salmon that "escape" are a second ecological concern associated with fish farms. Between 1991 and 2001, at least 413,000 Atlantic salmon escaped from BC fish farms.[122] Atlantic salmon are now routinely caught by commercial fishermen off the West Coast,[123] even as far north as Alaska,[124] even though Alaska does not allow fish farming and no fish farms operate in the northern half of BC. In one 17-day period alone, BC commercial fishermen caught over 10,000 escaped Atlantics.[125]

Escaped Atlantic salmon pose several risks to BC's marine ecosystem, including: changing the ecosystem by consuming native species; transferring diseases to wild fish populations (similar to disease amplification from non-escaped salmon); and out-competing the Pacific salmon in its habitat.[126] The history of species that are introduced into new ecosystems is riddled with disasters, leading one expert to advise that we treat all introduced species as "potentially problematic until substantial research suggests otherwise."[127]

There remain serious unanswered questions with respect to the risks posed by escaped farmed salmon. In fact, five of the seven ways in which Atlantic salmon could displace Pacific salmon in their habitat have not been scientifically examined at all (the other two showed that displacement occurred).[128] Despite this uncertainty, the salmon farming industry initially downplayed the risk of Atlantic salmon surviving in the Pacific, finding rivers, spawning, or producing viable offspring. All these events have occurred. Atlantic salmon have been discovered in 82 of BC's rivers and streams, including three where their offspring have been documented.[129] As only a very small percentage of BC's salmon rivers have been surveyed,[130] Atlantic salmon are likely present and spawning in BC rivers in greater numbers than documented. A conference of scientific experts concluded "Perhaps the most important question is not 'Can Atlantic salmon invade the northeastern Pacific?' but 'How large an impact might such an invasion have?'"[131]

Though the escape of an introduced species (in this case, Atlantic salmon) is often given greater consideration than the escape of a native species, the escape of Pacific farmed salmon also carries risks to wild Pacific salmon populations. The frequencies of certain traits in wild salmon (growth

rate, feeding efficiency, disease resistance) have developed for complex ecological reasons. The escape and breeding of farmed native salmon with wild salmon will change the genetic make-up of the wild population and result in "frequently negative" impacts that "call into question the long-term viability of many salmon populations."[132] In Norway, up to 80 per cent of fish caught in some rivers are farmed Atlantic salmon, significantly changing the natural genetics of those rivers.[133]

The fish farm industry has stated its intention to decrease escapes. However, the law of diminishing returns—wherein the cost of decreasing escapes below a certain point becomes prohibitively expensive—virtually ensures that escapes will continue.[134] The fish farm industry in Norway has a target of one escaped fish per tonne of production.[135] For BC, that would entail 68,000 salmon escapes per year from BC's fish farms, more if the industry expands. Others estimate BC escapes at 0.5 to 1 per cent of production,[136] meaning 70,000 to 140,000 farmed salmon escape every year from BC farms.[137]

A conference of scientific experts concluded "Perhaps the most important question is not 'Can Atlantic salmon invade the north-eastern Pacific?' but 'How large an impact might such an invasion have?'"

Waste from Salmon Farms

The "open" part of open net cage fish farming is also a concern due to biological and chemical agents released from the farm including: feces, uneaten fish feed, fish blood, flesh and scales, as well as antibiotics, pesticides and other chemicals. Salmon farmers rightly point out that some of these discharges act as fertilizers on the ocean floor, increasing the productivity of sediment organisms. But they can also "overload" the sediments, resulting in anoxia (lack of oxygen) and the production of hydrogen sulphide and methane gases, conditions "toxic to most organisms."[138] The environmental costs of this are so high that, according to one study, "internalizing the environmental cost of the nutrient released from salmon farms…reveals that the total cost of [farmed] salmon production exceeds the highest price paid for salmon in the 1980s."[139] The amount of feed per capita (and therefore the amount of waste on the ocean floor) used by the industry to raise farmed salmon has declined since the 1980s, but it is clear that the ecological impacts of nutrient enrichment are considerable.

This pollution, because of its impact on fish habitat, may well violate the federal Fisheries Act.[140] In fact, the Auditor General reported that, "there is a widely held view within the Department [of Fisheries and Oceans] that salmon farming, in some instances, has had some highly negative effects on fish habitat."[141] The 2001 enforcement report from BC's Minister of Water, Land and Air Protection shows that fish farm operators on Vancouver Island had full compliance with regulatory requirements in only one of 13 categories.[142] Despite this, no salmon farm in BC or any other province has been prosecuted for violations under the federal Fisheries Act.[143]

Sometimes the "solutions" to problems create problems of their own. For example, when disease outbreaks occur on fish farms, operators deal with them by giving feed-based antibiotics to the farmed salmon or applying pesticides to kill the source of the disease. Since water can flow freely from net cage fish farms to the marine environment and vice versa, these chemicals accumulate beneath fish farms and are distributed more widely into the marine environment due to ocean currents.[144] This is of particular concern with respect to pesticides intended to kill sea lice (like ivermectin and emamectin benzoate, also called SLICE). These chemicals are toxic to lobsters, a relative of the sea lice (both are crustaceans).[145] Other crustaceans—including commercially important species such as prawns, crab, and shrimp—are also at risk from these chemicals. Not surprisingly, shellfish harvesters in both BC and Scotland oppose the application of these pesticides.[146]

Impacts on Marine Animals

Marine animals—sea lions, seals, otters, and mink—are often attracted to fish farms as potential sources of food, and may cause damage to nets.[147] Fish farm operators use various methods to ward off these predators, including the use of special netting, scaring tactics such as dogs and noisemakers, and electric fences.[148] Both tourism operators and fish farm operators have testified that employees of fish farms have used firearms to kill marine mammals.[149] In fact, DFO issues licences for this very purpose.

Underwater acoustic devices can also drive off other marine mammals. The number of harbour porpoises in the Broughton Archipelago declined after acoustic devices were introduced.[150] Killer whales avoid the archipelago even though it is on their traditional migration route.[151] Little research exists on other potential impacts of these devices on marine organisms and ecosystems.[152] The salmon farming industry has acknowledged these impacts, and acoustic devices are now rarely used.

Ecological Risk

The only conclusion one can draw from the considerable list of environmental effects outlined above is that open pen fish farms pose a risk to the West Coast marine ecosystem. But what is the level of risk? A leading researcher in the area of risk assessment in fisheries stated that nobody could say, because no comprehensive ecological risk assessment has ever been conducted on BC's fish farms.[153] The literature is full of documented impacts of salmon aquaculture, but scientists continuously point to the substantial holes in the research.[154] Scientists often urge regulators to act with caution, given all this uncertainty.[155]

Regulators are not heeding this advice. The Auditor General found that the Department of Fisheries and Oceans was not meeting its obligations to protect wild Pacific salmon from fish farms, had no plan to manage the long-term risks of salmon farming, and had no plan for managing the risks of an *expanded* industry should the moratorium be lifted.[156] The DFO concurred with the Auditor General's conclusions.[157] Then-BC Fisheries Minister Stan Hagen, referring to the salmon aquaculture industry, said, "it was amazing to [him] to find out the lack of scientific information that we actually have in the year 2003."[158] Yet, despite the lack of planning and the absence of scientific certainty, the BC government lifted the seven-year-old moratorium on new fish farm licences in the fall of 2002.[159]

Feeding the World?

There is a perception among many people that aquaculture will help to feed the world.[160] Some proponents of aquaculture point to the depletion of important fish stocks around the world[161] and claim that fish farms will help to replace that source of protein in the human diet.

In the specific case of *salmon* aquaculture, however, this argument falls apart if one considers the source of fish feed used on salmon farms. Fish feed is composed primarily of fish oil and fishmeal, both derived from wild (mostly pelagic) species of fish, including anchovies, sardines, and pilchards. One analysis found that 3.2 kgs of fish used in feed are required to produce 1 kg of salmon.[162] Another estimates that it takes between 3.2 and 6.6 kgs of fish to produce 1 kg of farmed salmon, depending on the proportion of fish oil and fishmeal used.[163] An industry estimate places that figure at 4 to 6 kgs of wild fish.[164] Fish farming is thus using up the stocks of wild fish, some of which could be consumed directly and all of which are important to the well being of the marine ecosystem. Furthermore, these wild fish stocks are becoming so depleted that the fish farm (and fish feed) industry wonders how it will be able to expand any further.[165] It should be noted that intensive livestock agriculture—cattle and hog operations—also contributes to this depletion since fishmeal is used in

some of these operations. The fish farm industry, however, uses an increasing percentage of fish feed, and by 2010 will consume almost all of the world's fish oil and half its fishmeal.[166]

Who consumes wild stocks of fish and who consumes farmed salmon is also important. Wild stocks of fish used for feed often come from relatively poor regions of the world, such as South America and southeast Asia.[167] Peru has a large anchovy industry, but almost all of it goes to produce fishmeal.[168] Farmed salmon, meanwhile, is eaten by relatively affluent people at restaurants or bought at retail outlets in the north.[169] The vast majority of BC's aquacultured salmon is exported to the U.S. and Japan, while people in developing countries cannot afford to buy imported salmon.[170] The activities of the salmon farming industry are, therefore, exacerbating hunger in places where it is most evident.

Wild stocks of fish used for feed often come from relatively poor regions of the world, such as South America and southeast Asia. The activities of the salmon farming industry are, therefore, exacerbating hunger in places where it is most evident.

Finally, let us not forget the ecological impacts that fish farms have on natural ecosystems. These impacts may further deplete wild fish stocks that are used as food sources for both local human populations and species of fish and other marine animals higher in the food web.[171]

Ecological Footprint

The ecological sustainability of intensive aquaculture is also brought into question when one compares the ecological footprint of salmon aquaculture in BC with the commercial fisheries. The ecological footprint methodology allows us to estimate the total amount of area needed to undertake a certain activity, like salmon aquaculture or commercial fishing. The ecologically productive land and water appropriated for both the activity itself and all its required inputs—biological, energy, material, and labour inputs—are calculated when undertaking an ecological footprint analysis.

This analysis has been used to compare BC's production of different species of salmon from both aquaculture and commercial fishing. Peter Tyedmers' PhD dissertation from the University of British Columbia found that all forms of farmed salmon appropriate more area (including terrestrial and

Table 5: Ecological Footprint of Farmed and Commercially Caught Salmon (1996)

	Ecosystem Support per Tonne of Salmon		
	Terrestrial (ha)	Marine (ha)	Total (ha)
FARMED			
Atlantic	2.8	9.9	12.7
chinook	3.6	12.4	16.0
COMMERCIALLY CAUGHT			
chinook	0.9	10.1	11.0
coho	0.9	9.3	10.2
sockeye	0.7	5.0	5.7
chum	0.6	4.6	5.2
pink	0.5	4.5	5.0

Source: Tyedmers.

marine ecosystems) than commercial fishing (Table 5).[172] Despite the fact that only 56 per cent of farmed salmon feed comes from the oceans, the marine footprint of salmon farms is larger because farmed salmon don't convert food as efficiently into biomass as wild salmon and the food used for feed is generally from a higher trophic level than food eaten by wild salmon.[173] Terrestrial area requirements were higher for farmed salmon due to its high-energy inputs and because 40 per cent of feed is derived from terrestrial agriculture.[174]

This analysis contrasts quite dramatically with statements from BC's fish farming industry that fish farms use an insignificantly small area of BC's coastline. In order to get a true picture of the area needed, one must multiply the actual area of the fish cages themselves by a factor of 40,000 to 50,000 in order to include the marine area needed to produce the fish feed inputs alone.[175]

The salmon farming industry has likely improved the efficiency with which it feeds its salmon since 1996, so this comparison would be more favourable for the industry today. However, the analysis shows that a significant improvement in conversion efficiency would be required in order for farmed Atlantics to have a lower ecological footprint than even commercially caught chinook (the commercially caught species with the highest footprint).[176]

If one compares the required energy inputs and resulting greenhouse gas emissions, the sustainability of farming salmon appears even more in doubt. The farmed Atlantic salmon (the farmed species with the lowest energy needs) requires more than twice the amount of fossil fuel needed for harvesting coho salmon, the commercial species with the highest energy requirements.[177]

This analysis is corroborated by other studies performed on the efficiency of fish production systems. Comparing the dozen or so studies that have measured various aquaculture and commercial fish production systems shows that no salmon production system in the world is more efficient at converting energy inputs into protein than any commercial fishery.[178]

Overall Sustainability

Under scrutiny, it is clear that there are serious doubts about the sustainability of the salmon farming industry. The industry uses more material, biological, and energy inputs than commercial fishing. It creates more greenhouse gas emissions. It is leading to the depletion of wild fish stocks, not to their protection or sustainable management. In the process, it is actually taking food away from people who are most vulnerable to food insecurity while providing a relatively expensive product for those who can afford it. The person who has arguably most studied the sustainability of the salmon farming industry in BC has called it "a clear example of *un*-sustainable economic development."[179]

There are serious doubts about the sustainability of the salmon farming industry. It uses more material, biological, and energy inputs than commercial fishing, and creates more greenhouse gas emissions, while depleting wild fish stocks and taking food away from those most vulnerable to food insecurity.

The point of this section, however, is not to assess the environmental sustainability of salmon farming for its own sake. The intent is to lay out the impacts that the industry has on the marine ecosystem and to use this information to, in part, describe the risks that salmon farming poses to BC's economy. It is by comparing the economic risks and benefits of the industry that one can assess the way in which the industry should be managed. The next section lays out these economic risks.

PART 4

Economic Risks of Salmon Farms to Other Marine-Based Industries

THE *ECONOMIC* RISK THAT SALMON FARMING POSES TO BC'S OTHER MARINE--based industries flows in large part from the *ecological* risk that salmon farming poses to the marine ecosystem. If salmon farming—through disease transmission, escaped Atlantics and Pacifics, or pollution—eventually leads to the collapse of important salmon runs, this will have a negative economic impact on British Columbia. However, as explained in the previous section, no comprehensive and credible ecological risk assessment has been undertaken on BC's salmon farming industry. This makes it even more difficult to estimate the economic risk. Nevertheless, it would be instructive to at least describe the adverse economic impacts—some potential and others already realized—of the salmon farming industry on BC's other marine-based industries.

The Value of Wild Fish

Beyond its value as an icon of the province, the wild Pacific salmon holds important economic value for British Columbia. The GDP of the marine sports fishery, the commercial fishery, and the processing sector is almost five times greater than that of the aquaculture sector. Employment in industries dependent on wild fish stocks is more than seven times that of aquaculture. In other words, even if the aquaculture industry were able to expand as much as it is hoping, it would not match the economic importance of wild fish stocks.

Contrary to popular belief, the fish-processing sector is highly dependent on the commercial fishery, not on salmon farming.[180] Since 1994, the processing sector has declined with the commercial fishery, despite a surge in aquaculture.[181]

Meanwhile, the present fish farm industry poses economic risks to other marine-based industries. An expanded fish farm industry would increase those risks. The chance of the entire wild salmon population (or any other fish stock) collapsing completely is likely quite remote. Less remote is the risk that salmon farming poses to individual salmon runs, important runs like the pink runs in the Broughton Archipelago.

More than just an input to the commercial fishing and processing sector, Pacific salmon is also an important component of the marine ecosystem. It is a vital food source for bald eagles, killer whales, and grizzly bears—three wild animals of great interest to many tourists to BC. Wildlife viewing, as noted earlier, also makes important contributions to provincial GDP and employment. Decaying salmon have also been shown to be significant sources of nitrogen for coastal forests.[182]

The Price of Salmon

Salmon aquaculture has already had an important impact on the economic benefit of the wild salmon fishery. The tremendous increase in global salmon aquaculture production between 1982 and 1999—only partly contributed by BC—has decreased salmon prices by two-thirds.[183] This is because of the high degree of substitutability in the consumer's mind between farmed salmon and wild salmon.[184] The decline in wild salmon prices has also decreased the average price salmon fishermen can receive for their permits.[185] Since many fishermen view their permits or licences as others do a pension, depressed license prices lead to less security for salmon fishermen.

This does not, however, lead to a decline in the catch of wild salmon. In fact, because of decreased economic security and a need for fishermen to recover large capital expenses in boats and gear, salmon catches rose by 27 per cent between 1988 and 1997, even as prices declined.[186] Continued subsidies to wild salmon fisheries also contributed to this trend.

The salmon farming industry knows that its production is depressing salmon prices. Three of BC's fish farmers, in their annual reports for 2001, pinned low prices on global overproduction.[187] Market irrationality, however, leads them nonetheless towards the pursuit of greater production and efficiency.

Super Natural BC?

Salmon farming may deter tourists if the farms take away from the "natural" or "wilderness" experience for which many come to BC. Some tourist operators are already experiencing the impacts of salmon farming. In fact, there are direct conflicts between marine ecotourism guides—kayaking and wildlife viewing operations—and the salmon farming industry.[188] There are several reasons for this. Most directly, bays and beaches that were once accessible to the guiding community are now inhabited by salmon farm operations, and fewer campsites are available because of the proximity of loud or unsightly fish farms.[189] (The unavailability of bays and beaches due to fish farms is also an issue for power/sail cruising boats; for them, having fewer anchorage sites is a matter of safety as well as aesthetics.) An admittedly small survey (only 11 respondents) of the guiding community found unanimous agreement that client reaction to the farms was negative because ecotourists " have a low tolerance for industrial intrusions."[190] One member of the community also cited the substantial boat traffic surrounding salmon farms and the disconcerting effect of "often" hearing gunshots in the vicinity of farms.[191]

The dive community is more reluctant to speak out about conflicts between itself and salmon farming. Dive guides did not want to express an opinion on the effect of fish farms on their activities or industry, but it is unknown whether this is because impacts do not exist or whether divers are reluctant to speak out against an industry that routinely hires divers to inspect its net cages.

The expansion—even the existence—of fish farms is fundamentally at odds with the values that many of BC's tourists hold dear. A choice may have to be made between fish farms and tourism, the latter a larger industry for every economic indicator.

BC's tourism sector, including the marine ecotourism component, has shown tremendous growth in the past and has the potential for continued growth in the future. As wilderness shrinks in many places in the world, BC's natural beauty will only increase in value. The expansion—even the existence—of fish farms is fundamentally at odds with the values that many of BC's tourists hold dear and their reasons for traveling to this province. A choice may have to be made between fish farms and tourism, the latter a larger industry for every economic indicator.

Cultural Issues and First Nations People

The risks posed by the salmon farming industry outweigh the benefits when considering the social and cultural significance of wild fisheries and the potential socio-economic impacts of expanding aquaculture. The Salmon Aquaculture Review found that the overall impact of the industry on First Nations in the province has been negative.[192] Salmon farming has impacted traditional fisheries, such as clams, that aboriginals in the Broughton Archipelago depend upon. In return, First Nations participation in the salmon farming industry has been "very limited."[193] As of 1997, only 50 to 60 persons from First Nations were employed in activities relating to salmon farming,[194] though the total is likely higher now. Consequently, the position of First Nations people who participated in the Salmon Aquaculture Review in 1997 was "zero tolerance to any salmon farms."[195]

It is no surprise that many of BC's aboriginal people are unwilling to accept any risk to wild fish stocks, considering the importance of wild fisheries—especially wild salmon, shellfish, and herring roe—to First Nations people. In commercial fishing, 31 per cent of commercial fleet vessels are operated by aboriginal people.[196] In addition, 5 per cent of the total allowable catch goes to aboriginal people for food, social, and ceremonial purposes. Between 1998 and 2001, this constitutionally protected fishery averaged 450,000 salmon for BC's aboriginal population.[197] Replacing this food source with another—one likely less suited to the physiology of aboriginal people who have used fish as a staple for centuries—would be expensive. More importantly, coastal First Nations' cultures and histories are inextricably linked to fishing salmon and other wild fish.

The position of First Nations people who participated in the Salmon Aquaculture Review in 1997 was "zero tolerance to any salmon farms." It is no surprise that many are unwilling to accept any risk to wild fish stocks, considering their importance to First Nations people.

Not all First Nations oppose salmon farming, however. More recently, some First Nations have entered into agreements with salmon farming companies that allow the industry onto traditional territories in exchange for some socio-economic commitments, namely jobs, on the part of the industry. The Kitasoo First Nation from Klemtu is one high-profile example of such a bilateral agreement.

Conflict *between* First Nations can also be provoked by these agreements. The Heiltsuk people of Bella Bella, who are steadfastly opposed to salmon farms, have had to stomach the presence of the salmon farming industry in their declared traditional territory due to the Kitasoo agreement. Direct physical clashes between the Heiltsuk—often accompanied by representatives of the environmental community—and the salmon farming industry have ensued.

Potential impacts on cultural, social, and economic values go beyond those on First Nations people, however. The salmon farming industry poses an ecological risk to many communities that depend on wild fisheries resources. Fifteen BC communities—some predominantly aboriginal, some not—are particularly vulnerable because of their high dependence on fish harvesting and processing, their remoteness in the province, and the dearth of other economic opportunities.[198] These communities are Kyuquot, Ahousaht, Alert Bay, Sointula, Hartley Bay, Sayward, Kitkatla, Bella Bella/Bella Coola, Masset, Port Hardy, Ucluelet, Quadra Island, Tofino, Bamfield, and Prince Rupert. Some of these places at risk have already lost their wild commercial fisheries, though not all were because of salmon farming.

The salmon farming industry is concentrated in fewer communities (Campbell River, Courtenay/Comox, Tofino, Port Hardy, and Port McNeil) that in most cases differ from those at risk. Those communities that depend on wild fish stocks—including migratory species like wild Pacific salmon—

and derive little benefit from salmon farming would be in trouble if wild stocks were impacted. This could happen if the ecological risks posed by salmon farming were to manifest themselves in the collapse of a wild species or important run, like the pink salmon that migrate through the Broughton Archipelago. Communities at risk could thus get sideswiped in the race for fish farm expansion. And, as highlighted earlier, it is important to note even an expanded salmon farming industry is unlikely to create many new jobs.

The Sustainability of Other Marine-Based Industries

It needs to be pointed out that the environmental performance and sustainability of other marine-based industries is not unblemished. Commercial and sports fishing have obvious impacts on wild fish stocks. The DFO has been slow to apply the lessons learned from the Atlantic cod to the Pacific salmon and other fish stocks. Recent decisions to err on the side of caution and temporarily close down fisheries to conserve coho and sockeye runs are promising, but there is no guarantee that BC will have numerous abundant salmon runs in the decades to come. The province's commercial fishing sector has become more diversified, leading to more stability for fishermen and fishing communities, but newly exploited fish species are often lower in the food web. Thus, like many places in the world, we are "fishing down the food web," with potential consequences for higher-level predators like salmon.

The cruise ship industry's environmental performance has not been stellar either. Cruise ships routinely and legally dump untreated solid waste, food waste, sewage, and other waste at sea. The volume of waste has climbed with the expansion of the industry, showing that the voluntary approach it favours is not working to promote best practices in waste management.[199]

Even the whale watching industry poses potential ecological risks to the marine mammals it depends upon. The commercial whale watch industry *has* developed and implemented guidelines to protect whales from harassment or inappropriate viewing.[200] Still, there are limits to how much the industry can grow before the well being of the whales or the value of the experience for the tourist is compromised.[201]

The ecological risks posed by other marine-based industries to the marine environment are relevant when assessing the risk of salmon farming. However, the existence of these risks does not absolve the salmon farming industry of any scrutiny with respect to *its* potential impacts. If anything, it reminds us that all risks need to be considered, evaluated, and managed. We have policy tools to minimize the risk of commercial fishing, cruise ships, and whale watching just as we have policy tools to minimize the risk of salmon farming. These tools need to be applied in a way that acknowledges and considers the level of risk each activity poses.

The next section investigates technologies other than open pen fish farms. Evaluating the economic viability and ecological risks of alternative technologies—and comparing them to those of open pen fish farms—will point the way forward for policy makers at the provincial and federal level.

PART 5

Alternative Salmon Farming Technologies: Ecological and Economic Considerations

PILOT PROJECTS THAT USE ALTERNATIVE SALMON FARMING TECHNOLOGIES have already been undertaken in BC, and more are underway.[202] These technologies, popularly described as "closed containment" farms, differ somewhat with respect to their environmental performance and cost structure.[203] Generally, though results are limited and preliminary, these technologies show some promise on both fronts.

Closed containment systems are generally categorized as either in-water or land-based. Neither is truly "closed," since salt water both enters and exits the systems and not all the technologies treat the waste.

In-Water Closed Containment

Two different in-water models have been implemented on the West Coast. Mariculture Systems, which went through a successful pilot test in Washington state, uses a composite fibreglass tank.[204] Future SEA Technologies' bag system employs a coated fabric bag technology that has been implemented at aquaculture sites around the world, including Chile, Australia, and Canada.[205]

Because both use a solid barrier, which keeps marine predators away, there is a substantial decline in the risk of catastrophic and chronic escapes. Both systems can collect, concentrate and treat the solid waste generated by the farm.[206] In addition, preliminary trials have showed reduced mortality as a result of disease. This is possibly due to the constant current generated, which reduces fish stress and improves fish health. Water intake coming from depth and the impermeable sides of the tanks prevent contact with the external environment and prevent the transfer of diseases from tank to tank. Other positive influences on disease include reduced contact with the outside environment and the removal of waste from the rearing environment.[207]

Mariculture Systems is working on a filter for its new site that strains out bacteria and sea lice coming into and going out of the tank, but the filter does not, as yet, filter viruses.[208] The Future SEA Technologies' bag system does not have a filter, but in a recent trial has shown up to a 12-fold reduction in the amount of sea lice inside its pens compared to open net cages, likely for reasons listed above.[209]

Mariculture Systems is partnering with Yellow Island Organic Aquaculture on Quadra Island near Campbell River. Yellow Island operates its system under its own organic guidelines and currently uses no antibiotics or pesticides. This husbandry practice will be used in cooperation with the closed-containment tanks. Mariculture is also partnering with another Washington company to use fecal waste in its fish farms to generate methane, reducing its energy needs by an estimated 25 per cent.[210]

Land-Based Systems

Agrimarine Industries operates the only saltwater land-based Pacific salmon grow-out system in North America, just south of Nanaimo. The salmon are raised in large concrete tanks, eliminating the possibility of marine mammal predation.[211] Three barriers keep the salmon from escaping through the water inflow or outflow. Ammonia is largely removed and nutrient loading decreased through physical aeration. However, suspended solids (fecal matter and biological detritus) are pumped untreated into the ocean. Like the in-water systems, a lower incidence of disease exists among the farmed salmon, but untreated effluent has not removed the risk of waste and disease transfer.[212]

Financial Considerations

Mariculture System's pilot project in Washington state has shown promise from a financial standpoint. According to the company's own documents, the fixed capital costs are higher than a net cage system ($1.7 million vs. $1 million), but many of the operating costs are lower, leading to an overall cost advantage at the time of the pilot project of $0.46/pound.[213] The document claims that the cost advantage comes from: reduced mortality; reduced feed costs, since food utilization is higher and feed loss to current is eliminated; higher stocking densities; reduced labour costs, due to less requisite maintenance; and reduced repair costs.[214]

A cost analysis of the Future SEA Technologies' bag system shows that the payback period for this technology, under optimum conditions, is one harvest cycle or 18 months.[215] Its successful implementation in Chile also suggests that it has a competitive cost structure.

High infrastructure costs of having concrete tanks on land and the high-energy demands of its leased system (considered to use a flawed design) have been challenges for this pilot project. After the second production cycle, financial projections are reportedly beginning to show promise. Costs may be substantially reduced with a better engineering design operating at commercial production capacity.[216]

It should also be noted that fish produced in closed containment and those using organic husbandry practices can receive a premium of up to $0.25 each. Mariculture has been quoted a preliminary price of $0.50 per pound above conventionally produced farmed fish if both closed-containment and organic practices are used.[217]

Outstanding Issues

Though the financial numbers are promising for in-water closed containment systems, there remain some considerable concerns with respect to these technologies. With the recent sea lice/pink salmon problems in the Broughton Archipelago and the IHN outbreaks in Campbell River and Clayoquot Sound fish farms, it is significant that this technology considerably lowers the risk of disease transfer and amplification in wild Pacific salmon. The treatment of solid waste in the in-water systems also decreases that risk. But even though Mariculture's system removes sea lice and bacteria, a risk of viral infections remains.

The energy requirements of closed containment systems are also a concern. In-water systems have lower energy needs compared to land-based systems, but both are still above the energy requirements of net cage farms. This is unlikely to change, since closed systems use energy to pump water and to

treat it. Using more energy to treat farm sewage is a trade-off that some may be willing to live with, considering we often build treatment plants and use energy to treat human sewage. Both Mariculture and Future SEA Technologies have expressed an interest in generating renewable energy on site in order to power their electricity needs. This would certainly alleviate the energy concern, but would likely have implications for the financial bottom line.

The present closed containment systems, like net cage farms, also leave a large ecological footprint because they rely on large quantities of wild fish stocks to generate the feed. The increased feed efficiency documented in the Mariculture pilot project decreases this impact. So does Yellow Island's practice of partially deriving its fishmeal from commercial herring waste that would otherwise have been composted.[218] However, pressure on wild fisheries for fishmeal remains.

The salmon farming industry as a whole is attempting to develop vegetarian-based fish feeds, which will relieve the pressure on the world's wild fish stocks, while substantially reducing the ecological footprint of the industry.[219] For example, Nutreco is currently researching the use of vegetable oils in feed as part of its provincial pilot project.[220] Until this is accomplished, we must acknowledge that expansion of the fish farming industry—net cage or closed containment—puts at risk the health and abundance of certain wild fish stocks.

Mariculture's closed-containment tanks have shown financial promise. While the fixed capital costs are higher than a net cage system ($1.7 million vs. $1 million), many of the operating costs are lower, leading to an overall cost advantage.

Because production per facility can increase substantially in closed systems, it is possible to have present BC production levels with only one-third of the tenures.[221] Thus, in-water systems may improve, but do not resolve, the conflict between fish farms and marine tourism. If in-water systems preserve wild salmon stocks—which sustain bald eagles, grizzly bears, and orcas—tourism based on these icons of wilderness will also be sustained. Fewer marine predators at closed containment systems, and the tactics taken to ward them off, will also improve the wilderness experience of BC's tourists. But if the mere presence of fish farms has an impact on tourism sub-sectors—as is argued by the paddling guide community—then in-water closed containment systems will still have an impact. The energy requirements of closed containment farms may provide a small benefit in this regard, since farms will have to be located near power grids, i.e. near existing communities rather than in wilderness areas frequented by marine ecotourists.

There are also detrimental economic impacts that are not in any way resolved by the closed containment systems. The decline in the price of wild salmon will continue even if farmed salmon production is moved to closed containment systems, at least until a distinction is made between wild and farmed salmon in the consumer's mind. International cooperation is required—and should be pursued—in order to obtain adequate labeling of farmed salmon products. Arguably more than anything else, greater consumer awareness brought about through appropriate labeling of both wild and farmed salmon will drive the salmon farming industry towards greater sustainability in order to keep and expand the market share it now holds in many countries.

Notwithstanding these important and yet unresolved issues, there are reasons to proceed cautiously towards closed-containment systems. The fact that the waste, nutrient, escape, and (to a certain extent) disease problems have been resolved suggests that any decision to expand salmon farming should consider using this technology. However, such an expansion needs to be carefully undertaken, with the assurance that outstanding issues are being addressed. The financial picture needs to be clarified by including the externalized costs that both net cage and closed containment systems impose on the marine ecosystem.

PART 6

Going Forward

Recommendations on Salmon Farming

SEVERAL RECOMMENDATIONS FLOW FROM THE ABOVE ANALYSIS OF economic benefits and risks of different forms of salmon aquaculture.

1. Place a moratorium on new net cage licences and sites.

The economic benefits of an expanded net cage industry are quite modest. Employment is unlikely to increase even under an expanded industry, since significant industry expansions in Norway and Scotland have not increased employment. Modest tax returns to government—paired with substantial subsidies, tax credits, and indirect government expenditures—minimize or eliminate the government revenue motive for industry expansion. Increased exports alone are not enough of a justification for expanding the industry, since aquaculture exports from an expanded industry will still make up only about 1 per cent of the value of BC's exports.

The scientific community repeatedly points to both the documented impacts of salmon farming and the remaining uncertainties surrounding its ecological risk. These risks contrast starkly with the modest economic benefits that salmon farming will bring. Until ecological issues are fully resolved, it would be foolhardy to risk the significantly greater economic benefits that other marine-based industries bring for the much smaller economic benefits of net cage salmon farming.

2. Apply the precautionary principle to *existing and proposed* salmon farms—both net cage and closed containment—before allowing them to proceed.

The scientific community has repeatedly urged Canada's fisheries managers to use the precautionary principle when making decisions on salmon aquaculture.[222] The first question to be asked, consistent with the application of the precautionary principle, must be: "Are we making conservation and management decisions based on information that is uncertain, unreliable or inadequate?" The answer from scientists is yes, which means we need to err on the side of caution when making decisions. We need to consider future generations, avoid irreversible changes, apply available corrective measures, give priority to conserving natural resources, and place the burden of proof on those who will benefit from the activity.[223]

This precautionary approach may require that some dramatic decisions be made. It may make ministry officials order the fallowing of some net cage farms for certain periods, as has been recommended by the Pacific Fisheries Resource Conservation Council and others. It may increase the buffer around stream entrances. It may make waste regulation from salmon farms more stringent. It may shut down parts of the salmon aquaculture industry altogether. At the least, however, it should delay the implementation of any new farms—net cage or closed containment—until proponents prove that farms will *not* have an ecological impact, rather than leaving it up to scientists and regulators to prove that these salmon farms will have ecological impacts.

3. Properly consult First Nations people in accordance with recent court rulings regarding any decisions made about aquaculture in their traditional territories.

Some First Nations are in favour of aquaculture projects and others are opposed. Until greater certainty is gained through the resolution of treaty negotiations, First Nations must be given the right to allow or refuse aquaculture activities in their stated traditional territories. The BC government should ensure agreements are signed between the aquaculture industry and First Nations in cases where aboriginals favour aquaculture development.

4. Work with the international community—industry, governments, and scientists—to resolve issues that can be solved only with collective action.

The use of wild fish stocks to make fish oil and fishmeal is one of those issues. The salmon farming and fish feed industries see this as a major challenge. So should government regulators in many countries. Eliminating the tremendous pressure on wild fisheries resources used in fish feed will require many players in many jurisdictions finding and implementing solutions. Finding other sources of protein that can also be used as fish feed would be a good place to begin. Though obstacles remain, research has shown that a plant-based fish feed could be used as a protein source.[224]

The other issue that is international in scope is that of labeling. Consumers in every country have a right to know where their food comes from. There may be a place for salmon production through aquaculture, but consumers need to know whether they are eating a wild or farmed product, and so every salmon product should be clearly labeled. With this knowledge, and further public education about the aquaculture industry, will come a greater incentive for salmon farming companies to ensure that their industry is sustainable.

Conclusions

THE RESULT OF THIS ANALYSIS SHOULD MAKE BC GOVERNMENT REGULATORS pause before continuing to support the expansion of salmon farming on the province's coast. Allowing expansion to continue on the premise of jobs would be imprudent, given the limited promise that aquaculture can bring in this respect. It is also questionable whether the taxes paid to government will exceed the substantial direct and indirect expenses incurred by the BC and federal governments in allowing, encouraging, and regulating the salmon farming industry. An expanded industry would still provide modest export income for the provincial economy.

In contrast to the limited economic benefits, the ecological and economic risks appear significant. We are jeopardizing the province's sports fishery, commercial fishery, fish processing sector, and marine tourism—each of which contributes more economically than aquaculture does. The fact that most are locally owned and managed likely means more of their earnings stay in the BC economy. Taken together, the economic importance of these other marine-based industries dwarfs that of salmon farming in its present form (or future potential, even with growth).

Some of the province's other marine-based industries, especially in the fisheries sector, have provided substantial social and economic benefits in the past, and continue to be important to many communities. The rumours of their death have been greatly exaggerated, and they should not be dismissed so easily. Other opportunities, namely in tourism, show tremendous promise for growth while preserving the province's vital natural heritage.

We are jeopardizing the province's sports fishery, commercial fishery, fish processing sector, and marine tourism—each of which contributes more economically than aquaculture does.

There are alternatives, even in aquaculture. Alternative salmon farming technologies appear to have significantly lower ecological and economic risks. These alternatives—indeed all economic opportunities—carry risks, and the precautionary principle thus needs to be applied to them as well. Most important is that the burden of proof rests with proponents of economic activities, not with government, the academic community, or the non-profit sector. All of these actors, however, *can* play a part in assessing different economic opportunities, and promoting those that benefit British Columbians the most and are truly sustainable—provincially and globally.

Finally, aquaculture development cannot continue to neglect the concerns and aspirations of aboriginal citizens. Until clarity is established through the treaty process, First Nations should be included, respected, and accommodated in decision-making over aquaculture development in their traditional territories.

Endnotes

[1] van Dongen.

[2] van Dongen; and Rose.

[3] Naylor et al. 2000. p. 1017.

[4] BC Ministry of Finance and Corporate Relations. 2001a. p. 29; and BC Ministry of Finance and Corporate Relations. 2002a. p. 79.

[5] BC Ministry of Agriculture, Food and Fisheries. 2003a.

[6] David W. Ellis & Associates. p. 7.

[7] Hansard. 1990. p. 53-31.

[8] David W. Ellis & Associates. p. 7.

[9] BC Ministry of Agriculture, Food and Fisheries. 2003a; and BC Ministry of Finance and Corporate Relations. 2002a. p. 81.

[10] Department of Fisheries and Oceans. 2002.

[11] Lane. p. 1.

[12] Department of Fisheries and Oceans. 2002.

[13] Coopers & Lybrand Consulting. p. 5.

[14] Ibid.

[15] BC Ministry of Agriculture, Food and Fisheries. 2003b.

[16] Egan, David. p. 10.

[17] Asche et al. p. 304.

[18] Stolt-Nielson S. A. 2002. p. 1.

[19] Ibid. p. 12.

[20] Stolt Sea Farm. 2003.

[21] BC Ministry of Agriculture, Food and Fisheries. 2003b.

[22] Pan Fish. 2003a.

[23] Pan Fish. 2003b.

[24] Nutreco. p. 21.

[25] Ibid. p. 3.

[26] BC Ministry of Agriculture, Food and Fisheries. 2003b.

[27] Cermaq ASA. p. 8.

[28] Ibid. p. 3.

[29] Ibid. p. 4.

[30] George Weston Ltd. p. 30-31.

[31] BC Ministry of Finance and Corporate Relations. 2002a. p. 79.

[32] Statistics Canada. 2002a.

[33] BC Ministry of Finance and Corporate Relations. 2002a. p. 79.

[34] The methodology used in BC Ministry of Finance and Corporate Relations (2002a, 2001a) to calculate GDP, employment, exports, etc. for salmon farming included activities such as feed production and processing when the predominant activity undertaken by the operator was fish farming.

[35] Ibid.

[36] Ibid.

[37] Ibid.

[38] Ibid.

[39] BC Ministry of Finance and Corporate Relations. 2001b. p. 5.

[40] BC's aquaculture industry spent $24 million in 2001 contracting out to the processing sector (Statistics Canada, 2002b, p. 27), while the total revenues of BC's fish processing industry that year was $601.8 million (BC Ministry of Finance and Corporate Relations, 2002a, p. 85). In addition to this contracting out, BC's salmon aquaculture industry also processes its own salmon, but the data for GDP and employment are included in data for the entire industry.

[41] ARA Consulting Group. p. 14-2.

[42] Tourism British Columbia. p. 5.

[43] World Tourism Organization.

[44] Personal communication: Ric Careless: Executive Director, BC Wilderness Tourism Association. March 19, 2003.

[45] ARA Consulting Group. p. 14-2.

[46] Wilson. 2000. p. 60.

[47] Hoyt. p. 25.

[48] ARA Consulting Group. p. 14-2.

[49] Personal communication: Tom Beasley: Diving guide and member, Underwater Council of BC. March 7, 2003.

[50] ARA Consulting Group. p. 14-2.

[51] This estimate carries a significant amount of uncertainty. It was calculated using dive statistics for BC from Ladd et al. (2002, p. 125) and assuming that daily direct expenditures in scuba diving were equal to those in whale watching, derived from Hoyt (2002, p. 25).

[52] ARA Consulting Group. p. 14-2.

[53] WaveLength Magazine. 1997 and 2002.

[54] ARA Consulting Group. p. 14-2.

[55] This was estimated by the author from two personal communications, by multiplying the number of tour operators by the estimated revenue of each: Personal communication: Alan Wilson, Editor and publisher, WaveLength Magazine. March 10, 2003. Personal Communication: Peter Marcus: Owner, Gabriola Cycle and Kayak. March 17, 2003.

[56] Estimated from InterVISTAS Consulting Inc. p. 78-79.

[57] BC Ministry of Finance and Corporate Relations. 2002a. p. 81.

[58] BC Ministry of Finance and Corporate Relations. 2001a. p. 21.

[59] BC Ministry of Finance and Corporate Relations. 2002a. p. 83.

[60] Ibid. p. 81.

[61] Ibid. p. 83.

[62] BC Ministry of Finance and Corporate Relations. 2001a. p. 23.

[63] BC Ministry of Finance and Corporate Relations. 2002a. p. 83.

[64] Ibid. p. 30.

[65] Ibid. p. 81 and 83.

[66] BC Ministry of Finance and Corporate Relations. 2001a. p. 35.

[67] ARA Consulting Group. p. 14-2.

[68] InterVISTAS. p. 79.

[69] Ibid.

[70] Estimated from ARA Consulting Group. p. 14-2.

[71] BC Ministry of Finance and Corporate Relations. 2002a. p. 87.

[72] Ibid. p. 91.

[73] Ibid. p. 93.

[74] BC Ministry of Finance and Corporate Relations. 2002a. p. 87.

[75] Ibid.

[76] Tourism BC. p. 2.

[77] Calculated from BC Ministry of Finance and Corporate Relations. 2002a. p. 85.

[78] Calculated from InterVISTAS. p. 78.

[79] Calculated from ARA Consulting Group. p. 14-2.

[80] Rose.

[81] Ibid.

[82] Stolt Nielson S.A. p. 23; Nutreco. p. 30; Cermaq ASA. p. 8.

[83] Bjordal. p. 6.

[84] Statistics Canada. 2002b. p. 23 and 27.

[85] BC Ministry of Finance and Corporate Relations. 2001a. p. 7.

[86] BC Ministry of Finance and Corporate Relations. 2001b. p. 56.

[87] Norway Directorate of Fisheries. p. 11.

[88] Ibid. p. 12.

[89] Highlands and Islands Enterprise. p. 2.

[90] Coopers & Lybrand Consulting. Section 2, p. 22.

[91] The number of full-time, permanent jobs (400-800, depending on export markets) can be multiplied by the number of years in the study period (10 years) to arrive at person-years of employment (4,000-8,000), and multiplied by a factor that includes indirect and induced jobs (2.5) to get an impressive-sounding level of employment (10,000-20,000 person-years of direct, indirect, and induced jobs created).

[92] Coopers & Lybrand Consulting. Section 2, p. 4 and 22.

[93] Statistics Canada. 2002b. p. 10; and BC Ministry of Finance and Corporate Relations. 2002a. p. 81.

[94] Centre for the Study of Living Standards. p. 13.

[95] Coopers & Lybrand Consulting. Section 2, p. 14.

[96] Ibid. Section 2, p. 11.

[97] This assumes that BC's exports will experience the same growth over the next 10 years as it did from 1990 to 2000, the last decade documented in BC Ministry of Finance and Corporate Relations. 2002b. p. 81.

[98] BC Ministry of Agriculture, Food, and Fisheries. 2002a. p. 25.

[99] BC Environmental Assessment Office. 1997a.

[100] Statistics Canada. 2002b.

[101] BC Environmental Assessment Office. 1997a.

[102] New Brunswick Department of Fisheries and Aquaculture. p. 22.

[103] BC Environmental Assessment Office. 1997a.

[104] Department of Fisheries and Oceans. 2001.

[105] BC Ministry of Agriculture, Food and Fisheries. 2002b.

[106] Theodore.

[107] Leggatt.

[108] Standing Senate Committee on Fisheries.

[109] Auditor General of Canada.

[110] BC Environmental Assessment Office. 1997b.

[111] Gallaugher and Orr.

[112] Pacific Fisheries Resource Conservation Council. p. 1.

[113] Ibid. p. 5.

[114] Ibid. p. 6.

[115] Gallaugher and Orr. p. 37, 42, 43, 46, 50; and Pacific Fisheries Resource Conservation Council.

[116] Gallaugher and Orr. p. 1.

[117] Ibid. p. 52.

[118] Wilson. 2003

[119] Ibid.

[120] Intrafish.

[121] Wilson. 2003.

[122] Leggatt. p. 12.

[123] Naylor et al. 1998. p. 883.

[124] Leggatt. p. 20.

[125] Morton and Volpe. p. 105.

[126] Standing Senate Committee on Fisheries. p. 42.

[127] Leggatt. p. 12.

[128] Gallaugher and Orr. p. 34.

[129] Leggatt. p. 12.

[130] Auditor General of Canada. p. 30-22.

[131] Gallaugher and Orr. p. 22.

[132] Fleming et al. p. 1522.

[133] Ibid.

[134] Volpe. 2001a. p. 6.

[135] Norway Directorate of Fisheries. p. 13.

[136] Lough and Law (1995) and Alverson and Ruggerone (1997), cited in Volpe. 2001b. p. 15.

[137] Volpe. 2001b. p. 15.

[138] BC Environmental Assessment Office. 1997b. Volume 1.

[139] Folke et al. 1994.

[140] Leggatt. p. 7.

[141] Auditor General of Canada. p. 30-15.

[142] BC Ministry of Water, Land and Air Protection. 2002. Appendix 2.

[143] Auditor General of Canada. p. 30-15.

[144] Folke et al. 1997.

[145] Standing Senate Committee on Fisheries. p. 37. Waddy et al. p. 1098.

[146] Fong; and Blythman.

[147] Standing Senate Committee on Fisheries. p. 39. and Leggatt. p. 18.

[148] Standing Senate Committee on Fisheries. p. 39.

[149] Leggatt. p. 19.

[150] Standing Senate Committee on Fisheries. p. 39.

[151] Ibid. p. 39.

[152] Ibid. p. 40.

[153] Personal communication: Randall Peterman, Professor and Canada Research Chair in Fisheries Risk Assessment and Management. January 29, 2003.

[154] Standing Senate Committee on Fisheries. p. 69.

[155] Gallaugher and Orr. p. 75; and Standing Senate Committee on Fisheries. p. 71.

[156] Auditor General. p. 30-5 and 30-13.

[157] Ibid. p. 30-5.

[158] Government of British Columbia. 2003.

[159] van Dongen.

[160] Naylor et al. 2000. p. 1017.

[161] Pauly et al. p. 689.

[162] Naylor et al. 2000. p. 1019.

[163] Tyedmers. p. 191-192.

[164] Bjordal. p. 5.

[165] Ibid. p. 6.

[166] Tuominen and Esmark. p. 18.

[167] Tuominen and Esmark. p. 23; Naylor et al. 2000. p. 1020.

[168] Food and Agriculture Organization. p. 1.

[169] Pauly. p. 693.

[170] Ibid.

[171] Naylor et al. 2000. p. 1017.

[172] Tyedmers. p. 177.

[173] Ibid. p. 178.

[174] Ibid. p. 178.

[175] Folke et al. 1998.

[176] Tyedmers. p. 170.

[177] Ibid. p. 181.

[178] Ibid. p. 183.

[179] Ibid. p. 193.

[180] BC Ministry of Finance and Corporate Relations. 2001a. p. 35.

[181] Ibid.

[182] Reimchen. p. 16.

[183] Asche et al. p. 304.

[184] Ibid.

[185] Miller et al. p. 30.

[186] Naylor et al. 2000. p. 1018.

[187] Stolt Nielson S.A. p. 23; Nutreco. p. 30; Cermaq ASA. p. 8.

[188] BC Environmental Assessment Office. 1997c.

[189] Wilson. 1997. p. 2.

[190] Ibid. p. 4 and 12-16.

[191] Personal communication: Alan Wilson, Editor and publisher, WaveLength Magazine, March 10, 2003.

[192] BC Environmental Assessment Office. 1997d.

[193] Ibid.

[194] Ibid.

[195] BC Environmental Assessment Office. 1997e.

[196] Department of Fisheries and Oceans. 1999. p. 4.

[197] Department of Fisheries and Oceans. 2003.

[198] Gislason. p. 5.

[199] Klein. p. 26.

[200] Whale Watch Operators Association—Northwest.

[201] Wilson. 2000. p. 38.

[202] BC Ministry of Agriculture, Food and Fisheries. 2003c; and Personal communications: Rob Walker, Director of Marketing, Agrimarine. May 7, 2002. Response to request for internal alternative technology survey from Raincoast Conservation Society.

[203] Luce; and Mariculture Systems. 2002. p. 4.

[204] Mariculture Systems. 2003.

[205] G3 Consulting Ltd. p. 5-6.

[206] Mariculture Systems. 2003; and Future SEA Technologies. 2003.

[207] Clarke. p. 1; and Mariculture Systems. 2002. p. 2.

[208] Personal communication: Rick Luce, Vice President: Mariculture Systems. November 8, 2002.

[209] Clarke. p. 2.

[210] Personal communication: Rick Luce, Vice President: Mariculture Systems. November 8, 2002.

[211] BC Ministry of Agriculture, Food and Fisheries. 2003c.

[212] Personal communication: Rob Walker, Director of Marketing, Agrimarine. May 7, 2002. Response to request for internal alternative technology survey from Raincoast Conservation Society.

[213] Mariculture Systems. 2002. p. 3.

[214] Ibid. p. 1.

[215] Future SEA Technologies. Date not provided.

[216] Personal communication: Rob Walker, Director of Marketing, Agrimarine. May 7, 2002. Response to request for internal alternative technology survey from Raincoast Conservation Society.

[217] Personal communication: Rick Luce, Vice President: Mariculture Systems. April 28, 2003.

[218] Personal communication: Grace Cho, Biologist, Yellow Island Aquaculture Ltd. August 22, 2002.

[219] Tyedmers. p. 187.

[220] BC Ministry of Agriculture, Food and Fisheries. 2003c.

[221] Personal communication: Rick Luce, Vice President: Mariculture Systems. November 8, 2002.

[222] Gallaugher and Orr. p. 75; Standing Senate Committee on Fisheries. p. 71; Auditor General of Canada. p. 30-12; Leggatt. p. 26.

[223] Gallaugher and Orr. p. 77.

[224] Hardy et al. p. 20.

APPENDIX

Salmon Aquaculture Tenures in BC

March, 2003 • Source: BC Ministry of Agriculture, Food and Fisheries. 2003b.

Tenure	Parent/Operator	Company (if different)	Locations
1401621	Creative Salmon		Indian Bay, Tofino Inlet
1401643	Creative Salmon		Eagle Bay, Tofino Inlet
1405980	Creative Salmon	Tofino Aqua Farms	Baxter Islets, Dawley Passage
1406335	Creative Salmon		McCaw Peninsula, Tranquil Inlet
1408125	Creative Salmon		Ridout Islets and McCall Island, Tofino Inlet
1409666	Creative Salmon		Dawley Passage, Fortune Channel
1401188	EWOS	Prime Pacific Sea Farms	Goodridge Island, Sooke Basin
1401589	EWOS	Pacific National Grp.	Mussel Rock, Cypress Inlet, Clayoquot Sound
1401590	EWOS	Pacific National Grp.	Saranac Island, Bedwell Sound
1401974	EWOS	Blue Salmon Sea Farms	Hecate Bay, Cypress Bay
1403262	EWOS	Pacific National Grp.	Rant Point, Bedwell Sound, Clayoqout Sound
1403293	EWOS		Dixon Point, Shelter Inlet
1403297	EWOS		Belcher Point, Sulphur Passage
1403647	EWOS	EWOS	Bawden Point, Herbert Inlet, Ross Passage
1403679	EWOS	EWOS	Obstruction Island, Shelter Inlet
1403903	EWOS	Prime Pacific Sea Farms	Sooke Basin **Identified for relocation**
1403914	EWOS	Fortune Channel Farm	East side of Warn Bay, Fortune Channel
1403979	EWOS	Pacific National Grp.	Clayoquot Sound, Bedwell Sound, Bare Bluff
1403980	EWOS	Pacific National Grp.	East Shore of Bedwell Sound
1405933	EWOS	Blue Tornado Enterprises	Northeast McKay Island, Ross Passage
1406648	EWOS	Blue Tornado Enterprises	Herbert Inlet, NE of Binns Island
1407342	EWOS	Pacific National Grp.	McIntyre, 3 km SW of Bare Bluff, Bedwell Sound
1408492	EWOS	McCully Exploration	Matlset Narrows, Bedwell Sound
1408719	EWOS	Blue Tornado Enterprises	Millar Channel, 2 km S Hayden Passage
1404968	Greig Seafoods	Scandic Sea Food	Hecate Channel
1404969	Greig Seafoods	Scandic Sea Food	Steamer Point, Hecate Channel
1405007	Greig Seafoods	Scandic Sea Food	opposite Steamer point, Esperanza Inlet
1411064	Grieg Seafoods/Agrimarine		Muchalat Inlet/paired with upland private land base site
1411068	Grieg Seafoods/Totem Oysters		Williamson Point/paried with 0298167
1401284	Heritage Aquaculture	Barkley Sea Farms	San Mateo Bay, Alberni Inlet **Identified for relocation**
1403267	Heritage Aquaculture	BC Packers	Okisollo Channel, N of Quadra Island
1403895	Heritage Aquaculture	Connors Brothers	Simoom Sound, Wishart Peninsula
1403929	Heritage Aquaculture	Connors Brothers	Cliffe Bay, Wishart Peninsula
1404179	Heritage Aquaculture	Connors Brothers	Sir Edmund Bay, NE Shore Broughton Inlet
1404438	Heritage Aquaculture	BC Packers	South side San Mateo Bay, Alberni Inlet
1405181	Heritage Aquaculture	Connors Brothers	Cecil Island, Greenway Sound
1405381	Heritage Aquaculture	Connors Brothers	Cypress Harbour, Harbour Pt, Sutlej Channel
1405739	Heritage Aquaculture	Connors Brothers	Broughton Island (SE) , Greenway Sound (Maude)
1406618	Heritage Aquaculture	Penny Creek Marine Farms	Mactush Bay, Alberni Inlet **Identified for relocation**

Tenure	Parent/Operator	Company (if different)	Locations
1406650	Heritage Aquaculture	Connors Brothers	Raleigh Passage, Burdwood Grp.
1407730	Heritage Aquaculture	Connors Brothers	Mt. Simmonds Bay, Wells Passage
1407731	Heritage Aquaculture	Connors Brothers	Wehlis Bay, Wells Passage
2403035	Heritage Aquaculture	Connors Brothers	Raza Island, Raza Passage
1405542	Heritage Aquaculture/SKM Enterprises (affiliation) · SKM Enterprises · Barnes Bay, Sonora Island (Okis Island)		
1401514	Nutreco Canada	Hatfield Biotech	Yeo Pt., Cusheon Cove, Salt Spring Is./paired with 2407932
1401597	Nutreco Canada	Paradise Bay Seafarms	Conville Bay, Hoskyn Channel, Quadra Island
1401611	Nutreco Canada	Paradise Bay Seafarms	Bear Bay, Read Island
1401659	Nutreco Canada	Paradise Bay Seafarms	Dunsterville Bay, Hoskyn Channel
1403144	Nutreco Canada	Paradise Bay Seafarms	Sonora Point, Nodales Channel, Sonora Island
1403859	Nutreco Canada	Paradise Bay Seafarms	Conville Point,Hoskyn Channel, Quadra Island
1404284	Nutreco Canada	543757 BC	Centre Cove, Whiteley Island, Kyuquot Sound
1405003	Nutreco Canada	543757 BC	S. Point of Hohae, Kyuquot Sound
1405005	Nutreco Canada	Kyuquot Sea Farms	Amai Inlet, Amai Pt.
1405412	Nutreco Canada	Paradise Bay Seafarms	Orchard Bay, Kanish Bay, Quadra Is. **Identified for relocation**
1405768	Nutreco Canada	Paradise Bay Seafarms	Young Pass, Sonora Island
1406292	Nutreco Canada	Paradise Bay Seafarms	Cyrus Rocks, Okisollo Channel, Quadra Island
1406755	Nutreco Canada		Sansum Narrows
1406837	Nutreco Canada	414903 BC	Shelter Island Inlet, E. of Steamer Cove
1409081	Nutreco Canada	Kyuquot Sea Farms	Dixie Cove, Hohoae Island, Kyuquot Sound
2407932	Nutreco Canada		Church House/Paired with 1401514
6403484	Nutreco Canada	Kitasoo Aquafarms	Lochalsh Bay, Jackson Pass/Paired with 6406898
6406814	Nutreco Canada	Kitasoo Aquafarms	West Jackson Passage
6406836	Nutreco Canada	Kitasoo Aquafarms	Arthur Island
6406898	Nutreco Canada	Kitasoo Aquafarms	Oscar Passage/ Paired with 6403484
6406984	Nutreco Canada		Kid Bay
1403261	Omega Pacific Seafarms		Jane Bay, Barkley Sound
1401949	Omega Salmon Grp.	531643 BC	N. shore, W. Thurlow Island (Lees Bay)
1403715	Omega Salmon Grp.	531643 BC	Mayne Pass, E. Thurlow Island
1404089	Omega Salmon Grp.	Seven Hills Aquafarm	Varg Island, Raynor Grp., Queen Charlotte Strait
1404091	Omega Salmon Grp.	Anchor Seafarms	Shelter Passage, Wishart Island
1404918	Omega Salmon Grp.	Anchor Seafarms	Goletas Channel, S.E. Bell Island
1405245	Omega Salmon Grp.	531643 BC	W. Thurlow Island, Chancellor Channel
1406566	Omega Salmon Grp.	457444 BC	Loughborough Inlet, Poison Creek (also 1117, Griffin Cone)
1406628	Omega Salmon Grp.	531643 BC	Geneste Point, Sunderland Channel
1406832	Omega Salmon Grp.		South Shelter Inlet, E. of Steamer Cove
1407325	Omega Salmon Grp.	420857 BC	Doyle Island, Gordon Grp.
1407326	Omega Salmon Grp.	420857 BC	Duncan Island, Goletas Channel
1407426	Omega Salmon Grp.	531643 BC	Sunderland Channel
1407743	Omega Salmon Grp.	491119 BC	Cleagh Creek, Quatsino Sound
1407748	Omega Salmon Grp.	Alpha Processing	Shelter Bay, Richards Channel, N. of Port Hardy
1407749	Omega Salmon Grp.		Marsh Bay
1407822	Omega Salmon Grp.		Robertson Island
1409321	Omega Salmon Grp.	457444 BC	South Shore of Hardwicke Is., Chancellor Channel
1409321	Omega Salmon Grp.		Hardwick Island
1409640	Omega Salmon Grp.		Kent Island

Tenure	Parent/Operator	Company (if different)	Locations
1411041	Omega Salmon Grp		Masterman/Daphne
2402751	Omega Salmon Grp	503852 BC	Jervis Inlet near Glacial Creek
2402966	Omega Salmon Grp	531643 BC	SE Frederick Arm & Egerton Creek
2403015	Omega Salmon Grp	343513 BC	Homfray Creek, Homfray Channel
2403170	Omega Salmon Grp	Phillips Arm SeaFarms	Phillips Arm, East Side Cardero Channel
1401561	Omega Salmon Grp	Seven Hills Aquafarm	Hardy Bay, Port Hardy
1403325	Omega Salmon Grp	Sonora Sea Farms	Okisollo Channel, Sonora Island
0193432	SaltStream Engineering		Doctor Bay, West Redonda Island
1403300	Stolt / PASF Partners	424051 BC	Thurlow Pt. South, Nodales Channel
1403301	Stolt / PASF Partners	424051 BC	Brougham Pt., East Thurlow Island
1404309	Stolt / PASF Partners	Pacific Aqua Foods	Bickley Bay, E. Thurlow Island
1407385	Stolt / PASF Partners	424051 BC	Thorp Point, Holberg Inlet
2402924	Stolt / PASF Partners	424051 BC	Frederick Arm, Owen Point
1401722	Stolt Sea Farms		Koskimo Bay, Quatsino Sound
1403104	Stolt Sea Farms		Port Elizabeth, Gilford Island
1403313	Stolt Sea Farms		Baker Island, Blunden Passage
1403326	Stolt Sea Farms		Broughton Island (Deep Harbour)
1403328	Stolt Sea Farms		Tribune Channel, Sargeaunt Pass
1403748	Stolt Sea Farms		2 km NE Mahatta River, Quatsino Sound
1404379	Stolt Sea Farms		Upper Retreat Passage, Gilford Island
1404380	Stolt Sea Farms		Spring Passage, Midsummer Island
1404381	Stolt Sea Farms		North Swanson Island, Yokohamma Bay
1404681	Stolt Sea Farms		Bonwick Island, Arrow Passage
1404780	Stolt Sea Farms		Mistake Island, Havannah Channel
1405020	Stolt Sea Farms		NE Eden Island, Fife Sound **Identified for relocation**
1405180	Stolt Sea Farms		Watson Cove, Tribune Channel
1405183	Stolt Sea Farms		Wicklow Point, Broughton Island
1405184	Stolt Sea Farms		Smith Rock, Gilford Island, Tribune Channel
1405897	Stolt Sea Farms		Bockett Point, Havannah Channel, Lily Islets
1406655	Stolt Sea Farms		Potts Bay, Midsummer Island
1406960	Stolt Sea Farms		Monday Rocks, Quatsino Sound
1406961	Stolt Sea Farms		Koskimo Islands, Quatsino Sound
1408560	Stolt Sea Farms		Larsen Island, Indian Channel
1408758	Stolt Sea Farms		Doctor Islet, Tribune Channel
1404264	Stolt Sea Farms		Mound Island, Indian Channel
1409707	Stolt Sea Farms		Humphrey Rock
2402095	Target Marine Products	Hardy Sea Farms	Sechelt Inlet
2402424	Target Marine Products	Hardy Sea Farms	Northwest Sechelt Inlet
2402490	Target Marine Products	Hardy Sea Farms	North Salmon Inlet, Site #5
2402492	Target Marine Products	Hardy Sea Farms	North Salmon Inlet, Site #9
2402591	Target Marine Products	Hardy Sea Farms	Sechelt Inlet
2402613	Target Marine Products	Hardy Sea Farms	Hardy Island, Jervis Inlet, Site B
2402615	Target Marine Products	Hardy Sea Farms	Hardy Island, Jervis Inlet
2402738	Target Marine Products		E. Newcomb Point, Salmon Inlet
0298167	Totem Oysters		St. Vincent Bay, Jervis Inlet/Paired with 1411068
1401748	Yellow Island Aquaculture (1994)		East of Maude Island, Discovery Passage

References

ARA Consulting Group. 1991. "Marine Tourism in British Columbia: Opportunity Analysis." Prepared for Industry, Science and Technology Canada; BC Ministry of Tourism; and BC Ministry of Regional and Economic Development. (March).

Asche, F., T. Bjørndal, and J. A. Young. 2001. Market Interactions for Aquaculture Products. *Aquaculture Economics and Management*. Vol. 5: p. 303-318.

Auditor General of Canada. 2000. "The Effects of Salmon Farming in British Columbia on the Management of Wild Salmon Stocks." Report of the Auditor General of Canada: Chapter 30. (December).

BC Environmental Assessment Office. 1997a. "Salmon Aquaculture Review: Volume 1 - Part C. Chapter 2. The Salmon Aquaculture Industry." Electronic database accessed on March 17, 2003 at http://www.intrafish.com/laws-and-regulations/report_bc/v1chp2.htm

BC Environmental Assessment Office. 1997b. "Salmon Aquaculture Review Final Report." Electronic database accessed on January 28, 2003 at http://www.intrafish.com/laws-and-regulations/report_bc/

BC Environmental Assessment Office. 1997c. "Salmon Aquaculture Review: Volume 1 – Part D. Chapter 4. Salmon Farm Siting." Electronic database accessed on March 14, 2003 at http://www.intrafish.com/laws-and-regulations/report_bc/v1chp4.htm

BC Environmental Assessment Office. 1997d. "Salmon Aquaculture Review: Volume 4 – Part 1. Social Impacts." Electronic database accessed on March 14, 2003 at http://www.intrafish.com/laws-and-regulations/report_bc/v4iv.htm

BC Environmental Assessment Office. 1997e. "Salmon Aquaculture Review: Summary of First Nations' Position Regarding Fish Farming." Electronic database accessed on March 14, 2003 at http://www.intrafish.com/laws-and-regulations/report_bc/v2chp6.htm

BC Ministry of Agriculture, Food and Fisheries. 2003a. "Fisheries Statistics: Aquaculture." Electronic database accessed on February 28, 2003 at http://www.agf.gov.bc.ca/fish_stats/statistics-aqua.htm

BC Ministry of Agriculture, Food and Fisheries. 2003b. "Aquaculture Tenure List." Excel database. (March). Victoria, BC.

BC Ministry of Agriculture, Food and Fisheries. 2003c. "Fisheries and Aquaculture: New Technology Development." Electronic database accessed on June 2, 2003 at http://www.agf.gov.bc.ca/fisheries/technology/new_tech.htm

BC Ministry of Agriculture, Food, and Fisheries. 2002a. "2001/02 Annual report: A new Era Update." Victoria, BC.

BC Ministry of Agriculture, Food and Fisheries. 2002b. "New Standards Allow Sustainable Growth in Aquaculture." Press Release. Victoria, BC.

BC Ministry of Finance and Corporate Relations. 2002a. "British Columbia's Fisheries & Aquaculture Sector." (September). Victoria, BC.

BC Ministry of Finance and Corporate Relations. 2002b. "British Columbia Financial and Economic Review: 2001." 61st Edition. Victoria, BC.

BC Ministry of Finance and Corporate Relations. 2001a. "British Columbia's Fisheries & Aquaculture Sector." (May). Victoria, BC.

BC Ministry of Finance and Corporate Relations. 2001b. "BC Fish Products and Seafood Industry in the 1990s." Victoria, BC.

BC Ministry of Water, Land and Air Protection. 2002. "Marine Salmon Farming Compliance Report." Electronic database accessed on March 11, 2003 from: http://wlapwww.gov.bc.ca/vir/cos/aquarpt5.htm

Bjordal, Kjell. 2001. "At the cutting edge." *Perspective*. EWOS. No. 3.

Blythman, Joanna. 2001. "Salmon farmers in for a grill." *The Sunday Herald*. (March 11). Glasgow.

Centre for the Study of Living Standards. 2003. "Productivity Trends in Natural Resources Industries in Canada." Prepared for Natural Resources Canada. Ottawa, Ontario.

Cermaq ASA. 2002. "Annual Report 2001." Oslo, Norway.

Clarke, C. 1999. "Observations on sea lice in a SEA System floating bag and a conventional pen." *Aquaculture Update*. Vol. 86. (June 2). Pacific Biological Station. Nanaimo, BC.

Coopers & Lybrand Consulting. 1998. "Economic Potential of the British Columbia Aquaculture Industry." Prepared for Western Economic Diversification Canada. (July).

David W. Ellis & Associates. 1996. "Net Loss: The Salmon Netcage Industry in British Columbia." Prepared for the David Suzuki Foundation. (October). Vancouver, BC.

Department of Fisheries and Oceans. 2003. "Annual aboriginal catch totals by species." Excel database. DFO: Information Management, Corporate Services – Pacific Region. Vancouver, BC.

Department of Fisheries and Oceans. 2002. "Salmon—Pacific Region: Aquaculture." Electronic database accessed on June 16, 2003 at http://www.pac.dfo-mpo.gc.ca/ops/fm/Salmon/aquacult.htm

Department of Fisheries and Oceans. 2001. "Backgrounder: DFO and the environmentally sustainable development of Canada's aquaculture industry." (September 25). Government of Canada. Ottawa, Ontario.

Department of Fisheries and Oceans. 1999. "1999 Fact Sheet." DFO, Pacific Region.

Egan, David. 2001. "Salmon Farming Overview: 2000." Presentation to the BC Salmon Farmers Association AGM. (July 5). Campbell River, BC.

Fleming, Ian A., Kjetil Hindar, Ingrid B. Mjolnerod, Bror Jonsson, Torveig Balstad, and Anders Lamberg. 2000. Lifetime success and interactions of farm salmon invading a native population. *Proceedings of the Royal Society of London (B)*. Vol. 267: p. 1517-1523.

Folke, C., N. Kautsky, N. Berg, A. Jansson, and M. Troell. 1998. The ecological footprint concept for sustainable seafood production: A review. *Ecological Applications*. Vol. 8 (Suppl. 1): p. S63-S71.

Folke, C., N. Kautsky, and M. Troell. 1997. Salmon Farming in Context: Response to Black et al. *Journal of Environmental Management*. Vol. 50: p. 95-103.

Folke, C., N. Kautsky, and M. Troell. 1994. The costs of eutrophication from salmon farming: Implications for policy. *Journal of Environmental Management*. Vol. 40: p. 173-182.

Fong, Petti. 2003. Pesticide scares prawn fishermen: Fisheries minister Stan Hagen has ordered an application for SLICE to combat sea lice in fish farms." *Vancouver Sun*. (February 28). Vancouver.

Food and Agriculture Organization of the United Nations. Date not provided. "Healthy Tasty and Cheap: FAO Encourages Peruvians to Eat Anchovies."

Future SEA Technologies. 2003. "Sustained Environment Aquaculture." Electronic database accessed on June 2, 2003 at http://www.futuresea.com.

Future SEA Technologies. Date not provided. "Operational Cost/Benefit Comparison with Conventional Net Cage Fish Farming."

G3 Consulting Ltd. 2000. "Salmon Aquaculture Waste Management Review and Update." Prepared for: BC Ministry of Environment, Lands and Parks. Burnaby, BC.

Gallaugher, Patricia and Craig Orr. 2000. "Aquaculture and the Protection of Salmon." Proceedings from Speaking for the Salmon workshop, held at Simon Fraser University. (July). Burnaby, BC.

George Weston Ltd. 2002. "Annual Report 2001: On the Rise."

Gislason, G.S. 1998. "Fishing Communities in Transition." Prepared for the Department of Fisheries and Oceans, Government of Canada.

Government of British Columbia. 2003. "Transcript of the Open Cabinet Meeting." Executive Council: March 14, 2003. Electronic database obtained on March 20, 2003 at http://www.gov.bc.ca/prem/down/tran/open_cabinet_meeting_march_14_2003.htm

Hansard. 1990. "Joint Meeting, Norwegian and Canadian Standing Committees of the Environment." Standing Committee of the Environment, House of Commons. (September 12). p. 53-27 to 53-32.

Hardy, Ronald W., Dave A. Higgs, Santosh P. Lall, Albert G.J. Tacon. 2001. "Alternative Dietary Protein Sources for Sustainable Production of Salmonids." (May31).

Highlands and Islands Enterprise. 1999. "Economic Impacts of Salmon Farming." (July). Inverness, Scotland.

Hoyt, Erich. 2002. "Whale watching 2001: Worldwide Tourism Numbers, Expenditures, and Expanding Socioeconomic Benefits." Prepared for International Fund for Animal Welfare. Yarmouth Port, Mass.

InterVISTAS Consulting Inc. 2001. "Port Vancouver Economic Impact Study." Prepared for the Vancouver Port Authority. (August). Vancouver.

Intrafish. 2003. "Millions lost, harvested early in PNA disease outbreak." (March 5).

Klein, Ross. 2002. Left In Its Wake. *Alternatives Journal*. Vol. 28, #4: p. 24-27.

Ladd, Gary, Victor Stephen, and Linda Stevens. 2002. The Abacus Project: establishing the risk of recreational scuba death and decompression illness. *South Pacific Underwater Medicine Society (SPUMS) Journal*. Vol. 32, #3: p. 124-128.

Lane, David. 2002. "Status of the 1997 Salmon Aquaculture Review Recommendations." T. Buck Suzuki Environmental Foundation. (October).

Leggatt, Stuart M. 2001. "Clear Choices, Clean Waters: The Leggatt Inquiry into Salmon Farming in British Columbia." (November).

Luce, Rick. 2002. "Alternative Technologies in Aquaculture." Presentation at the BC Aboriginal Fisheries Commission Fish Farming and the Environment Summit. (September 26). Waututh Nation Community Centre, North Vancouver, BC.

Mariculture Systems. 2003. "SARGO Fin Farms." Electronic database accessed on June 2, 2003 at http://www.sargo.net.

Mariculture Systems. 2002. "Sustainable Closed Containment Systems for Aquaculture." (July).

Miller, Kathleen A., Gordon R. Munro, Ted L. McDorman, Robert McKelvey, and Peter Tyedmers.

2001. The 1999 Pacific Salmon Agreement: A Sustainable Solution? *Canadian-American Public Policy*. Vol. 47: p. 1-66.

Morton, A.B. and J. Volpe. 2002. A Description of Escaped Farmed Atlantic Salmon *Salmo salar* Captures and Their Characteristics in One Pacific Salmon Fishery Area in British Columbia, Canada, in 2000. *Alaska Fisheries Research Bulletin*. Vol. 9(2): p. 102–110.

Naylor, Rosamond L., Rebecca J. Golburg, Jurgenne Primavera, Nils Kautsky, Malcolm Beveridge, Jason Clay, Carl Folke, Jane Lubchenco, Harold Mooney, and Max Troell. 2000. Effect of aquaculture on world fish supplies. *Nature*. Vol. 405: p. 1017-1024.

Naylor, Rosamond L., Rebecca J. Golburg, Harold Mooney, Malcolm Beveridge, Jason Clay, Carl Folke, Nils Kautsky, Jane Lubchenco, Jurgenne Primavera, and M. Williams. 1998. Nature's subsidies to shrimp and salmon farming. *Science*. Vol. 282: p. 883-884.

New Brunswick Department of Fisheries and Aquaculture. 1999. "1998-1999: Annual Report." (October). Fredericton, New Brunswick.

Norway Directorate of Fisheries. 2001. "Key Figures from Norwegian Aquaculture Industry: 2000." Department of Aquaculture.

Nutreco. 2002. "Annual Report 2001."

Pacific Fisheries Resource Conservation Council. 2002. "2002 Advisory: The Protection of Broughton Archipelago Pink Salmon Stocks." Report to the Minister of Fisheries and Oceans and the BC Minister of Agriculture, Food and Fisheries. (November).

Pan Fish 2003a. "Pan Fish Investors: Key Figures." Electronic database accessed on February 5, 2003 at http://www.panfish.com/investors/keyfigures

Pan Fish. 2003b. "Pan Fish Investors: Shareholders in Pan Fish as of 24.01.03." Electronic database accessed on February 5, 2003 at http://www.panfish.com/investors/shares/shareholderstop.html

Pauly, Daniel, Villy Christensen, Sylvie Guenette, Tony J. Pitcher, U. Rashid Sumaila, Carl J. Walters, R. Watson, and Dirk Zeller. 2002. Towards sustainability in world fisheries. *Nature*. Vol. 418: p. 689-695.

Reimchen, Tom. 2001. Salmon nutrients, nitrogen isotopes and coastal forests. *Ecoforestry*. Vol. 3: p. 13-16.

Rose, Chris. 2002. "Future looks fine on floating ships." *Vancouver Sun*. (May 27). p. D4.

Standing Senate Committee on Fisheries. 2001. "Aquaculture in Canada's Atlantic and Pacific Regions." (June).

Statistics Canada. 2002a. "The Daily: Provincial Gross Domestic Product." (April 22). Ottawa, Ontario.

Statistics Canada. 2002b. "Aquaculture Statistics, 2001." (October). Ottawa, Ontario.

Stolt-Nielson S. A. 2002. "Stolt-Nielson S.A. Annual Report 2001." London, England.

Stolt Sea Farm. 2003. "Stolt Sea Farm at-a-Glance." Electronic database accessed on January 29, 2003 at http://www.stoltseafarm.com/company_information_intro.asp

Theodore, Terri. 2003. "Federal Fisheries department launches plan to protect BC pink salmon." (February 20). Canadian Press.

Tourism BC. 2003. "The Value of Tourism: Building Tourism with Insight." (February).

Tuominen, Taija-Riitta and Maren Esmark. 2003. "Food for Thought: The Use of Marine Resources in Fish Feed." WWF-Norway. (February).

Tyedmers, Peter. 2000. "Salmon and Sustainability: The Biophysical Cost of Producing Salmon Through the Commercial Salmon Fishery and the Intensive Salmon Culture Industry." PhD dissertation. University of British Columbia: Vancouver, BC.

van Dongen, John. 2002. "Why BC Lifted the Moratorium on Fish Farms." Press Release, Ministry of Agriculture, Food, and Fisheries, Province of BC. (September 26).

Volpe, John. 2001a. "Testing assumptions associated with farm-escaped Atlantic salmon in British Columbia." Presentation to the Leggatt Inquiry into Salmon Farming in British Columbia.

Volpe, John. 2001b. "Super un-Natural: Atlantic Salmon in BC Waters." David Suzuki Foundation. Vancouver, BC.

Waddy, S.L., L.E. Burridge, M.N. Hamilton, S.M. Mercer, D.E. Aiken, and K. Haya. 2002. Emamectin benzoate induces molting in American lobster, *Homarus americanus*. *Canadian Journal of Fisheries and Aquatic Sciences*. Vol. 59: p. 1096-1099.

Wavelength Magazine. 2002. Vol. 12. #2.

Wavelength Magazine. 1997. Vol. 7. #2.

Whale Watch Operators Association—Northwest. 2003. "Best Practices Guidelines—2003." Electronic database accessed on June 17, 2003 at http://www.nwwhalewatchers.org/guidelines.html

Wilson, Alan. 1997. "An Inescapable Conflict? Marine Ecotourism and Salmon Farming." Submission to the Salmon Aquaculture Review Committee. (January).

Wilson, Jodie. 2000. "Sustainable Management of Ecotourism: Whale Watching in Tofino, British Columbia: A Case Study." Master's thesis. University of Victoria: Victoria, BC.

Wilson, Carla. 2003. "Salmon virus costs fish farms millions." *Victoria Times Colonist*. (March 5).

World Tourism Organization. 1997. "Tourism 2020 Vision: Executive Summary." Madrid, Spain.

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