Beyond Quotas

Private Property Solutions to Overfishing

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In March 1996, Glen Clark, the premier of British Columbia, predicted that the Fraser River commercial sockeye fishery would be shut down for the year. "It's pretty clear from the numbers," he explained, "that it won't sustain a commercial fishery" (Cernetig 1996a). The warning followed two nearly disastrous years in British Columbia's salmon fishery. In 1994, several million Fraser River salmon failed to appear at their spawning grounds. The board reviewing their disappearance concluded that fishermen had come within 12 hours of wiping out the province's most important sockeye run. "The resource is now, more than ever before, critically endangered," it warned. "If something like the 1994 situation happens again, the door to disaster will be wide open" (Fraser River Sockeye Public Review Board [FRSPRB] 1995: xii, 12). Academics agreed that a crisis loomed. Biologist Carl Walters cautioned that, in the absence of profound restructuring, the Pacific salmon fishery would likely go the way of the Atlantic cod fishery (Walters 1995: 4).

The following season again saw salmon shortages. In August 1995, with the returning salmon numbering two-thirds less than pre-season estimates, federal Fisheries Minister Brian Tobin closed the Fraser River sockeye fishery with a grim comment: "As it stands now, we don't have a fishery. Period. And unless the

numbers change, we won't have a fishery in the future" (Damsell 1995). In a news release on November 8, 1995, British Columbia's fisheries minister, David Zirnhelt, described the year's salmon returns as "the worst in memory," noting that harvest volumes had declined 42 percent from recent averages (Valhalla 1996). A report commissioned by the forest industry reiterated the decline of salmon productivity, concluding that of the Georgia Strait's five salmon species, four—coho, pink, sockeye and chinook—were not sustainable (Levy, Young, and Dwernychuk 1996: xvii, xviii, 224). "If the resource is not protected," the authors warned, "there simply will not be any fish" (Morton 1996).

While attention has focused on the commercial catch, salmon sought by sports fishermen are also in trouble. Chinook populations have been declining for more than a decade and have virtually disappeared from popular fishing spots in the Strait of Georgia. According to Carl Walters, stocks are now at 10 percent of what they should be (Mavericks 1995). If left alone, it could take between 12 and 16 years for the Georgia Strait chinook to recover; if fished lightly, these stocks could take a century to recover (Walters 1995: 44).

Declining biodiversity also threatens British Columbia's salmon. The province's streams have supported thousands of genetically distinct populations. But more and more fish now come from fewer and fewer streams. The last several decades have witnessed the weakening and extinction of many stocks. The dramatic decline is apparent in the Georgia Strait, which has lost approximately one-third of its stocks (Walters 1995: 3, 5, 9, 11; Levy et al. 1996: xv).

A number of factors have contributed to the salmon's diminishing numbers and reduced diversity. The most obvious is overfishing by commercial, sport, or aboriginal fishermen. Regardless of regulators' efforts since 1968 to limit entry and reduce capacity, too many fishermen continue to catch too many fish. Acknowledging the former problem, Fred Mifflin, the minister of Fisheries and Oceans, announced in March 1996 his intention to reduce the fleet by 50 percent (Canada, DFO 1996), and is now trying to lure from the fishery the very people his government has been paying to stay. Federal assistance to fishermen has long contributed to the fleet's overcapacity since, without unemployment insurance, thousands of fishermen would have had to leave the fishery. Estimates put the portion of fishermen that could not

survive without government support at between 30 percent and 60 percent (Walters 1995: 24; Cernetig 1995c; Mifflin 1996).

Their numbers aside, fishermen are taking too many fish. In 1994, sockeye harvest rates neared 80 percent of the run, well over the harvest rate of 70 percent recommended for the most productive sockeye stocks (FRSPRB 1995: 39; Walters 1995: 38). In 1994, competition with the United States encouraged Canadian managers to take risks with salmon destined for the Fraser River. After negotiations on the Pacific Salmon Treaty broke down, Canada pursued an "aggressive fishing strategy," encouraging its fleet to intercept the Fraser run before Americans could harvest it. The fish war encouraged a "grab-all" attitude in the fleet, helping create the season's disaster (FRSPRB 1995: xiii).

Sustainable levels of fishing of some stocks may also contribute to the overfishing of others. When fishing effort increases at the mouth of a river with a productive hatchery, catches not only of the targeted enhanced species but also of non-targeted wild species increase. Hatchery operations have thus hastened the loss of biodiversity (Pearse 1982: 51–52; Walters 1995: 5, 34).

Destruction of habitat may rival overfishing as a cause of the salmon's recent decline. Scientists debate the effects and significance of habitat loss or damage. One review attributes 20 percent to 30 percent of recent biodiversity losses to habitat damage (Walters 1995: 9). Another blames habitat damage for far greater losses (Meggs 1991). While environmental effects are not easily quantified—they may occur over decades, with many years lapsing between activities and their cumulative effects—it is clear that British Columbia's environment has been altered in many ways that have harmed salmon (Pearse 1982: 13, 14, 19).

One of the province's earliest environmental disasters occurred at Hell's Gate on the Fraser River. In 1911 and 1912, construction crews of the Canadian Northern Railway illegally dumped great amounts of rock into the Fraser canyon; two years later, railroad blasting set off a massive rock slide. These events changed the river's flow pattern and prevented salmon from swimming upstream to spawn. Millions of salmon died below Hell's Gate. Commercial catches plummeted to 25 percent of their former sizes; they remain below historical averages to this day (FRSPRB 1995: 3–4; Meggs 1991: 90–100).

Since then, countless other activities have degraded salmon habitat (Meggs 1991: 3, 10, 81–82, 200–18, 235-47; Levy et al. 1996:

xv–xx, chaps. 4, 6 and 7; Valhalla 1996). Logging roads and landslides caused by logging have covered stream beds with silt; clear-cutting has changed water run-off patterns and stream temperatures; and log transportation has destroyed river beds. Pulp mills have littered river and ocean beds with fibre mats; decay of these and other organic mill wastes has robbed water of oxygen needed by fish; and the effluents from mills have contaminated waters with toxins, such as dioxins and furans. Hydroelectric dams have blocked migrating fish, altered flows and changed water temperatures. Mine tailings have poisoned waters with heavy metals. Agricultural run-off has contaminated waters with fertilizers and pesticides. Urban development has decreased the amount of habitat available for salmon; it has also increased run-off, exacerbating high and low flows. And, fish farms have polluted waters and threatened wild stocks with diseases and interbreeding.

Sewage pollution also threatens British Columbia's salmon. Every day, British Columbians discharge 1.7 billion litres of waste water into the province's waters. Sixteen communities simply chop up or screen their sewage before discharging it into coastal waters. Most municipalities treat their sewage, but treatment does not ensure that effluents will not damage the marine environment. Approximately 59 percent of British Columbia's treated waste water receives only primary treatment, which leaves considerable amounts of toxins and organic matter in the effluent (British Columbia Ministry of Environment, Lands and Parks 1991b; Environment Canada 1994). And many treatment plants, such as the Greater Vancouver Regional District's Annacis Island and Lulu Island facilities, regularly fail to meet provincial water quality requirements (British Columbia Ministry of Environment, Lands and Parks 1991a, 1992, 1993, 1994a, 1994b, 1995, [1996]). Upgrading the Annacis Island plant headed the list of environmental recommendations made by the Fraser River Sockeye Public Review Board in 1995 (FRSPRB 1995: 70). In the Vancouver region, combined sewers—sewers carrying both storm water and sanitary sewage—increase sewage pollution. During storms, when combined sewers fill with more water and wastes than the local treatment plants can handle, they overflow into the Fraser River and Burrard Inlet, discharging approximately 62 billion litres of raw sewage over the course of a year (Sewage Treatment Review Panel 1992: 3–2).

Sewage from treatment plants and combined sewer overflows degrades salmon habitat in a number of ways. Suspended solids may prevent sunlight from reaching underwater plants that aquatic organisms feed on. They may destroy spawning zones. Microorganisms that break down organic matter in suspended solids consume oxygen, making less available for fish. Nutrients in sewage have the same effect; phosphorus and nitrogen stimulate plant growth, such as algal blooms, which oxygen-consuming microorganisms then decompose. Sewage effluents also directly harm fish. Suspended solids may clog gills and abrade exposed membranes. Toxins in the effluent may cause stress and disease, interfere with reproduction, growth, migration, and feeding, and increase vulnerability to predators. Effluents that are disinfected with chlorine, but not subsequently dechlorinated, may injure fish gills and induce convulsions; chlorinated effluents—discharged by 20 of British Columbia's 116 municipal sewage treatment plants—may be deadly to fish hundreds of metres downstream (Nantel 1996; Sierra Legal Defence Fund 1994; People for Puget Sound and Save Georgia Strait Alliance 1995).

Government failure

The overfishing and degradation of habitat now threatening British Columbia's salmon reflect decades of mismanagement by federal and provincial governments. The federal government has insufficient knowledge, resources, and incentives to monitor fishing or water quality, or to enforce regulations governing them. The 1982 Commission on Pacific Fisheries Policy warned that the Department of Fisheries and Oceans knew "surprisingly little" about fish habitats, failed to monitor industrial operations, and had "alarmingly deficient" information about fisheries resources (Pearse 1982: 23, 29, 34). In recent decades, budget cuts and spending shifts have further reduced government monitoring of the fishery, to the point where it is now, in the words of one critic, "hopelessly inadequate" (Walters 1995: 26, 69–70). The 220 or so enforcement officers of the Department of Fisheries and Oceans cannot possibly monitor all of British Columbia's 160,000 square miles of ocean, its 27,000 kilometre coastline or its 1,500 spawning streams (Walters 1995: 42–43; Martinolich, personal communication May 7, 1996; Cernetig 1995c). A 1994 memorandum of the Department of Fisheries and Oceans complained that the department lacked the staff and budget required to monitor

the aboriginal fishery (Cernetig 1994). The board reviewing 1994's disastrous Fraser salmon runs described "a general breakdown in enforcement" and the fisheries officers' "troubling laxity of diligence," blaming the crisis on staff and budget cutbacks (FR-SPRB 1995: 18, 45, 58–62). Reports prepared for that review revealed the government's inability to count fish, monitor catches, predict mortality rates, or otherwise regulate the fishery (Cernetig 1995a). Nor have provincial governments adequately monitored pollution or enforced regulations protecting salmon habitat; they have lacked the data necessary to calculate pollution loading rates and to evaluate their effects (Levy et al. 1996: xvi, xix–xx).

Problems of inadequate monitoring and enforcement, however, cannot simply be resolved with more money. Whether or not there are budget restrictions, governments face myriad deterrents from conserving and protecting salmon stocks. That they are subject to irresistible political pressures has been evident since 1889, when initial attempts to conserve salmon by restricting entry into the Fraser fishery met with fierce resistance. Fishermen were outraged by the government's proposal to limit licences to 450. Bowing to political pressure, the government agreed to issue an additional 50 licences. Then, retreating further, it suspended the regulations. Within three years, it had issued another 221 licences (Meggs 1991: 32–34, 38). The government's next attempt to limit entry—this time to the Skeena and Rivers Inlet fisheries—lasted less than a decade. Initiated in 1908, licence restrictions were eased to accommodate the canneries' demands and then lifted entirely to make jobs for soldiers returning from the first World War (Pearse 1982: 78).

The 1982 Commission on Pacific Fisheries Policy warned of the government's ongoing inability to withstand heavy pressures from fishermen. "Management," it reported, "has in many respects been reduced to a series of desperate attempts to meet the demands of vocal user groups without visibly destroying the resource." It noted that the government itself acknowledged such failings: The Department of Fisheries and Oceans had admitted to it that "In the past, escapement targets have often been compromised on the basis of compelling social considerations" (Pearse 1982: 37).

The government continues to accommodate powerful fishing interests, compromising conservation requirements in the pro-

cess (Levy et al. 1996: 224). Fisheries biologist Carl Walters charges that the allocation system "is dominated more by threat of civil disobedience than by reasoned analysis of where rights and privileges ought to lie" (Walters 1995: 5). In setting catch limits, the government has accepted the fishing industry's overly optimistic stock assessments, ignoring its own researchers' more cautious recommendations (Cernetig 1996b). The government faces pressure not just from the commercial fishery but also from the sport fishery. For instance, in 1987, the efforts by Tom Siddon, then minister of Fisheries and Oceans, to reduce sport fishing for chinook in the Georgia Strait prompted a massive postcard campaign that persuaded his government to refrain from strong action, settling instead for an ineffective compromise (Walters 1995: 27). Pressured from all sides, Paul Sprout, the director of the Operations Branch, Department of Fisheries and Oceans, complained that his department resembled a Ping-Pong ball bounced between competing user groups (Mavericks 1995).

Powerful polluters have also long had the ear of government regulators. Having licensed—and frequently subsidized—polluters, and having benefited politically from their promises of development and jobs, governments have become apologists for them, refusing to implement or enforce strict regulations. A 1978 study found that 80 percent of the discharges into the Fraser River estuary exceeded permitted limits for quality or quantity (Fraser River Estuary Study Steering Committee 1978, cited in Pearse 1982: 21). But, as the premier of British Columbia explained to the prime minister of Canada in a letter of April 27, 1977 opposing the strengthening of the federal Fisheries Act, the province feared that cleaning up British Columbia's waters might jeopardize its "close cooperation" with resource-based industries; the act, he continued, was "out of step with the multiple resource use essential to the development of a healthy economy" (Pearse 1982: 21).

Geoff Meggs chronicles a half century of governments' turning a blind eye to pollution and habitat degradation. He describes both the provincial government's disregard of fisheries resources when, in 1949, it invited Alcan to build the Kemano project, and the federal government's failure to prosecute when Alcan refused to implement the fish mitigation measures the government had recommended (Meggs 1991: 200–01). He tells of the refusal in the 1960s by a regional director of the Department

of Fisheries and Oceans to enforce water flow agreements on rivers whose salmon runs had been depleted by dams or to enforce controls on pulp mill wastes. Despite the evidence to the contrary, the director insisted that his department had "pollution problems related to new industries fairly well under control" (Meggs 1991: 204–06). Noting economist James Crutchfield's 1965 comment that forest companies "get away with murder through political blackmail," Meggs relates the 1979 story of the government's caving-in to pressures from loggers whose activities damaged salmon habitat in the Queen Charlotte Islands. Romeo LeBlanc, then minister of Fisheries and Oceans, had authorized officers to charge 16 loggers and their employer with violating the Fisheries Act; however, when confronted by opposition from provincial officials, the woodworkers union and the company, he ordered the charges stayed and allowed logging to proceed (Meggs 1991: 206, 216). Meggs also documents a 1989 memorandum from Otto Langer, a habitat manager at the department of Fisheries and Oceans, warning that "should the public discover how we are determining who should or should not be charged [it] would amount to a near scandal." Langer explained, "We have determined that DFO-friendly corporations or parties with provincial permits . . . will enjoy relative immunity from the Fisheries Act . . . A continuation of this philosophy will result in a wholesale loss of fish habitat and a continued degradation of water quality" (Meggs 1991: 244–45).

Not surprisingly, governments are equally reluctant to enforce pollution regulations when doing so would cost them money instead of political capital. Their approach to sewage pollution illustrates the conflicts of interest that exist when a government is both the polluter and the regulator. Sewage pollution is illegal, and British Columbia's Waste Management Act purportedly limits the amount and type of contaminants in sewage treatment plants' effluents. Many plants chronically fail to comply with permits issued under the act. Yet noncompliance rarely brings convictions: in the past six years, the province has convicted only two noncomplying plants. Nor is the federal government's record more impressive. The federal Fisheries Act provides for fines of up to $1 million a day—and up to three years imprisonment for repeat offenders—for those who destroy fisheries habitat or deposit deleterious substances in water frequented by fish. The act, however, is rarely enforced: between 1977 and 1996, the

federal government filed only three prosecutions against municipal sewage offenders (Nantel 1996: 14–15, 17–18).

In 1993, the Save Georgia Strait Alliance and the United Fishermen and Allied Workers Union, fed up with the Greater Vancouver Regional District's dumping raw sewage from a combined sewer into Burrard Inlet, launched a private prosecution under the Fisheries Act. The provincial Crown soon took over the case from the private complainants, as is its policy, to ensure that prosecutions that proceed are in "the public interest." In 1995, the Crown's special prosecutor dropped the charges, explaining that the provincial and local governments had an unwritten agreement to allow the discharge of raw waste from overloaded pipes. What he did not mention was that the province found itself in a financial conflict of interest: successful legal action would have proved expensive for the province, which finances between 25 and 75 percent of the capital cost of upgrading sewage treatment facilities (Simpson 1995; Anonymous 1996; Nantel 1996: 15).

All too often, government conflicts—political or financial—result in inaction. History illustrates the inertia that takes over when governments face tough decisions. Governments on both sides of the border between Canada and the United States have a long record of establishing inquiries into the Pacific salmon fishery, and then ignoring their recommendations or delaying their implementation. An international commission, appointed in 1908 to investigate boundary fisheries, recommended regulations regarding gear size and location, a closed season, and water pollution. Canada implemented the regulations but, seeing that the Americans had not done so, repealed them. Another joint commission, established in 1918, recommended that the two countries adopt a convention to preserve and protect salmon and establish a commission; the treaty, however, was not adopted. The countries finally signed a convention to protect the Fraser River and Puget Sound sockeye in 1929; however, it did not become effective until 1937, and the regulations recommended by the joint commission it established were not promulgated for yet another eight years (Gregory and Barnes 1939: 72–75).

Nor are contemporary governments more likely to act decisively, as is shown by their ignoring repeated warnings since the 1980s of a pending salmon crisis and their refusing to pursue—or to allow others to pursue—promising information-gathering

and management initiatives (Walters 1995: 30; Cernetig 1995b; Howard 1995). The Fraser River Sockeye Public Review Board remarked, when reviewing past reports, "we wonder to what extent their recommendations were actually taken seriously . . . We wonder if anybody is listening" (FRSPRB 1995: 12, 38). It is in governments' self-interest to delay in the face of uncertainty. In one critic's words, bureaucrats "are rewarded not for effective action, but for making every problem disappear into an endless tangle of task force meetings and reviews" (Walters 1995: 49). Sadly, few bureaucrats suffer the consequences of irresponsible management decisions or inaction. An absence of personal accountability characterizes both levels of government. Officials of the Department of Fisheries and Oceans who presided over the decline of British Columbia's salmon stocks continue to enjoy professional rewards. Indeed, sanctions in the field are rare; even those responsible for the disastrous errors in Atlantic cod assessments have never been officially reprimanded (Walters 1995: 22).

Private property: an alternative to government failure

No one should be surprised that under governments' not-so-watchful eyes, fishermen and industries have reduced British Columbia's salmon fisheries and habitats to their present state. Overfishing and habitat degradation have been predictable: individuals, firms and organizations have simply responded rationally to a system of perverse incentives. Throughout the last century, fishermen have had incentives to catch as much as they could, for if they had not taken the fish, their competitors would have done so. Polluters have had incentives to foul rivers, estuaries and the ocean, since these waters have provided cheap waste disposal. Meanwhile, governments have had incentives to permit the destruction of resources; overfishing and pollution, no matter how devastating, have offered short-term gains that have helped ensure re-election.

Fisheries regimes need not be characterized by such perverse incentives. Alternative ownership and management structures can encourage stock conservation and habitat enhancement. A key characteristic of all such successful regimes is accountability, or the internalization of costs and benefits: decision makers in the fisheries and in industry must stand to gain from wise decisions and lose from poor decisions. Fishermen must have incentives both to harvest efficiently and to "grow" salmon, either by

conserving stocks or by increasing the productivity of their habitat. They must be confident that they will reap the rewards of activities that preserve or improve the stocks; likewise, they must understand that they will bear the costs of any risks taken (Keen 1983: 202–3). And industry must be accountable for any decision to pollute; only then will it have incentives to develop waste disposal methods that do not degrade habitat.

In general, regimes under which fishermen hold strong private property rights provide the necessary accountability. Property rights give fishermen reason to become more than mere harvesters, since they create incentives to conserve and enhance stocks, and to protect and restore the habitat on which they depend. The more secure the fishermen's rights to the stocks, the more likely they are to profit from investment in their habitat's productivity: as their resource grows, their catch will increase (Keen 1983: 197–98, 203; Scott 1988: 33; Hide and Ackroyd 1990: 42–44; Pearse and Walters 1992: 175–76; Pearse 1992: 117–18, 120; Walters 1995: 50–51). Secure rights also give fishermen powerful legal tools with which they can protect stocks and habitats. Under our legal system it is far easier to defend one's own property against depletion or pollution than it is to protect common property (Brubaker 1995, 1996).

Several features characterize regimes offering strong private property rights. One of the most important attributes of a property right is its exclusivity. Those holding exclusive rights may prevent others from using the resource (Pearse 1979: 13). The more exclusive the system of rights, the more completely internalized the costs, benefits, and risks of any action will be. Since rights are only as exclusive as they are enforceable, enforceability is also an essential element of a successful property rights regime. Rights holders must be able to exercise maximum control over their assets (Scott 1955: 116–17). Few will want to invest in a resource subject to interception or poaching. It has been feasible before now to limit access only to stationary species and others close to shore, but recent technological advances make it possible to control access to more mobile or distant fisheries, and thus to enforce property rights in them. Technological innovations and property rights create a virtuous circle: property rights foster technological innovations, by giving people incentives to develop them; in turn, technological innovations foster the development and assignment of property rights, by making them easier

and less costly to enforce. While some new technologies remain prohibitively expensive, many are becoming increasingly attractive and available to fisheries owners (De Alessi 1996: 9–10; Walters 1995: 45, 54, 67).

The strongest property rights are perpetual. Permanent rights encourage management decisions that ensure long-term productivity rather than short-term gain. Permanent rights are also transferable, and transferability enables efficient managers to buy out bad managers, ensuring that rights end up in the hands of those who can make the best use of them. Finally, under the strongest property rights regimes, decision making is devolved as far as possible. Decision making is most effective in a system that allows for full information. In the case of the fisheries, complex and varying ecologies often preclude decision making from afar. The best decisions are often made by the fishermen themselves, who often have more detailed and more immediate knowledge of fisheries than a remote government does.

Various property rights regimes display the above characteristics in different degrees. Property falls on a continuum from unowned property (to which everyone enjoys unrestricted access), through common property (access to which is restricted to those holding licences or other rights), to solely owned property (Pearse 1979: 13–16). As the forms of property move along the continuum, their "rights intensity" increases; they acquire more of the desirable characteristics of strong property rights (Scott 1988: 11–12). Within the second category, for example, fall both limited licences and individual transferable quotas (ITQs). Both constitute property and have acquired market values (Scott 1988: 24; Neher, Arnason and Mollett 1988: 265). But ITQs, giving holders the right to take a specified quantity of fish or a specified percentage of a catch, generally offer greater exclusivity, duration and transferability (Scott 1988: 26–27). ITQs are accordingly stronger property rights than are licences. As would be expected, the stronger right does indeed encourage more efficient and sustainable fishing. Because holders of limited licences have no right to a specified quantity of fish, they retain incentives to expand their fishing power and to race for fish. In contrast, under many circumstances ITQs eliminate the race for fish. Secure quotas in a fishery in which effort does not increase considerably as the fishery nears its total allowable catch (TAC) give fishermen incentives to fill their quota efficiently, keeping their costs as low as possible (Pearse 1982: 84).

Quota holders may, of course, retain incentives to race to catch fish in the locations where (or at the times when) stocks are the most accessible, the most concentrated, the largest, or of the highest quality (Townsend and Wilson 1987: 321; Anderson and Leal 1993: 164; Copes 1986: 286; Johnson and Libecap 1982: 1014).

While quotas are generally superior to weaker forms of property rights, they do not always provide constructive incentives to those who hold them. It is often possible to fine-tune quota systems to provide better results, but it may be better still to move along the continuum of property rights towards sole ownership and avoid many of the problems posed by ITQs. Enforcement is one problem, as quotas do not eliminate incentives to cheat (Walters 1995: 17; Anderson and Leal 1993: 164). Monitoring and enforcement of catch limits would be difficult and costly in the British Columbia salmon fishery, where thousands of small boats can land at hundreds of locations (Copes 1986: 282). "Quota-busting" plagued early experiments with quotas in the Bay of Fundy herring fishery; fishermen and processors colluded to falsify catch records (Copes 1986: 282). Enforcement has also proved difficult in New Zealand's paua (abalone) fishery; illegal catches increase the total catch by 50 percent (Hide and Ackroyd 1990: 36). Cheating on such a scale, in addition to its immediate and adverse effect upon stocks, interferes with their long-term management. When fishermen underreport their catches or otherwise falsify their reports, the quality of data on the fishery declines and, without reliable estimates of stocks, managers cannot set optimal exploitation rates (Copes 1986: 282).

Sole ownership—be it by individuals, communities, associations of rights holders or corporations—would facilitate enforcement. Geographically based rights would be easier to enforce than catch-based rights: owners could monitor the entry of boats into their areas more easily than they could monitor the boats' catches. If all fishing boats were equipped with transponders, the cost of monitoring their locations would constitute a small fraction of current enforcement costs (Walters 1995: 67). Furthermore, if fisheries owners themselves, either independently or through associations or corporations they govern, set catch and size limits, they would have fewer reasons to cheat; their own rules would seem more reasonable than those set by remote governments. Ownership would also internalize some of the costs of cheating, since to the extent that their underreporting of catches

reduced stocks and the reliability of information, owners would suffer the consequences.

Sole ownership would also reduce incentives to "high-grade," or to discard smaller fish in favour of larger fish. Since discarded fish are often killed, high-graders would hurt their own future prospects. In contrast, the holders of numerically based quotas, who could take their quantity of fish regardless of the health of the stock, have incentives to discard fish of lower value and to meet their quotas with only the highest quality fish yielding the greatest market value (Townsend and Wilson 1987: 321). This practice has been observed in Atlantic trawlers filling their quotas for groundfish (Copes 1986: 285). Quota systems, however, may be designed to discourage high-grading. Assigning ITQs to a percentage of the catch would help internalize the costs of high-grading. Alternatively, the problem could be overcome by assigning separate quotas for fish of various values or by assigning a single quota by value rather than weight (Copes 1986: 289; Neher et al. 1988: 115).

The by-catch problem—the catching of fish not of the target species—also lends itself to sole-ownership solutions. Those holding geographically based property rights would be allowed to catch any kind of fish within a given area. They would have incentives to maximize the catch mix and to waste no species. In contrast, single species quotas, if rigorously enforced, can create incentives to discard by-catch, killing the fish in the process. Managers often treat the catch of fish in which fishermen hold no quota as an offence, inadvertently encouraging fishermen to dump incidentally caught fish in order to avoid penalties (Pearse 1992: 118). New Zealand's fishermen did just that when their government insisted that by-catch be forfeited to it. The government wisely responded by expanding the scope of property rights: it made by-catch species tradeable commodities, enabling fishermen to trade quota species for by-catch and reducing their incentive to discard otherwise valuable fish (Jeffreys 1995: 310).

Private ownership of geographic areas would also help address other issues associated with managing complex ecosystems where the fishing of one species affects other species, their habitat, their food sources, or their prey. Under a quota system, rights to single species may create conflicts between the owners of interdependent species. If fishermen in one fishery can ignore the costs they impose on other fisheries, both rights holders and the ecosystem

suffer. It may thus be necessary to give a single owner complete control over two or more interdependent fisheries (Wilson and Dickie 1995: 153–66). If the owner of a fishery that is harvested in a way that inevitably harms another also owned the harmed fishery, his harvesting techniques would only harm himself.

One of the strongest arguments for sole ownership is that it limits the opportunities for government interference in a fishery. Many quota systems maintain considerable government involvement, and the quota holders generally remain outside of management. The government continues to set the total allowable catches, to manage fish stocks, to assign quotas, and to assume responsibility for environmental protection (Scott 1988: 27). Furthermore, in systems in which rights are assigned to absolute quantities of fish, the government may intervene to assign more rights or to buy back excess rights if the total catch is larger or smaller than expected (Pearse 1992: 117–18, 120). But governments have miserably mismanaged British Columbia's salmon fishery, and a quota system would do little to eliminate the factors that have encouraged irresponsible management. Governments would not acquire new incentives or abilities to establish sustainable harvest levels, they would remain susceptible to political pressures, and the costs of their unwise decisions would continue to fall not on themselves but on the people who have a stake in the fishery (Anderson and Leal 1993: 168, 180; Hide and Ackroyd 1990: 62, 68).

Political control over quotas has created uncertainty and resentment, and prompted wasteful lobbying in Alaskan and New Zealand fisheries (De Alessi 1996: 4). In the words of one New Zealander,

> The spectre of too many fishermen chasing too few fish has been removed by the Individual Transferable Quota system only to be replaced by special interest groups fishing politically on land for a share of the resource. The spectre now is of government carving and recarving a pie whose worth is diminishing steadily in proportion to the time and effort spent squabbling over who is to get what . . . Political allocation makes property rights insecure which, in turn, discourages investment. And when resource pies get sliced politically, one person's gain is always another's loss. (Hide and Ackroyd 1990: 1–2)

The uncertainty that results from government control over the fisheries results in a weakening—and devaluing—of fishing rights. Without confidence that quotas are secure, fishermen will have fewer incentives to make long-term investments in efficient harvesting techniques or stock enhancement, potential purchasers will be unwilling to invest in them, and bankers will be unwilling to lend money against them (Hide and Ackroyd 1990: 35; De Alessi 1996: 4; Neher et al. 1988: 115).

Self-managed ownership would remove decisions about catches and habitats from the political arena. After the initial allocation of rights, the matter would leave governments' hands. Rights holders, or the associations or corporations representing them, would set catch limits, monitor fishing activity, enforce regulations, and exclude interlopers. Owner-managers would base harvest levels and methods on economic rather than political factors. Since economically efficient harvest levels are likely to be sustainable, economic decisions are more likely than their political counterparts to be ecologically sound. And those who wished to acquire rights would not waste resources lobbying government; they would simply purchase rights from others in market transactions that left buyer and seller better off.

Market successes from sole ownership of fisheries

A dearth of experience with sole ownership of Pacific salmon makes it difficult to confirm the theoretical advantages of strong property rights discussed above. While a number of aboriginal communities once assigned exclusive rights to Pacific salmon, significant differences in fishing pressures, environmental threats, and legal regimes call into question the usefulness of applying their solutions to contemporary problems (Meggs 1991: 53–54; Higgs 1982: 58–60; Johnsen 1986: 41–67). More directly applicable are the experiences of the owners of inland Atlantic salmon fisheries. Despite the differences between the species—Atlantic salmon remain healthy when they return to their spawning grounds, making river fisheries feasible—similar economic principles should govern both.

Experience on both sides of the Atlantic ocean confirms that strong property rights provide fisheries owners with increased incentives to reduce fishing pressures, implement conservation measures, and enhance stocks and their habitats. Knowing that they will gain from any activities that better their stocks, those

holding secure rights are more likely than others to engage in ecologically beneficial activities. And, they are likely to put their resources to the highest valued use—generally sports fishing rather than commercial fishing.

In New Brunswick, where 45 percent of the salmon rivers are privately owned, and another seven percent are leased from the Crown, private owners have proven superior managers of salmon. Their exclusionary practices have long been credited with protecting salmon stocks on the province's rivers. In the words of Wilf Carter, the former president of the Atlantic Salmon Federation, "[p]rivate ownership historically has given better stewardship of salmon rivers, and better management. It's limited the pressure on the fishery" (Lee 1995b: A8) New Brunswick's private owners generally restrict access to their waters, hiring wardens to keep away poachers, and limiting the number of people fishing in their pools. Many lodges and camps on the Miramichi and Restigouche rivers accommodate one or fewer guests per pool on any given day. Their practices contrast strikingly with those of the provincial government, which allows unrestricted public fishing in more than 70 percent of the salmon waters it manages (Lee 1995a: A10).

It is in the owners' economic interest to limit fishing pressures. Good salmon pools are valuable real estate, fetching millions of dollars on the market. They also attract anglers willing to pay hefty fees for a few days' fishing. Several lodges charge between CDN$350 and CDN$450 per day for accommodations and fishing, while some charge almost CDN$1000 per day (Lee 1995d: A2, 1995e: A2, 1995n: A1, A4). These prices differ dramatically from those charged by the province. A New Brunswick salmon licence cost CDN$17.12 for the 1995 season, a sum that even the province's director of fisheries management has described as "a pittance." The exclusive right to fish in a stretch of Crown reserve water costs only an additional CDN$20 per day (Lee 1995c: A2).

Recent experience in Quebec confirms that people will conserve stocks when they will benefit economically from doing so. In the 1970s, Micmac Indians gill-netted salmon at the mouth of Quebec's Cascapedia River, threatening the river's salmon stocks and the sports fishery that depended on them. The netters had no incentive to reduce their catches, until, in 1982, they were granted half the seats on the board governing fishing in the river and a promise of half of the jobs generated by the river's sport fishing

industry. Enjoying broader rights, they realized that salmon were of far greater value to the sports fishery than to the net fishery: a salmon worth CDN$3 a pound in a net generates CDN$176 a pound in the sports fishery. They decreased their netting accordingly, contributing to a dramatic improvement in salmon fishing on the Cascapedia (Pearse 1988: 82–84; Lee 1995p: A1, A12).

Iceland's inland sport fishing industry also illustrates the ecological and economic benefits conferred by strong property rights. There, all rivers are privately owned by those, mainly farmers, whose land borders them. Owners guard against poaching. Through fishing associations, they control the number of people fishing on a river. The fishing association for the 40-kilometre-long Nordura River permits only 12 rods a day on all of its 250 salmon pools combined. Such measures have helped create and protect some of the world's most prolific salmon rivers (Lee 1995f: A8, 1995g: A1, A12).

As in New Brunswick, Iceland's fisheries owners have strong economic incentives to limit pressures on their stocks. The owners of productive rivers can get rich from fish. Farmers often lease their rights to angling clubs, outfitters, or individual fishermen, and anglers pay between CDN$100 and CDN$3,000 a day for good fishing opportunities. A farmer, bringing in on average CDN$260 for each fish caught in his waters, can earn more than CDN$100,000 annually from a fishing club. Others also benefit; each salmon caught brings, on average, CDN$1,000 into Iceland's economy (Mavericks 1995; Lee 1995g: A1, A12.

Iceland's rights holders further reduce pressures on their fisheries by buying out their competitors. In 1989, the Angling Club of Reykjavik, which holds leases on 10 rivers, permanently bought out one of the country's few remaining salmon netting operations (Lee 1995g: A12). On a grander scale, the North Atlantic Salmon Fund, based in Reykjavik, has raised $4 million—in part from those who hold rights to salmon fisheries in both Europe and North America—to purchase the rights of ocean fishermen off Greenland and the Faroe Islands who catch salmon that would otherwise return to rivers to spawn. The fund purchased the Faroe Island's salmon quota for 1991 for about $800,000, and has renewed the agreement every year since. In 1993 and 1994, the fund purchased Greenland's salmon quota for about $400,000. It holds purchase options on future quotas for both countries, and intends to exercise them (Lee 1995i: A16).

In Scotland, whose rivers are world-famous for salmon fishing, exclusive, transferable rights to fish for salmon and trout, generally separate from any land rights, are held by individuals, companies, associations, trusts, fishing clubs, or the Crown. Here again, owners looking after their financial interests will limit pressures on their stocks. Anglers pay over CDN$2,600 a day to fish on a good salmon river. Productive rivers are extremely valuable. Sale prices have reached CDN$35,000 for each salmon in the average annual catch, or CDN$3.5 million for a stretch of river producing an average of 100 salmon a year (Williamson 1993, 1991: 18; Lee 1995j: A12, 1995m: A7).

To protect their fisheries, many Scottish owners set up district fishery boards, which appoint bailiffs to police the rivers (Williamson 1993). More importantly, Scottish owners have a long history of excluding others from their fisheries by buying out those who have rights to fish, and then operating their newly acquired fisheries at a reduced intensity or shutting them down completely. Those with rights to rod fisheries were purchasing rights from net fishermen as early as the eighteenth century. In the late nineteenth century, rod fishermen removed nets from the rivers Dee and Tay. More recently, anglers have established the Atlantic Salmon Conservation Trust (Scotland) to purchase and retire salmon netting stations along the coast, in rivers, and in estuaries. Netting stations currently cost approximately CDN$50 per fish in the average annual catch. As salmon farming reduces the price of salmon and lowers the profitability of ocean netting operations, buy-outs of commercial netting operations will become less expensive (Williamson 1993, 1991: 11, 14–15; Lee 1995j: A1, A12, 1995k: A6; Anderson and Leal 1991: 129–30).

Fisheries owners do not just conserve existing stocks; they improve them. Confident that they will be able to reap the rewards, they invest considerable money and effort in both stock and habitat enhancement. Iceland's Ranga River is a case in point. A volcanic eruption in 1941 killed most of the river's fish, and deposited on the river bed sand that prevented salmon eggs from surviving. The river supported little fishing for decades; in 1984, fishermen caught only 10 salmon in the river, in 1985, only 17. In the late 1980s, a fishing guide started experimenting with restocking the Ranga's salmon using smolt ponds. He soon acquired a lease on the entire river, where he runs a lodge and outfits fishermen; he stocks the river with between 75,000 and

100,000 smolts every year. Landowners are also improving the river, creating fish lies and spawning areas and installing a fish ladder at a large waterfall. Their efforts have paid off, making the Ranga one of the more productive rivers in the country. In 1995, anglers caught over 1,500 fish in the river. They paid handsomely to do so; the cost of accommodations and fishing on the Ranga can be as high as CDN$800 a day (Lee 1995h: A1, A12).

The owners of fishery rights in Scotland similarly understand that their economic future is tied to their fisheries' health. They often form district salmon fishery boards that protect and develop their stocks by operating hatcheries and improving rivers. Such efforts are not restricted to sport fishermen; those with commercial netting rights in bays and estuaries help finance enhancement projects (Williamson 1993: 3; Lee 1995l: A1, A7).

Strong property rights also provide fisheries owners with the authority—and the legal tools—to protect their resources from pollution. Those holding strong property rights in fisheries need not rely on the governments to protect their interests; they may take matters into their own hands and sue those who violate their rights. Nowhere is this better exemplified than in Britain, where virtually all inland fisheries, except those in public reservoirs, are privately owned (Clarke 1967: 149–51, quoted in Dales 1968: 68). British fisheries owners may sue those who, by polluting or obstructing lakes or rivers, harm their assets. Many who own or lease threatened fisheries have sought the assistance of the Anglers' Co-operative Association (renamed the Anglers' Conservation Association in 1994), a self-supporting, voluntary organization with 16,000 members that finances common law court cases, helping fisheries owners obtain both injunctions to clean up rivers and damages to compensate for losses. The Association has brought some 2,000 actions since its founding in 1948; it has lost only two (Anglers' Co-operative Association 1996, n.d.; ACA staffer, personal communication April 12, 1996; Bate 1994: 14, 1993: 52–54).

In its early years, the Anglers' Co-operative Association won legal battles against a paper mill, steel and iron companies, a chemical company, a power station, polluting farmers and numerous local authorities that fouled rivers with sewage (Anglers' Co-operative Association n.d.; Bate 1993: 54–61, 72–74). In the 1990s, its targets have included a sewage treatment plant whose phosphate-laced effluent killed fish in a Welsh lake, a water company

applying for permission to withdraw water from small streams near Canterbury, and the owner of a trout farm who allowed rainbow trout to escape into a river inhabited by brown trout (Anglers' Co-operative Association 1993). Association members have frequently brought cases against those polluting places far away from their fishing areas. Pollution in an estuary or in the lower reaches of a river may prevent salmon and trout from migrating upstream to spawn, and courts have ruled that such chemical pollution creates a material obstruction to the free passage of fish, violating the rights of fisheries owners (Bate 1993: 57, 60).

The Anglers' Co-operative Association has found that even fishermen who do not take their cases to court will benefit from the preventative effect of possessing actionable rights; the credible threat of a lawsuit has served as an excellent deterrent. As the Association's successes have gained prominence, polluters' determination to defend themselves in court has decreased, and cooperation has often replaced resistance. When approached by the Association, a number of corporations and local governments have decided against building facilities that would pollute or obstruct rivers or have taken measures to correct existing pollution in order to avoid lawsuits (Bate 1993: 68–70).

Occasionally, fishermen in Canada have likewise exercised their rights to protect their privately held fisheries from pollution. New Brunswick, where the Crown granted fishing rights along with land to early settlers, and where many fisheries remain in private hands, has seen several such challenges. One early case was launched by the Nepisiquit Real Estate and Fishing Company, which owned a number of lots along the last 20 miles of the Nepisiquit River, where its members fished for salmon and trout. During the summer of 1912, the Canadian Iron Corporation discoloured the river's waters while grinding up and washing its iron ore, a process that caused leakage into one of the river's tributaries. The fishing company went to court, claiming that the pollution injured spawning grounds and practically destroyed its fishing privileges. Although Canadian Iron denied the charges, the judge hearing the case had visited the site and had seen the dirtied, muddied water. He explained that a riparian (a person living beside a lake or a river) "has the right to the full flow of the water in its natural state, without any diminution or pollution" (*Nepisiquit Real Estate and Fishing Company, Ltd.* v. *Canadian Iron Corporation, Ltd.* (1913), 42 N.B.R. 387 (Ch.D.): 392). The iron mill

had unquestionably altered the Nepisiquit's natural condition, and the judge accordingly restrained the company from polluting the river. Happily, the salmon soon returned (Lee 1995o: A10).

In 1963, New Brunswick riparians sued for a different kind of damage to their fisheries—that caused by hydroelectric dams. Three dams built in the 1950s and 1960s on the St. John River and its tributaries virtually destroyed a great salmon river system. The Tobique Salmon Club owned 50 miles of riparian rights along the Tobique River, a tributary of the St. John. When the New Brunswick Power Commission built its three dams, the club sued, settling for CDN$400,000, which it used to purchase a fishing camp on Quebec's Matapedia River (Lee 1995q: A1, personal communication April 12, 1996).

Even armed with the strongest property rights, fisheries owners do not always prevent harmful developments or eliminate pollution. Sometimes it is cheaper for polluters to compensate or to buy out their victims. As long as fisheries owners can obtain injunctions against polluters, they can make meaningful choices between defending their fishery and accepting an offer from a polluter. Armed with the power to shut a polluter down, fisheries owners are in a strong bargaining position. They may insist that the pollution stop; alternatively, they and the polluter may reach a satisfactory compromise involving the installation of abatement equipment or operational changes. Or, the polluter may make it worthwhile for the fisheries owner to leave the business. The resulting bargains, freely and fairly arrived at, reflect the values and circumstances of all directly involved parties.

Possibilities for sole ownership of fisheries in British Columbia

In Eastern Canada and in Europe, exclusive property rights have both encouraged and enabled individuals and firms to conserve salmon stocks and to preserve their habitats. How applicable are such experiences to British Columbia? It obviously would not be feasible to follow the owners of Atlantic salmon in restricting harvesting of Pacific salmon to spawning grounds, since the fish will have deteriorated, and will be of little value, by the time they arrive there. The extent to which specific stocks could be controlled by restricting fisheries to river mouths has been much debated but little studied. Some have suggested that it is precisely that opportunity for control that makes salmon particularly well suited

to private ownership. Others argue that the solution may be more appropriate for some rivers and species than others. For example, it may be better to catch chum, which have already begun to deteriorate as they approach their spawning streams' mouths, further offshore. Still others, noting offshore fishing's important contribution to the understanding of stock sizes, have warned that confining fishing to terminal fisheries near rivers of origin could jeopardize this knowledge (Wilen 1988: 259; Walters 1995: 43; Pearse 1982: 44–45, 47).

While limiting fishing to the mouths of rivers holds promise and warrants further investigation, technological innovations may obviate the need for such limitations. Many recent innovations are variations on branding, the mechanism long used to identify and claim cattle grazing in the commons. Implanting tiny computer chips in fish permits them to be identified as they pass by a monitor. Genetic fingerprinting makes it possible to learn in which stream a salmon hatched; analysis of the elemental content of one scale from a fish likewise makes possible the identification of the fish's natal stream. A simpler solution involves identifying salmon with an externally visible mark indicating their origin. As the rivers of origin become readily identifiable, it becomes possible for the original owners of the salmon to assert ownership over them even while they are at sea. Those who caught marked fish could be required to release them unharmed or to pay their owners for them (De Alessi 1996: 9–10; Walters 1995: 45, 54, 67).

While enforcement may remain difficult, it is hard to believe that private owners would fare as badly as have public agencies. Experience confirms the theory that private owners will invest in the monitoring and enforcement required to protect their valuable assets. Indeed, both theory and practice encourage optimism on all fronts. Both suggest that private owners will be better managers, that they will operate the fishery more efficiently, and that, under their care, British Columbia's salmon stocks will recover their former abundance.

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