CHAPTER 6

Fish Farms and Neoliberalism: Salmon Aquaculture in British Columbia

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INTRODUCTION

Industrial salmon aquaculture was introduced to British Columbia on the basis of three promises: (1) to provide jobs and resources to coastal communities—especially First Nations—that had been hard hit by the downturn in the province's forest and fishing industries; (2) to help to feed the world, by delivering on the potential to use the oceans to farm fish to provide protein-rich food; and (3) to relieve pressure on increasingly threatened coastal salmon stocks. Salmon aquaculture thus looked to be an ideal contribution to addressing important global problems. Since its introduction in 1980, however, salmon aquaculture has largely failed to deliver on its promises, spawning an increasingly vocal campaign by environmental groups defining it as a problem in its own right.

These groups have drawn attention to many environmental and social issues. A prominent issue has been the negative impact of escaped non-native Atlantic salmon on wild populations (Volpe, Anholt, and Glickman 2001; Fleming et al. 2000). Attention has also been drawn both to increasing parasitic infestations that have threatened not only farmed fish but also wild stocks (Krkošek, Lewis, and Volpe 2005; Morton, Routledge, and Williams 2005) and to the farms' use of antibiotics, pesticides, and fungicides, which have potential negative impacts on both

human health and the surrounding ecosystem (Hites, Foran, Carpenter et al. 2004; Hites, Foran, Schwager et al. 2004). Further concerns include the impact of the farms' waste—both fecal and chemical—on the ocean floor (Cabello 2004, 2006, 2007), the impact on ecosystems where food for the farmed fish is harvested (Deutsch et al. 2007), and the failure to deliver on local jobs or support for local economies (Marshall 2003). Amid an increasingly recognized crisis in the health of wild salmon stocks, even the province of British Columbia's own commission examining the issue of salmon aquaculture has expressed skepticism that open-pen salmon aquaculture can ever be made sustainable.[1] Nonetheless, as of 2007, the industry continues to spread north along the Pacific coast to Prince Rupert.

In this chapter, we seek to explain both why the industry has failed to deliver on its promises and the broader implications of this failure for efforts to address not only the environmental problems created by the salmon aquaculture industry but also the broader global problems that salmon aquaculture was introduced to remedy. Put simply, our argument is that the ecological issues that so often define the salmon farming controversy in BC and elsewhere are in fact physical manifestations of socioeconomic pressures. The salmon aquaculture industry has developed as it has because of the economic necessities imposed by producing salmon for a global marketplace. Efforts to conserve profitability in a globalized, commodity-based market have resulted in simply transferring the costs of production to associated ecological and social systems. The problematic impacts of the industry are, in other words, the *local* manifestations of a *globally* integrated market; any related policy debates take place within this decidedly glocal context. Indeed, the apparent reluctance on the part of political authorities to address these impacts arises from a structural political bind that can also be traced to the global organization of the economy: regulating the industry to address these local problems would render it globally uncompetitive, thus threatening the economic welfare of those coastal communities (and voters) dependent on the industry. This situation poses a significant challenge for any democratic government.

The issue of salmon aquaculture in BC is thus a rich illustration of the underlying challenges faced by efforts to respond to many environmental problems today: although these problems often manifest locally, affecting specific ecosystems and populations, the drivers of the problems are frequently global, appearing to be beyond the control of the relevant governance institutions. Governments are thus left struggling to address ecological problems while ignoring the underlying drivers, which amounts to treating the symptoms but ignoring the disease. The implications of addressing the disease are considered in the final section of the chapter.

Before we begin, though, a caveat: the analysis we develop is specific to salmon aquaculture in British Columbia, and although the underlying argument about socioeconomic and political drivers of environmental problems has much wider relevance, its application to other forms of aquaculture at other sites must proceed

with care. Many of the ecological problems we have drawn attention to in the BC context will not appear under other circumstances: aquaculture has a long history, and under some conditions has been sustainable (Costa-Pierce 2002). Sustainable aquaculture definitely has a role to play in global and domestic food systems and food security. However, any aquaculture operation subject to the socioeconomic and political conditions we describe here will quickly be forced to function in such a way that ecological externalities will rapidly render it unsustainable.

WHAT IS THE ISSUE?

Development of the Industry

Perhaps the most important global context for the development of the salmon aquaculture industry has been the call for a "blue revolution" to help meet the nutritional needs of a growing global population. In the middle of the last century, many populations around the world were food deficient. The situation became acute when food demands rose sharply in the baby-boom years following World War II, and most arable land was already under cultivation. An array of technical advances (artificial fertilizers, pesticides and herbicides, irrigation, artificial selection) combined to produce high-yield crop strains genetically capable of responding to the new production model of intense agrichemical and irrigation input (see Mulligan, chapter 3). These advances, combined with the adoption of increased mechanization and energy use on farms, resulted in unprecedented increases of production per area. When combined, these technologies enabled the large-scale conversion of oil and water into grain. This so-called "green revolution" ushered in the age of industrial agriculture, achieving minimal sustenance for growing populations despite an overall decline in the number of farmers working the land.

The production capacity of these now conventional technologies, however, is being exhausted, and history is poised to repeat as the global human population is increasingly food insecure. Production capacity of farmland has plateaued and in many cases has declined, reflecting degradation of the land's production capacity by green revolution industrialization (Tilman et al. 2002). The agribusiness-funded scientific community has predictably responded by suggesting that a new generation of advances—for example, GMOs (genetically modified organisms)—must be implemented if widespread famine is to be avoided (US National Academy of Sciences 2000). Unreported in such technocentric analyses is that today's global agriculture produces more than adequate supplies to feed every person on earth a 2,500-calorie daily ration. Despite this apparent abundance, 60 million people die annually as a direct result of insufficient access to food. To put a finer point on the troubling ethical corollary that is raised, the same number of people could be adequately fed, thus ending the crisis, by the grain saved if Americans reduced their intake of meat by 10 percent (Landis 2004). Today, as in the past, the critical

issue for much of the world's poor is not a shortfall of production but access to otherwise abundant food. Nonetheless, the complex and nuanced drivers responsible for decreasing global food security are often ignored, resulting in simplistic prescriptions: hungry people will be fed if we can just produce more food.

Along with assorted techno-fixes, such as GMOs, aquaculture—the farming of marine and freshwater species—is now being promoted as a potential solution to meet the perceived shortfall in demand for protein. Aquaculture has an ancient history beginning in China during the Zhou dynasty, approximately 2,300 years ago (Li 1994). Within 200 years, the practice of polyculture (simultaneous cultivation of multiple, synergistic species) had become widely established and remains a fixture to this day in China and across much of the world. In contrast, modern industrial aquaculture is characterized by its reliance on external inputs of energy toward the production of an export crop with the primary objective of generating profit, not food.

The potential protein production capacity of aquaculture cannot, however, be ignored, and many are now calling for a "blue revolution"—the application of new technologies to repeat, in the world's oceans, the "successes" of the green revolution on land. Proponents cite three major objectives of the blue revolution: (1) to increase food security for those currently or soon to be in deficit; (2) to relieve harvest pressure on wild fish stocks; and (3) to provide economic opportunities for struggling communities (Skladany and Harris 1995). In western industrial states, the development of aquaculture is based exclusively on intensive production models that favour salmon and shrimp operations over alternative, more sustainable lower-trophic-level species and more balanced production models, such as polyculture (Skladany and Harris 1995).

In fact, the tenets of the blue revolution are now fundamental objectives codified within the US national food policy. The US Department of Commerce (the US government department that oversees agriculture in all its forms) has recently set ambitious objectives to ensure the blue revolution will occur in US waters. Among these goals are to increase the value of domestic aquaculture production from the present $900 million annually to $5 billion and to increase exports of US aquaculture goods and services from the present value of $500 million annually to $2.5 billion (US Department of Commerce 2003) .

The blue revolution has clearly begun, but it differs from its predecessor, the green revolution, in two important ways. First, the green revolution's success was based on innovations that enabled greater production without increasing the footprint of operation. Although some improvements in efficiency are evident in the blue revolution, the majority of its increasing production is due simply to the expansion of the physical area used for operations. Second, the green revolution focused on grain (primarily carbohydrate) production, the backbone of the human diet. In contrast, protein is the product of the blue revolution; though protein is

obviously an important dietary component, its contribution is very much secondary to carbohydrates in terms of feeding food-deficient populations.

The dominant case history that frames the development of the blue revolution is salmon farming. First raised in Norway in the 1970s, farmed (Atlantic) salmon has grown to be a dominant global aquaculture product. This process was not without its setbacks. After a decade of meteoric growth, the effects of the industry began to be seen in Norwegian wild salmon populations. The detrimental effects of hybridization between wild and farm-escaped salmon have been well documented (Fleming et al. 2000); however, the best documented effects to date have been those involving disease and parasite transfers among wild and farmed fish. One of the most alarming events occurred in the early 1980s, when farm-borne epidemics of the potentially fatal parasite *Gyrodactylus* devastated wild fish populations. Fuelled by public outrage, the ensuing Norwegian government crackdown on the industry resulted in its major reconfiguration. Many operators adapted to the regulations, while others began looking for alternative venues for their operations. Concurrently, in September 1984, Brian Mulroney was elected prime minister of Canada. High on his agenda was the replacement of the *Foreign Investment Review Act* with the *Investment Canada Act.* The new legislation essentially removed the criterion that Canadian citizens hold majority ownership of Canadian registered companies.

And so the stage was set for the migration of Norwegian salmon farm companies to Canada. At home in Europe, Norwegian companies were being compelled to conform to strict (and in some cases costly) new operating procedures, whereas the Canadian federal government threw open the door for them to operate unfettered in Canada. The British Columbia coastline, in particular, provided exemplary physical and biological habitat required by the industry. Meanwhile, coastal British Columbia was starting to experience both the early stages of a downturn in the forest industry and some concern about the abundance of wild salmon stocks. Many coastal communities were supported almost entirely by a combination of forestry and fishing, a situation that rang alarm bells in the provincial government. Thus, a new industry that could support these communities was particularly welcome, making regulators positively predisposed to the arrival of the Norwegians to help solidify the fledgling BC salmon farming industry.

At the time, the BC aquaculture industry was based exclusively on farming Pacific (*Oncorhynchus*) salmon species. The influx of Norwegian operators also meant the importation of the Norwegian species of choice—Atlantic salmon (*Salmo salar*). The Norwegians had spent unprecedented resources establishing an international export market for farmed Atlantic salmon, and they were not about to undermine that success by introducing a novel (in the eyes of their major markets at that time) product in the form of farmed Pacific salmon. The transition in British Columbia's aquaculture industry from Pacific salmon to Atlantic salmon

was swift (see figure 6.1) and rang the first alarm bells for observers concerned about the impact of escaped Atlantic salmon on wild populations. With the exception of some isolated objections lodged within the BC Ministry of Environment, little resistance was voiced to this paradigm shift in the BC industry.

As of 2006 (the most recent data available), Atlantic salmon comprises 76 percent of farmed salmon in BC (chinook salmon and some coho salmon, both Pacific salmon species, comprise the balance) (British Columbia Ministry of Agriculture and Lands 2007). The influx of Norwegian salmon farms not only changed the dominant species being farmed but it altered the production volume. In 1988, during the early days of the industrialization process, BC farmers produced only 80,000 kilograms of Atlantic salmon; in 2002, with the industry in full blush, production exceeded 71,600 metric tonnes (see figure 6.2). Today, BC is the fourth-largest producer of Atlantic salmon in the world, behind Chile, Norway, and Scotland. Although BC's industry has shown impressive growth over the past two decades, industry growth in competing countries has been even greater. For example, in 1990, Chile did not produce a single Atlantic salmon, but in 2006 the Chileans produced 485,000 metric tonnes.

What Is the Problem?

Perhaps the most important impact of the tremendous growth of farmed salmon production has been the erosion of the value of salmon on the global marketplace. The massive global increase in farmed salmon production resulted in falling wholesale salmon prices, for both farmed *and* wild salmon. The immediate con-

Figure 6.1 Production of Farmed Atlantic and Pacific (Chinook and Coho) Salmon in British Columbia, 1980–2006

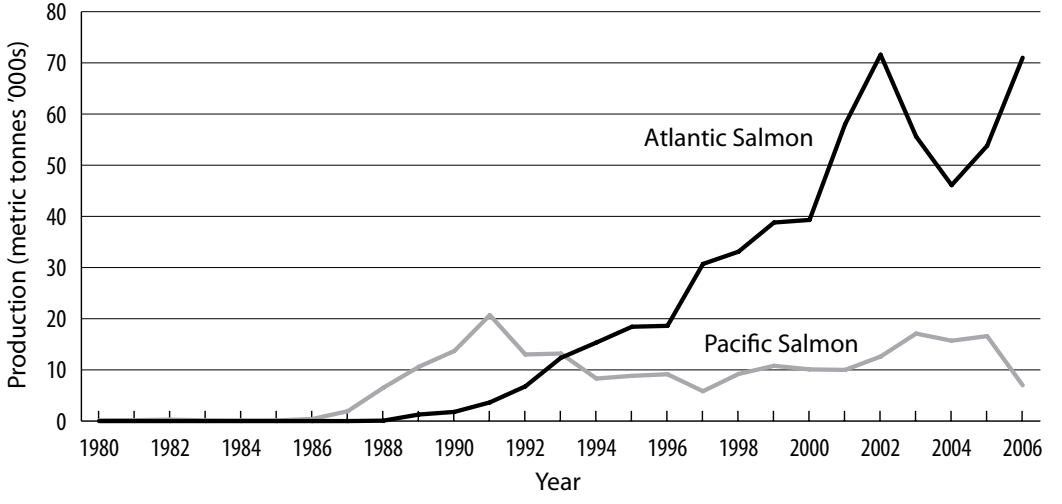

Figure 6.2 Value and Production of Pacific Salmon Versus Farmed Atlantic Salmon, 1988 and 2002

Species	1988 Production (metric tonnes '000s)	2002 Production (metric tonnes '000s)	Change	1988 Value[a] ($/kilogram)	2002 Value ($/kilogram)	Change
Chinook	5.92	1.69	–71%	7.40	4.19	–43%
Chum	30.30	12.35	–59%	2.73	0.49	–82%
Coho	7.08	0.47	–93%	5.33	2.34	–56%
Pink	32.22	8.61	–73%	1.53	0.33	–78%
Sockeye	11.94	10.15	–15%	8.07	3.97	–51%
Farmed Atlantic	0.08	71,600	+895,000×	7.40	3.33	–55%

[a] For Pacific salmon species (chinook, chum, coho, pink, and sockeye), value is the ex-vessel value, the amount paid to fishers for their raw catch. For farm Atlantic salmon, the value is the gate value, the unprocessed value of farmed fish, excluding costs of packaging or transporting the fish to the point of sale.

sumer benefit was clear. But from the perspective of producers, particularly those in BC whose business plans had been developed in the heyday of salmon prices, the new reality of a globalized salmon commodity market significantly challenged their fiscal viability.

From 1988 to 2002, the wholesale value of BC farm salmon dropped 55 percent. To overcome this precipitous decline, producers in BC and elsewhere were forced to adopt ever-increasing economies of scale, their strategy being that to preserve a stable profit margin in a market of diminishing unit value, they needed to produce more units, as cheaply as possible. Production in 2002 had increased 895,000 times over that of 1988 (see figure 6.2). Thus, the dramatic decline in the unit value of farm salmon was more than compensated for by the rise in production by six orders of magnitude. BC is by no means unique. The same scenario has been played out in all salmon farming nations, with each company in competition with all others to produce the most salmon for the least cost.

The competitive profile of the industry is complicated by the fact that the vast majority of global production is generated by relatively few multinational companies, each operating in many countries. These companies can pit one region against another in their efforts to reduce costs. It is this economic reality from which most issues currently associated with industrial aquaculture arise; the globalization of salmon has transformed this fish from a seasonal, high-value delicacy to a low-value commodity available year-round that comes with significant environmental—and therefore public relations—implications. Thus, the underlying problem: as each company, in each region, has sought to lower production costs, a constant effort emerges to intensify production and reduce any inputs that add

expense, such as labour or transportation, which in turn increasingly externalizes the costs of production, forcing natural or social systems to bear these costs.

The high-profile issue of the predominance of sea lice on salmon farms and the resultant increased infection of juvenile wild salmon exemplify how the globalization of salmon production can generate serious localized environmental impacts. In BC, the term *sea lice* refers to two ectoparasitic crustaceans: *Lepeophtheirus salmonis* and *Caligus clemensi*. Both species occur naturally in coastal BC waters, and both are known to infect wild and farmed salmon in BC. The former is a salmon specialist and the latter a generalist, known to also infect numerous non-salmonid fish species.

The lifecycle of both types of sea lice is generally the same: fertilized eggs (up to many hundred per female) are attached to the female who is in turn attached to an adult salmon in the ocean. In time, the eggs hatch into free-swimming nauplii larvae, which grow and advance through copepodid, chalimus, and finally adult stages. Relatively early in this progression, the young sea louse must find a host salmon (or perhaps one of a short list of other species in the case of *C. clemensi*). Given that the louse is free-floating in the Pacific Ocean, the chances of literally running into a prospective host (not to mention successfully attaching) are extraordinarily slim. Therefore, natural sea lice abundances tend to be unsurprisingly low. This scenario changes dramatically when salmon farms enter the equation.

Salmon farms, by virtue of being home to as many as 1.5 million salmon restricted to cages in a 1-hectare (surface area) site provide a high chance of success for any nauplii lucky enough to float through. Eventually such nauplii attach to their host, mature, and produce nauplii of their own. However, now the chances of successfully finding a host are very, very good—resulting in more farm-salmon infections—and the cycle repeats itself until, if left unchecked, epidemic conditions rapidly set in. Although this situation is clearly bad news for the farm salmon, how does it affect wild salmon?

Salmon farms are constructed in areas that, among other things, provide shelter from the open ocean (and thus from storms and other risks of exposure). For this reason, the heads of bays and fjords are particularly attractive; but these locations are where the outlets of salmon-bearing rivers are also found. In the spring and early summer, when young wild salmon smolts migrate from their home rivers to the ocean, they do so in the absence of adult salmon, which are feeding offshore. Thus, under natural conditions, the absence of hosts in the inshore areas keeps juvenile lice abundance very low, allowing juvenile salmon to pass through with little impact. However, the situation can change dramatically if a salmon farm is located on the smolts' migration path.

Research in the Broughton Archipelago has shown that an average farm can amplify local sea lice abundance 33,000 times over ambient levels, resulting in an infection rate of more than 70 times what would normally occur. Further, this

highly magnified farm "lice footprint" was detectable 30 kilometres from the salmon farm under investigation (Krkošek, Lewis, and Volpe 2005), considerably beyond the "organic footprint" (Parrish et al. 2006, 33). The lice are spread even further as infected juvenile salmon continue on their migration to sea. They may cover considerable distances before they succumb to their infection, as most eventually will, and all the while the once juvenile sea lice attached to and feeding on them grow and mature into reproductive adults. By the time these sea lice are ready to reproduce, they may have travelled 20 or 30 kilometres from their originating farm. In the interim, new juvenile salmon, having not been exposed to a salmon farm, have joined the migrating school from other rivers along the migration corridor. But the now mature sea lice, having been picked up as nauplii 30 kilometres away, are now producing their own eggs and nauplii, and those young smolts recently joining the migration become infected. Krkošek, Lewis, and Volpe (2005) documented this phenomenon and witnessed how, through this process, a single farm infected otherwise unexposed salmon smolts more than 30 kilometres distant. These fish, in turn, extended the original farm's sea lice footprint to more than 70 kilometres (the limit of the research survey). Dynamics of this nature are widely accepted as being responsible for spectacular collapses of Broughton Archipelago pink and chum salmon runs (Krkošek, Lewis, and Volpe 2005; Morton, Routledge, and Williams 2005).

These data are no surprise to anyone familiar with either fundamental epidemiology or the history of salmon aquaculture. Clustering hosts into exceptionally high densities and exposing them to contagion invites epidemics. Even if this theoretical expectation is not compelling, we need only look at the experiences of other jurisdictions that have gone before. Indeed, a very similar series of events occurring in Norway previously, and referred to above, precipitated the rapid expansion of salmon aquaculture in BC. Thus, we should not be surprised to see history repeating itself, particularly given that many of the founders of BC's current industry are those who resisted Norwegian government-imposed reform in the aftermath of the *Gyrodactylus* incidents there.

If these events were predictable, then why were they not avoided, or at least remedied after they had been identified? On the surface, the answer appears complex and includes, among other reasons, multiscale ecological dynamics and aggressive political agendas. However, the actual underlying explanation is much simpler—sea lice epidemics (and other environmental issues around salmon net pens) are fated to occur and reoccur as a result of the global expansion and organization of the salmon industry. The most desired salmon farming areas on the BC coast are in waters where the adjacent land is wilderness (typical of most of the coast). This location is key, because the salmon farms have no road access: all materials coming and going (feed, crew, product, waste, equipment) are conveyed by marine transport, an exceptionally expensive option relative to regular truck

transport. (In contrast, on the developed coastlines of Norway, Scotland, and much of Chile, less expensive truck transport is used to a much greater degree.) The reliance of the BC industry on marine transport represents a significant increase in production costs compared with those incurred by the international competitors, but BC producers cannot pass this cost on to consumers without losing market share. Therefore, transportation costs are added to the nominal cost of farming salmon in BC.

The rapid escalation of global farm salmon production has resulted in a worldwide glut of supply, diminishing further the product value for BC producers and resulting in a wide-scale transition of salmon from high-value seasonal delicacy to low-value common commodity. The new reality of the global salmon commodity market tightly constrains options for adding product value in BC. Thus, the only hope for maintaining economic solvency is adopting greater economies of scale and further cutting production costs.

This clash between environmental responsibility and economic viability represents a general pattern repeatedly seen across the array of issues associated with industrial-scale salmon aquaculture. For example, as the value of farmed salmon erodes, the nominal per capita cost of an Atlantic salmon escapee also diminishes. The incentive for costly net maintenance declines as leaky net pens become more cost-effective—revenue lost through escapes becomes less than the labour and material costs consumed to retain them. Social dynamics are also affected by product value erosion. Labour is the second-largest operating expenditure for salmon farms after feed. Falling salmon prices necessitate greater automation of the production system to trim costs. From 1997 to 2003, BC farmed-salmon production increased approximately 100 percent, but on a per-unit production basis, wages, and salaries dropped 29 percent across the BC aquaculture sector (Cox 2005). Diminishing returns to coastal residents reduce the freedom to innovate and explore alternative production models, leaving only one option—intensifying industrialization.

Value erosion as a consequence of farm overproduction also sets in motion an analogous feedback process in the salmon capture fishery. From 1988 to 2002, the production of every salmon species in the BC capture sector declined between 15 percent and 71 percent. Contrary to the basic tenets of economic supply and demand, as the supply decreased so did its value, up to 82 percent as in the case of chum salmon (*Oncorhynchus keta*) (see figure 6.2). A simple analysis of catch values suggests fishermen today must harvest at a rate of up to five times that of 1988 to achieve an equivalent earning power.[2] Thus, as prices drop, fishing pressure must increase to preserve earning power. Further, each effort to increase the catch leads to an in investment in larger boats, more sophisticated electronic equipment, and so on, increasing the amount of fish that must be caught to absorb rising capital costs to remain competitive. Thus the pressure on stocks is amplified further

(Ludwig, Hilborn, and Walters 1993). Increased fishing pressure thus leads to smaller stocks, which results in increasing pressure to catch more fish, and the depensatory cycle is in motion—greatly amplified by the negative market effects of an overabundance of farmed salmon.

On the surface, a multinational salmon farming conglomerate and an Amazonian rancher do not have much in common. However both have little control over how they make their living. The contexts are dramatically different; the underlying driving processes are the same. Both are locked in a battle, not against competitors or restrictive government policy, but against a kind of mass psychosis so pervasive as to be iconic of modern societies: the myth of cheap.

"Cheap" salmon, or "cheap" beef in the case of the Amazonian rancher, is an abstraction. In fact, "cheap" does not exist. Costs are transferred at various points in the production chain, but do not disappear. The most damaging aspect of the industrial salmon-farming experience is the emergence of a consumer culture expecting that salmon should be available fresh year-round for the same price as factory-farmed chicken. And although such availability and low prices can be achieved, the price of these accomplishments is the massive economies of scale that demand significant ecological and social subsidies. These subsidies are not reflected in the retail price, but are costs just the same. Consumption of clean oxygenated water, removal of organic and other wastes by ocean currents, assimilation of escaped fish, and greatly amplified numbers of sea lice in the ecosystem are just the start of the real costs transferred to the environment and to society at large.

Salmon farmers, like everyone else, would like to see the need for these subsidies eliminated. However, the reality is that farmed salmon is now a low-value global commodity, and BC, relative to Norway or Chile, is an expensive place to farm salmon. In this way, the ecological issues that arise as a consequence of industrial salmon farming are symptoms of a larger and more profound problem: the underlying socioeconomic drivers that shape the salmon farming industry (and most others) relentlessly push it toward unsustainable practices. The global organization of the industry means that salmon produced in BC must compete in the marketplace with salmon sourced from places where it is less expensive to produce —because of regulatory structures, geography, labour costs, or any other of a range of factors. Thus, every effort is made within the industry to render it competitive; and each "cost-saving measure" carries its own range of ecological or social impacts, such as parasite infestations as a consequence of the siting of farms to reduce transportation costs, or increased mechanization of farms and thus reduced wages or job losses to reduce labour costs. If, despite these cost-saving measures, BC salmon aquaculture is simply unable to compete, the industry is in jeopardy, which in turn threatens a range of economic impacts. It is to these wider consequences that we turn next.

STAKEHOLDERS: WHAT IS AT STAKE, AND FOR WHOM?

The stakeholders in the emergence of salmon aquaculture are many, and by no means all are human. Perhaps the most obvious threat posed by salmon farming is to wild salmon stocks, indicating that one of the promises of the blue revolution —to reduce pressure on wild stocks—is far from being met. The pressure on wild stocks comes from two different directions, both discussed above. The first set of pressures arises from the intensification of farmed salmon production methods. With each intensification, the survival of wild stocks becomes more precarious: they must swim through more parasite-infested waters, compete with escaped Atlantic salmon for food and spawning habitat, and survive in oceans more contaminated with the wastes from fish farms. Any one of these challenges threatens the stocks, as seen in Norway, but the combination—especially when added to other strains on salmon stocks arising from habitat destruction and climate change—is contributing to at times catastrophic collapses in wild salmon runs.

The second set of pressures on wild stocks arises from the reduction in price for both wild and farmed salmon. Those attempting to make a living from fishing must now catch at least five times as many salmon as they did in 1988 to achieve the same income. This situation is occurring in the context of many salmon stocks already showing signs of stress—or indeed collapse—as a consequence of overfishing and habitat destruction. Thus, the fishing pressure on wild stocks steadily increases, as families dependent on fishing for their livelihoods must consistently urge governments to allow more intensive fishing. Or, as is increasingly the case, these smaller fishing boats simply cannot compete, and the fishing fleet becomes dominated by larger, industrial fleets.

Dramatic changes in wild salmon stocks in turn have enormous repercussions throughout the marine and terrestrial ecosystems linked by their lifecycles. As anyone who has stood next to a stream full of spawning salmon can attest, an incredible range of species depends upon the fall arrival of protein- and nutrient-rich salmon: from bears, wolves, and eagles, to insects and micro fauna (Ben-David, Hanley, and Schell 1998; Darimont, Reimchen, and Paquet 2003; Hocking and Reimchen 2006). Even riparian trees and plants benefit in important ways from the nutrients that seep into the ground from the carcasses of salmon dragged away from the stream and partially consumed (Bilby, Fransen, and Bisson 1996; Naiman et al. 2002). Salmon are thus considered to be a keystone species in aquatic habitats. Additionally, due to the wide diversity of animals that feed on adult salmon in the ocean, salmon are also considered to be a dominant species in marine ecosystems (Cedarholm et al. 2000). Not surprisingly dramatic changes in their numbers trigger a cascade of complex effects that fundamentally change how these ecosystems function (see, for example, Shiomoto et al. 1997).

However, the impacts of a decline in or loss of salmon stocks would also be felt in diverse ways within human communities. Most profoundly affected would be First Nations, who have relied on salmon for millennia, not only to provide vital nutrition but also as the focus for some of their most important cultural and spiritual practices (see Bocking, chapter 2). Salmon have sustained coastal First Nations and consequently have an appropriately central role in their societies, which is not only true historically but also characterizes the situation today. Commercial salmon fishing, for example, has been one of the only and most important sources of income for many First Nations in desperate need of economic development. As the price of wild salmon has declined, many First Nations fishers have been forced out of the industry, unable to compete with larger, corporate-controlled fishing fleets. In addition, what has sustained these communities historically, and what they look to now and in the future, is the wealth of their lands and resources. The cascading ecosystem impacts of a decline in salmon stocks would reverberate through their communities.

Some of the same impacts would be, and are being, felt in other coastal communities in BC. Many of these communities have been almost entirely dependent on resource extraction industries, primarily forestry and fishing. Both industries, although challenging and often dangerous, tended to provide well-paying incomes, providing, in some communities, a livelihood for several generations. As both industries have struggled through significant downturns in the past two decades, these communities have struggled against a loss of control over their personal and collective destinies. Many former fishers, accustomed to supporting their families comfortably, have found themselves out of work with no job opportunities in their home towns and few transferable job skills to offer on a wider labour market. Young people in the town, seeing the uncertainty in the industry, choose not to follow their parents, instead leaving to seek work elsewhere (Naylor, Eagle, and Smith 2003). And so, whole communities begin to shrivel and disappear, and with them the history and traditions of the place and industry are lost. In some sense, this evolution is nothing new for rural communities in BC: resource-based economies are often cyclical, and the west coast has certainly witnessed a long history of boom and bust fisheries, evidenced by disintegrating herring processing plants and their supporting towns scattered in remote locations along the coast.

Understandably then, a dramatic increase in fish farming appeared attractive to some of these communities. Two of the industry's key promises were jobs for rural communities and a relief from the pressure on wild stocks: in light of the economic crisis faced by these communities, many expressed strong support for an emerging aquaculture industry, including some First Nations (although others remained consistent in their resistance to salmon farming, concerned about the impact on wild stocks). Salmon farming has become a bitterly divisive issue, particularly in First Nations, but also in other coastal communities (Schreiber 2006).

This context also explains the provincial government's enthusiasm for the aquaculture industry: facing a crisis in the economic viability of BC's rural communities, fish farms appeared to be a perfect solution. The industry could be sited near existing communities, providing jobs and income in precisely the places they were needed. Supporting the development of the industry thus headed off strong waves of voter discontent, costly increases in social programs that would have been necessary to support these communities through a shift in economic foundations, and the making of unpopular decisions to allow these communities to whither away. What is more difficult to explain is why the government's enthusiasm for aquaculture has remained so strong, despite the industry's poor record on job creation[3] and environmental impact, but we will turn to these factors in greater detail below.

The final stakeholders are the companies that have invested in the development of the industry. Three companies operating in BC together control more than 90 percent of the annual farmed salmon production: Cermaq, Greig, and Marine Harvest. All are Norwegian-based multinationals, with well-developed aquaculture operations in other regions of the world, operating under a variety of subsidiary names in Canada and abroad.

What is the "status" of these multinationals as stakeholders? Although they are well invested in the aquaculture industry in the region and therefore stand to feel significant impacts of any changes, these effects would be primarily in the form of lost profits. However, as these companies operate now, they extract profits from the region, provide some relatively low-paid jobs, and contribute to the range of other impacts described above. Thus, although they are clearly considered stakeholders, what is at stake for them is significantly different from, although closely connected to, what is at stake for other stakeholders. Currently, multinational companies reap the vast majority of the benefits of the industry and take these benefits out of the region, whereas local communities experience both minimal benefits and a range of long-term and potentially devastating impacts. Although this situation does not mean companies have nothing to lose, we must keep in perspective where and how benefits and losses are experienced, both in the short and long term.

Thus, as is often the case in environmental conflicts, the array of stakeholders is diverse, and even more so is what is at stake for each. Crucially, though, at stake is not only whether salmon aquaculture will provide a viable future to its stakeholders and at what cost but extends to questions about who is benefiting—and who should benefit—from the rise of the industry. Also at stake are alternative possible futures: to what extent does the pursuit of salmon aquaculture itself potentially foreclose other possibilities, both positive and negative? Assessing this question requires that we consider the implications that range beyond the immediate stakeholders, and it is to this focus that we turn next.

INTERNATIONAL IMPLICATIONS

Of the international implications of the rise of salmon aquaculture introduced above, perhaps most obvious is the dramatic increase in availability of inexpensive salmon for consumers. No longer a seasonal delicacy, salmon is now widely available to consumers in diverse forms, from lox to steaks, patés to fillets. Although farmed salmon is not necessarily healthier than wild salmon (Hites, Foran, Carpenter et al. 2004; Hites, Foran, Schwager et al. 2004), compared with many other options, it is a healthier source of protein for consumers. However, as discussed above, this availability contributes little to addressing the problem of global hunger (Sachs 2007). The primary target for salmon products is consumers who are already generally consuming a high-protein diet.

The harvesting of wild fish (anchoveta, mackerel, and other small oily species) to produce the food necessary for the farmed salmon happens mostly in the waters off the coasts of Peru and Chile, in the so-called Peruvian upwelling zone. The increasing harvest of these stocks to feed the growing production of industrial-scale salmon (and shrimp, pigs, and chicken) is widely considered unsustainable (Pauly et al. 2002). Furthermore, because these same species are the basis of the food web in the upwelling zone, their mass removal jeopardizes regional fisheries and the viability of dependent human communities (Deligiannis 2000).

On the whole, then, much as an increase in the consumption of beef in the developed world is bad news for the hungry (because it redirects sources of badly needed carbohydrates toward cattle farming), an increase in farmed salmon, by depleting potential food sources, may add to the disparity between those who are well fed and those who go hungry. This suggestion is not to deny that protein from the sea will not or cannot be a vital part of addressing the challenge of global hunger, only to note that farming species such as salmon, which are carnivorous and thus high on the trophic level, may not be the most appropriate way to feed the hungry.

The second set of international implications rests in the potential impact of salmon farming on the global fisheries crisis. The two dynamics described above at a local level—the impact of the reduction of salmon prices on local fisheries and the impact of salmon farming on wild stocks and ecosystem resilience—are also operative on the international scale. That we face a crisis in global fisheries is well documented (Pauly et al. 1998; Myers and Worm 2003). Given the anticipated population growth and increases in prosperity, which are generally associated with a higher level of protein consumption, the pressure on these fish stocks is likely to increase. In this context, the dangers posed by salmon farming are relatively clear: although farmed salmon may in the short run provide a source of relatively inexpensive protein, this solution is fundamentally misleading. The appearance of "cheap" conceals the longer-term (and, ultimately, potentially devastating) impact

on ecosystem health and resilience and increases pressure on wild fisheries as they seek to compete, which, in turn, threatens to exacerbate the crisis in global fisheries. The third promise of salmon aquaculture was to provide opportunities for economic development in rural communities; however, as we've seen above, salmon aquaculture in BC also largely fails to deliver on this pledge.

Thus, perhaps the most compelling international implication of the salmon aquaculture case lies in its failures. Although fish farming is a successful international industry in financial terms, it illustrates the potential of the blue revolution to go significantly wrong. Instead of salmon aquaculture contributing to addressing global hunger, reducing pressure on wild stocks, and empowering local communities, we see quite the opposite. We see an example of the considerable promise of aquaculture missed, as an inappropriate model for aquaculture is followed.

The primary failure here is that the industry was structured and has developed in a deeply problematic way. Put differently, although farming a high-trophic-level species poses problems if the agenda is to feed the hungry, more crucial is the fact that any industry constrained by the socioeconomic drivers that salmon aquaculture has been subjected to will struggle to do other than to externalize its ecological and social impacts, and thus will not be sustainable.

One potentially positive move forward would be for the BC industry to remove itself from the global salmon commodity market and rebrand itself as a "green" (and necessarily smaller) industry player, specializing in the production of a superior-quality product grown in closed-containment facilities that eliminate the flow of wastes, parasites, and other harms to the wild environment. The "Super-Natural BC" brand is already in place across much of the world, which already visualizes BC and its natural products as pristine manifestations of nature. An alternative production strategy within the BC salmon farming industry would benefit from leveraging this image in the global market place instead of existing in spite of it.

This strategy implies that robust, regionally appropriate regulatory structures, rather than the internationalized market, would be a more appropriate approach to shaping the industry if sustainability is the primary concern. Given the significant amount of international effort over the past decades invested into creating a free trade system that seeks to resist exactly these types of regionally appropriate regulatory structures, this option poses serious international implications indeed. The suggestion is that if we wish to address the root causes of environmental problems, something must be changed, either in the functioning of the global economy itself or in the regulatory capacities available to shape the conditions of production, and thus the market.

WHAT IS BEING DONE? POLICY RESPONSES

If we focus specifically on salmon aquaculture in BC, at first glance it might appear that little is being done to even begin to address the magnitude of the challenge faced. To some extent this inaction is the case: the response of the provincial government has thus far been disappointing, to say the least. Over the past two decades, as the body of scientific evidence that salmon aquaculture poses significant threats to ecosystem health has grown (Naylor et al. 2000; Deutsch et al. 2007), and the NGO-led public outcry about their impacts has increased, government responses have been limited. Despite declaring a temporary moratorium on the number of tenure sites in BC from 1995 to 2002 (although production during this period increased more than threefold: 27,276 tonnes to 84,200 tonnes), successive governments have, on the whole, largely encouraged the industry to expand.

If we return briefly to the sea lice example, we can see how even when a clear solution to some of the problems raised appears obvious, the government has failed to act. The obvious first step in fighting sea lice epidemics in wild salmon is to adopt strict tenure-siting protocols to minimize cumulative farm effects, including sea lice on wild stocks. In other words, farms should be spatially separated—as adopted in Norway, following the *Gyrodactylus* outbreaks there. The incremental cost to Norwegian producers was modest. In BC, however, the salmon farm industry has reacted in exactly the opposite fashion. As the value of farmed salmon drops, the need to cluster farms more and more tightly has increased to minimize travel (and thus, costs) between tenures during the course of operations. As a result, the majority of BC salmon farm sites are highly clustered, with each cluster being located as close as possible to a town that serves as a transportation hub. Major clusters are currently situated around Vancouver Island adjacent to Port Hardy, Port McNeil, Campbell River, and Tofino. Proposed industry expansion north will see Prince Rupert on the mainland added to the list.

The obvious solution to increased sea lice infestations is to reduce farm densities, move farms away from wild salmon smolt migration corridors, and/or fallow farms during the spring out-migration. Taking these actions, however, would not be economical. As a consequence, not only do we see no regulatory moves in the directions that would respond to the sea lice crisis, we see exactly the opposite: the government approving increases in the density of salmon farms.

The government's action contrasts the robust efforts on the part of others to research the impacts of salmon farms and to raise public awareness about their dangers. Research into the impacts of salmon farms has been pursued by both university- and NGO-funded scientists. As of this writing, the Institute for Scientific Education's (ISI's) *Science Citation Index* (1965 to the present) yields 239 peer-reviewed primary papers on the topic.[4] Campaigns to alert the public, both within BC and more widely, have been led by a range of different groups, ranging

from grassroots organizations, such as the Coastal Alliance for Aquaculture Reform (CAAR, www.farmedanddangerous.org), to large Washington, DC–based organizations, such as the Pure Salmon Campaign (www.puresalmon.org). Of particular importance have been the organizations' efforts to link the issues around salmon aquaculture to emerging regional and global campaigns and to institutions working toward sustainability in the seafood sector more generally, such as the Monterey Bay Aquarium (which launched the Seafood Watch pocket guides; see www.mbayaq.org) and the Marine Stewardship Council. By raising the question of aquaculture sustainability in these contexts, these groups effectively link the issues around aquaculture to larger issues of the sustainability of global fisheries, helping to educate consumers about the links between their consumption practices and larger dynamics of ecological sustainability.

Overall, at the government level, we see relatively little evidence of efforts to respond to the challenges posed by salmon aquaculture in BC. However, thanks to the work of NGOs and concerned scientists, these issues are becoming more prominent in public debate, which, in the longer term, will pose important challenges to the government's current position. Further, by bringing this issue onto the radar screen of contentious consumers, these activities have created the necessary market conditions for the successful introduction of an alternative, and potentially more sustainable, product. A growing subset of the consuming public is willing to pay a "green subsidy" for sustainably produced farmed salmon. Whether the industry can deliver, however, remains an open question.

ANALYSIS: THE CHALLENGE IS BIGGER THAN AQUACULTURE

It is misleading to seek to explain the ecological impacts of salmon farming without first contextualizing these effects within wider socioeconomic dynamics. The ecological problems posed by the industry are a direct consequence of the pressures resulting from the need to compete in a global marketplace. Thus, understanding the challenges posed by salmon aquaculture is impossible without careful attention to how local and global contexts are intertwined. Although many of the problems that arise from salmon farming—such as sea lice epidemics, waste and pollution issues, and escapes of Atlantic salmon—manifest locally, other problems—such as the pressure placed on wild stocks by the dramatic reduction in the global price of salmon, or the stripping of ecosystems to produce fish food—manifest globally. Although we have argued the cause of the unsustainability of salmon farming rests in the structure of the global economy, understanding why salmon farming is such a compelling industry in BC requires familiarity with local contexts, such as the downturn in forestry and fishing industries. And, perhaps most importantly, understanding both the perils and promises of aquaculture more generally requires not

only familiarity with the dynamics of global hunger but also the specificity of the local communities that will be impacted—positively or negatively—by particular aquaculture operations.

This analysis leaves many questions unanswered, however. Perhaps central among them is why the federal and provincial governments have been reluctant to more rigorously regulate the salmon aquaculture industry. We have provided a preliminary response to the question: the economics of salmon aquaculture are unforgiving, and the industry players have successfully convinced governments that stricter regulation would make their product uncompetitive in the global marketplace, thus threatening the viability of the industry. However, this analysis begs a larger question: why are these governments so apparently powerless to resist this economic logic? In jurisdictions to the north and south of the BC coast—the states of Washington and Alaska—governments have not chosen to encourage the development of industrial salmon aquaculture. Given that the economies of Canada and British Columbia are both currently in periods of relative growth, why are governments unwilling to run the risk the profitability of an industry to protect the sustainability of vital natural resources?

Answering this question requires an understanding of the structural binds in which governments, especially democratically elected governments, find themselves. For at least the last half-century, the populations of Canada and other wealthy countries have come to expect continuous economic growth. That is, we have come to expect that our lives will be at least as good as those of our parents: our jobs will be better and our houses will be bigger, or at least as nice, as those of our parents. On the whole, this growth has been delivered: the expansion of the economy over the past 50 years is unprecedented. Consequently, in most wealthy countries, our lives are indeed materially richer than those of our parents. However, when this expectation is not met, we tend to blame the government and to vote a different party into power. Governments know this and know that they have a relatively short time (typically a four- or five-year electoral cycle) in which to deliver or sustain economic growth. They also assume that the best way accomplish this growth is to support the development of industries in whatever way they can, in hopes that these industries, in turn, will flourish and provide jobs, income, and tax revenue.

As the economy has become increasingly globalized over the past 50 years, however, this strategy has begun to pose challenges to governments. Their responsibility was once to nurture industries as much as possible while protecting the population from the negative impacts of these industries, thus requiring support of environmental regulation and trade unions. Because such regulations were enforced on all domestic companies, they didn't appear to disadvantage one company over another. However, nurturing industries now means helping them to be competitive in a global marketplace, where they compete against companies whose governments may have chosen not to regulate them, or not to support trade

unions. As a consequence, production costs for these companies are lower. To compete, Canadian companies pressure governments constantly to limit regulation, which would thus reduce their costs. We have seen this process in action in the case of salmon aquaculture.

To make matters more complicated for governments, although economic growth is important to voters, it is not the only thing that is important. Voters also care about a healthy environment and about safe working conditions. Governments must constantly balance these competing imperatives: to maintain legitimacy with voters, they must deliver enough economic growth without too many negative consequences. In some cases, the balance is easier to achieve: coastal economies in Washington State were diverse enough that the loss of an aquaculture industry wasn't catastrophic; coastal economies in Alaska are so dependent on a thriving wild salmon fishery that they perceived the risk of aquaculture as being too great. Sometimes, however, governments get the balance wrong: either the industry fails or the environmental impacts raise unexpectedly strong public reactions, and the government loses power. Governments are left in a rather precarious position: in the absence of agreement from all other countries to impose similar regulations, imposing any regulation on an industry is to potentially damage its competitiveness.

This quandary, in turn, might raise a further question of why, in this context, governments have been so much more eager to negotiate treaties agreeing not to impose regulations (for example, to support free trade) than to work collectively with other governments to agree to supranational regulation of industries. Answering this question requires understanding the rise and at least the temporary triumph of the ideology of neoliberalism—the belief that the more unfettered the market (that is, the fewer regulations imposed upon industries), the more economic growth it will stimulate. Under this belief, the ultimate interest of all citizens is economic growth, with all other interests secondary. The underlying belief that sustains this ideology is thus that we can grow our way out of all of the challenges we face. In the context of salmon aquaculture, this ideology manifests in the belief that at some magical economy of scale, profits will be such that environmental problems can be addressed. As we've seen above, such an assumption, although it may bring comfort to the governments who proceed with it, is risky at best, and incredibly destructive at worst, as communities and ecologies—neither of which are infinitely resilient—pay the price of its failures.

Thus, although some kind of environmental regulation of salmon aquaculture seems necessary, both federal and provincial governments remain paralyzed: if they don't regulate quickly or effectively enough, they may lose votes; if they regulate and the industry goes under, they will definitely lose votes and tax revenue, and they will then incur the need for expensive social services. The crux of the situation, however, rests in the fact that the activity in question—and virtually all

economic activity—has environmental impacts, and the more those impacts are externalized, or kept out of the economic sphere, the more impossible the conundrum becomes. In the longer term, unless environmental impacts enter into the market in some way—presumably through regulation, particularly regulations that place costs on the use of ecosystem services—or unless the logic of the free market is dislodged as the supreme ideology of our times, governments will be prevented from ever addressing the root causes of environmental problems. Thus, the conundrum of salmon aquaculture, and of many of the other environmental issues analyzed in this volume, will remain hanging in the balance of how governments assess their voting publics.

WHAT CAN BE DONE? INTERNATIONAL AND LOCAL POLICY OPTIONS

Although much of our analysis points to apparently abstract, structural causes at the root of the challenges posed by salmon aquaculture, and thus might appear discouraging, there are important signs of hope. Change happens in many different, and often unexpected, ways.

To begin at the international level, at least two emerging developments suggest important contexts for policy change. First, according to increasing evidence, particularly in the difficulties encountered in negotiating the newest—Doha—round of global trade agreements through the World Trade Organization, the hold of the neoliberal ideology of free trade is beginning to weaken, in part because its negative impacts on environmental and social well-being are becoming increasingly evident. The Doha round was meant to focus particularly on the trade in service industries and agricultural products (and thus would have directly affected the aquaculture industry, among others), but has foundered, particularly on the issue of agricultural subsidies. Although the reasons for the failure of the Doha round are complex and diverse, the lack of agreement has brought to the surface the diverse and in many cases detrimental impacts of free trade, which, in turn, have dented the neoliberal ideology that claims these negative impacts are less important than free trade and will disappear in the face of free trade's benefits.

What the failure of the Doha round will mean in the longer term remains unclear. However, as suggested by the analysis above, insofar as international trade agreements set the parameters within which the global marketplace functions, such agreements are vital to the future of environmental issues. Regulation is one of the most important tools available to shift the type of socioeconomic drivers that have shaped the aquaculture industry. Global trade agreements set the terms within which trade can be regulated, either by international governance or by domestic governments. Thus, arcane and distant as they may appear, trade negotiations are a vital arena within which the parameters of environmental struggles

will be shaped. Should these negotiations—in explicit challenge to the ideology of free trade—begin to focus on embedding environmental considerations into their governance regimes or reinforcing the capacities of governments to regulate trade based on environmental concerns, the range of policy tools available to governments to respond to environmental impacts would shift substantially.

The second emerging development is related to the first. As both domestic and international environmental organizations began to perceive governments' unwillingness to regulate key industries, these organizations have expanded the traditional focus of their activities to include not only pressuring governments but also seeking to influence the market structure directly. Thus, in response to industry claims that cutting environmental corners is an unfortunate necessity to be competitive, NGOs have worked to create market incentives to enable industry to make different choices.

A relevant example is the Marine Stewardship Council (MSC), modelled on the successful Forest Stewardship Council (FSC). Both organizations oversee voluntary sustainability certification regimes: companies can apply to have their products certified as sustainable; in return they are allowed to market their products with the appropriate MSC or FSC label. Consumers, in turn, can purchase with a clearer conscience regarding the environmental impact of their purchase and, in exchange, many are willing to pay a premium, thus enabling companies to cover their additional costs. In effect, this voluntary program internalizes environmental costs into the marketplace.

Although the certification approach generates many concerns and limitations —on its own, the impact is clearly limited to the creation of niche markets, not to wide-ranging market change—when viewed in a larger context, the program's range of contributions to addressing these problems becomes more apparent. Such programs educate both companies and consumers about both the environmental impacts of their activities and their available options; they provide financial incentives to develop and trial new, more environmentally friendly approaches to production; they assist companies in "greening" their activities, making them more likely to push for regulation to enforce "greener" standards (which will reinforce their competitiveness in the marketplace); they make visible latent consumer—and potentially voter—values, and empower consumers—and voters—to demand wider application of these new approaches. In this way, the MSC and FSC programs potentially pave the way either for wider-ranging government regulation—as governments begin to see the potential for an industry to thrive while attending to environmental impacts—or for more extensive non-governmental regimes to develop. They also—and this benefit should not be discounted—ensure the survival of some small, environmentally friendly companies that support local economies here and there but that would otherwise be unable to compete in the global marketplace.

Seen independently, these two different developments may appear modest, but they are the tips of much larger icebergs. At the sites of both activities, key issues at stake are being raised, researched, and thought through, and capacity is being built, enabling other kinds of governance arrangements or government regulations to emerge. These programs provide meeting points for diverse participants—specialists in international trade, biologists researching environmental impacts, corporate analysts and leaders, activists, and others—to share insights and develop new approaches to addressing these challenges. And the approaches developed here often become the foundations for wider regime development. In this context, although it is too early for precise prescriptions about the institutional forms such regimes should take, encouragement is gained from the wide-ranging focus on embedding environmental issues into economic activity in a more sustained and robust way. This approach is vital to any attempt at addressing the challenges posed by salmon aquaculture in BC: a change in the underlying socioeconomic drivers.

Sustained and important pressure for change is also building at the local level, ranging from communities that are consistently resisting the invasion of salmon farms into their regions, to institutions—restaurants, shops, schools, companies—that are refusing to purchase or sell farmed salmon products.[5] The wider education and certification campaigns have led to an increasing market for sustainable seafood and sustainable aquaculture products, which requires significant innovation in aquaculture methods if its demands are to be met. If BC is to have a sustainable finfish aquaculture industry, a wholesale shift is needed in the actual production practices. Such a shift can be encouraged by the kinds of socioeconomic changes discussed above, but new, sustainable aquaculture methods must still be developed and trialled. However, extensive debate continues about the range of options available. As long as the industry standard remains a globalized, low-value, homogenized product, there is little incentive or indeed little possibility for change. The strategy that BC stands to profit from is the leveraging of its own global reputation as a wild and natural paradise, home to wild (and perhaps) "sustainable farmed salmon—the ethical alternative." But as long as BC tries to compete head to head with Norway and Chile, the industry will be hamstrung by higher costs of production, forcing it, in an attempt to remain competitive, to offload those costs to its supporting natural and human communities.

CONCLUSION

Actual processes of change are complex and obscure, but each of the approaches discussed above has the potential to make crucial contributions toward a solution. Both globally and in BC, sustainable approaches to aquaculture are possible and should be taken seriously. Any change that reduces the offloading of production costs to the local ecological and social environments (the use of closed-containment

facilities, for example) would be a step forward. The stark challenge remains: the underlying logic of the system must be addressed, an approach that requires embedding economy in ecology in a much more radical way. This change can be accomplished at different scales, and indeed pressure at different scales will be necessary to realize it. The creation of niche markets for sustainably produced aquaculture products will make viable other economic practices; changes in trade rules and regulations will enable ecological considerations to enter into pricing; and strong civil society pressure has the potential to encourage more effective government regulation, and to argue that consumers want, and are willing to pay the price of, good food. In other words, a long-term solution not only requires farming the right species under the right conditions but also requires the appropriate governance and corporate structures to support the communities that bear the impact of the operations and a shift in socioeconomic drivers toward sustainable, not "cheap," food.

The situation outlined here is not restricted to the aquaculture industry in BC. For example, the Okanagan Valley region is the venue for increasingly fractious debates pitting the lure of economic opportunity in the form of an export economy based on industrial-scale wine grape production and vinification against those that see a more local and diverse economic profile for the region—including maintaining the region's traditional agriculture crops, such as tree fruit. In 1993, an acre of Okanagan farmland was selling for $3,000; today with the rush to tear out tree fruit crops and replace them with wine grapes, land is going for the equivalent of $150,000 per acre, motivating many landowners to sell, often to absentee owners from Alberta or further afield. This trend, in the eyes of some, further destabilizes the community. The current BC Minister of Agriculture, Pat Bell, whose portfolio includes both traditional agriculture and aquaculture weighed into the Okanagan debate with some astute observations:

> Not all fruit production acreage is convertible to grapes, nor would it be appropriate for that to happen. What makes the BC wine industry successful is the focus on quality. Australian grape producers leave 20× the number of grapes on the vine each season as are produced in the entire Okanagan Valley. Australia is a commodity producer, it has scale, it can compete. BC doesn't and never will have the scale to be a commodity player. But through your focus on quality and branding you become a very successful niche player. (Bell, cited in Stueck 2006, B4)

The minister has found wisdom in the Okanagan situation. However, in the case of salmon aquaculture and the position of BC relative to Chile and Norway, those on the coast await a similar insight.

NOTES

1. See the BC Legislative Assembly's *Special Committee on Sustainable Aquaculture Final Report* (British Columbia, Special Committee on Sustainable Agriculture 2007).
2. This estimate is conservative because the 1988 figures have not been adjusted for inflation.
3. Between 1997 and 2003, real wages in British Columbia's fish farming industry declined 29 percent (Marshall 2003).
4. The search string used was *farm** OR *aquaculture* AND *salmon* AND *impact*.
5. For more information on the campaign against farmed salmon, see the website of the Coastal Alliance for Aquaculture Reform, www.farmedanddangerous.org.

DISCUSSION QUESTIONS

1. Can you suggest a policy "solution" to the sustainability challenges posed by salmon farming in British Columbia?
2. The analysis above suggests some tensions between democracy and sustainability. What are these tensions, and how might they be negotiated? Put differently, are the political institutions we have inherited capable of achieving sustainability?
3. What does the case of salmon aquaculture in British Columbia reveal about the links between ecological, social, and economic sustainability?
4. To what extent are the dynamics influencing the sustainability of the salmon farming industry in British Columbia also apparent in cases discussed in other chapters?

SUGGESTED READINGS AND ONLINE RESOURCES

Sustainable Fisheries/Aquaculture Advocacy Organizations

Coastal Alliance for Aquaculture Reform: www.farmedanddangerous.org

David Suzuki Foundation: www.davidsuzuki.org/Oceans

Living Oceans Society: www.livingoceans.org

Marine Stewardship Council: www.msc.org

Monterey Bay Aquarium Seafood Watch Program: www.mbayaq.org

Pure Salmon Campaign: www.puresalmon.org

Information About Global Fisheries

National Geographic: Global Fisheries Crisis: www7.nationalgeographic.com/ngm/0704

Sea Around Us Project: www.seaaroundus.org

The State of World Fisheries and Aquaculture (SOFIA): www.fao.org/fishery

Global Trade, Agriculture, and Sustainability

International Institute for Sustainable Development, publications on international trade: www.iisd.org/publications

Institute for Agriculture and Trade Policy: www.iatp.org

The Politics of Economic Growth

Booth, D. 2004. Economic growth and environmental change. In *Hooked on growth: Economic addictions and the environment*, 55–99. Toronto: Rowman and Littlefield.

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