North American Pacific Salmon:

A Case of Fragile Cooperation

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I. Introduction

The United States and Canada have a long and rocky history of alternating between cooperating on joint management of Pacific salmon harvests and squabbling over their respective shares of the catch. In June 1999, the two nations signed the Pacific Salmon Agreement, which amends the 1985 Pacific Salmon Treaty[1] (U.S. Department of State, 1999). In so doing, they emerged from a six-year period of discord marked by bickering, failed negotiations, and conservation-threatening harvest practices. Their hope is that the new agreement will provide a foundation for stable, mutually beneficial cooperative management of these fisheries. In reaching the agreement, the two nations consented to temporarily set aside a long-smoldering dispute about the equitable division of the harvest and to focus on implementing multi-year abundance-based harvesting regimes that would foster conservation and restoration of depressed salmon stocks. This recent progress, as well as difficulties that have been encountered over the years, may provide lessons for other fisheries agreements.

In many respects, Canada and the United States are well situated to achieve cooperative management of these fisheries. During the UN Third Conference on the Law of the Sea, Canada and the United States cooperated in insisting that LOSC Article 66 be adopted, which effectively banned directed high seas fishing for salmon (Burke, 1991; United Nations, 1982). Specifically, Article 66(1) of the LOS Convention directs that "[s]tates in whose rivers anadromous stocks originate shall have the primary interest in and responsibility for such stocks."[2] The primary purpose of Article 66 – strongly supported by both Canada and the U.S. – is to prevent high seas fishing for salmon and other anadromous fish.

This largely eliminated Russian and Japanese interceptions of North American salmon and left Canada and the U.S. free to jointly manage their salmon stocks as "shared" fishery resources. Although rumors about illegal, unreported catch on the high seas circulate from time to time, there is little evidence that such activity has a significant impact on North American salmon stocks. Even though the two nations are free from the complication of high-seas interceptions, the coordination problem for North American Pacific Salmon is complicated and involves at least 4 major players: Canada, Alaska, Washington/Oregon and 24 Treaty tribes located in Washington, Oregon and Idaho. In addition, most of these players must contend with competition among sub-units (e.g. competing commercial, sport and Native American/First Nations harvesting groups) for access to the salmon resources. The four major players differ in their management objectives and levels of bargaining power. Furthermore, both management objectives and the balance of bargaining power have changed over time.

Unfortunately, neither the 1985 Pacific Salmon Treaty, nor the earlier Fraser River Convention[3] were well designed to accommodate such changes. As incentives to cooperate shifted, disputes ensued. Two major periods of discord can be identified. The first lasted for roughly two decades prior to the signing of the 1985 Pacific Salmon Treaty (Munro and Stokes, 1989). The second ran for six years prior to the conclusion of the new Pacific Salmon Agreement in June 1999 (Huppert, 1995; McDorman, 1998a; Munro et al., 1998; Miller et al., 2001).

One of the most prominent features of the Pacific salmon case is the fact that environmental shocks have played a major role in destabilizing efforts to cooperatively manage these fisheries.

For example, the most recent period of disarray was fueled by a dramatic increase in northern salmon abundance, coupled with declines in southern stocks. These trends upset the expected division of benefits under the terms of the 1985 Treaty.

Another critical factor in the history of U.S./Canadian negotiations over Pacific salmon is the existence of pronounced asymmetries among the players. These are driven by the impacts of salmon migratory behavior on access to shared stocks, by differences in the relative productivity and resilience of various salmon populations, and by differences in commercial, cultural and aesthetic valuations of the resources. The significance of such asymmetries was enhanced by the fact that until recently, the parties had considered only a narrow range of options for sharing the benefits of the fishery and had ignored the potential role for side payments. Specifically, bargaining had focused primarily on defining commercial harvest shares, with the benefits accruing to each jurisdiction coming only from its own harvests. This narrow approach, together with the fact that the parties often tended to ignore the reality of one another's individual rationality positions and differing management objectives, severely hampered their efforts to find cooperative solutions. Whenever cooperation broke down, aggressive competitive harvesting tended to deplete stocks and reduce the rents derived from the shared resources.

The1999 Pacific Salmon Agreement represents a break from the past in that, for the first time, side payments are implicitly incorporated in the agreement. This provides greater flexibility and allows the distribution of benefits to be effectively decoupled from the allocation of commercial harvests.

At present, the new agreement has been in place for nearly three full fishing seasons, allowing for relatively peaceful operation of these fisheries. Although the success of the agreement is yet to be determined, it appears to have laid the groundwork for improved cooperative management of these shared stocks. Ultimate success can only be judged by the extent to which the agreement facilitates stable cooperation over the long term, while promoting such diverse goals as preservation and restoration of salmon resources, efficient management of fisheries, and a mutual perception that the distribution of the benefits is equitable.

Like the previous arrangements, this new agreement will have to stand the test of changing conditions. The changes now challenging the Pacific salmon industry include dramatic declines in prices for commercially harvested fish as a result of increased competition from the farmed salmon industry, and restrictions on harvesting levels and methods designed to protect fragile stocks. In addition, natural fluctuations in stock productivity will continue. Recently, there has been some evidence of a reversal of the trends of the past two decades, in that many southern stocks are rebounding, while some Alaskan stocks have declined. There also have been some puzzling changes in the migratory behavior and survival characteristics of some salmon stocks that will significantly reduce the potential contribution of those stocks to each nation's fisheries. Specifically, over the past few years, some of the Fraser River's late sockeye runs have entered the river several weeks earlier than their historical pattern only to die in massive numbers prior to spawning (PSC, 2002).

II. Nature of the resources and fisheries

Pacific salmon are anadromous fish. In other words, the adults migrate from the ocean to spawn in rivers and streams. After hatching, the juveniles spend a period of weeks to years in the freshwater (depending on species and stock), then disperse into the ocean environment where they feed and mature before returning to their natal streams to spawn and die (Pearcy, 1992).

While some salmon stocks remain in coastal areas throughout their lives, many others spend a year or more in a long-distance migration across the feeding grounds of the subarctic Pacific. As a result of their homing behavior, there are literally hundreds of biologically distinct salmon stocks spawning in streams and rivers along North America's west coast.

Many of the salmon stocks originating in the rivers of western North America are transboundary resources because they cross interstate and EEZ boundaries during their oceanic migrations. Most stocks follow a general pattern of swimming north as juveniles to feed in more productive waters and then return along the coast from north to south as they head to their spawning streams (see Figure 1).

Figure 1

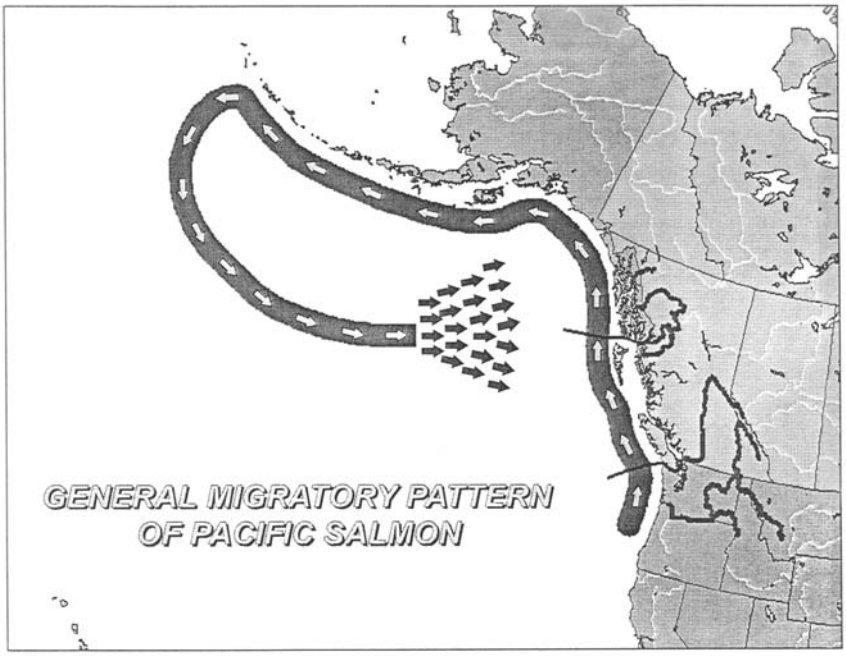


Figure 1
Source: Canada (1997), Department of Fisheries and Oceans, *Pacific Salmon Treaty: Moving Towards Equity and Conservation,* paper prepared by Bud Graham, Director of Fisheries Management, Department of Fisheries and Oceans, Pacific Region.

Most of the commercial harvest of salmon occurs as the adults return to spawn, generally not directly in the rivers, but rather in marine areas where several species and stocks are intermingled. To some extent, this harvesting pattern is driven by the fact that several species deteriorate in quality as they approach their spawning streams, and thus can command higher prices if caught earlier, while they are still in mixed-stock areas (Interviews, 1998-2001)[4]. In addition, Alaskan fishery officials explain their policy of deliberately moving fishing effort into the offshore mixed stock area as helping to prevent local overharvesting while reducing monitoring and management costs (Interviews, 1998-2001). As a result of these harvesting patterns, it is inevitable that harvesters from each jurisdiction will "intercept" some of the salmon heading to spawn in the rivers of other jurisdictions. In addition, the migration patterns create

distinct asymmetries by putting Alaska in a good position to intercept British Columbia's salmon while allowing B.C. harvesters to easily target many of the coho and chinook stocks heading south to the Columbia River and other U.S. west coast streams. Canada's Fraser River sockeye and pink salmon have historically been easily accessible to Washington state fishing vessels operating in the Strait of Juan de Fuca. However, the relative accessibility of those stocks to the U.S. and Canadian fleets has not been constant over time, as will be discussed below.

Pacific salmon once supported thriving Native American cultures from northern California to Alaska. When settlers poured into these regions in the late 19th and early 20th centuries, they quickly displaced the native fisheries by intercepting the returning salmon before they reached the traditional in-river fishing sites of the Native communities (American Friends Service Committee, 1970; Higgs, 1982; Glavin, 1996; Schwindt, 1995). The rapid growth of commercial harvests soon threatened to deplete salmon runs. All of the jurisdictions responded to the threat by creating agencies to regulate gear and fishing seasons. However, these authorities could never fully control harvests of the salmon stocks within their purview, because many salmon could be caught as they passed through the waters of neighboring jurisdictions on their return migration. Such "interceptions" became increasingly important over time as fishing effort expanded in offshore areas.

Commercial fisheries exploit five species of Pacific salmon: chinook *(Oncorhynchus tshawytscha)*, coho *(O. kisutch*), sockeye *(O. nerka)*, pink *(O. gorbuscha)*, and chum *(O. keta*). Chinook, sockeye and coho, are the most valuable species. They are currently marketed primarily as fresh or frozen fish, although there is still a substantial market for canned sockeye. Pink salmon is a low-valued species used primarily for canning, but its abundance in Southeast Alaska in recent decades has supported the development of a major fishery. All five species are harvested in Alaska, British Columbia, and Washington State, while only coho and chinook are harvested in significant numbers in Oregon and California. Harvesters employ a variety of gears, including troll lines, purse seines, and gill nets. To some extent, these harvesting groups target different species, but some salmon stocks encounter a gauntlet of competing gears.

Sport fisheries, primarily for coho and chinook, have grown in the post -World War II era and now account for a sizeable share of the harvest of these species outside of Alaska (see, e.g., NPAFC, 1999). There are also minor sport harvests of pink, sockeye and chum salmon. Steelhead *(O. mykiss)* is a related species that is important to in-river sports fisheries, but it is neither commercially targeted nor significantly affected by marine fisheries, and thus is not subject to international management.

Most rivers along the Pacific coast of North America from California's Central Valley northward once supported salmon runs. Where streams have been heavily modified by human activities, some wild salmon runs have disappeared, while others have diminished. In many rivers, wild runs have been supplemented and/or supplanted by hatchery production. For example, prior to its development, the Columbia River system had been the major source of salmon south of the Canadian border. Over the course of the twentieth century, a series of dams harnessed the Columbia and its major tributary, the Snake River, to provide most of the region's hydroelectric power as well as irrigation water, flood control and navigation benefits. Natural salmon stocks in the Columbia system declined, and were partially replaced by hatchery production located in the lower part of the basin. Several Columbia Basin stocks have been listed as threatened or endangered under the U.S. Endangered Species Act, and efforts are underway to restore those populations (U.S. Federal Register, 2000). In British Columbia and Alaska, the

natural variety and abundance of salmon populations is greater than in the south, and there have been fewer adverse impacts from destruction of spawning habitat.

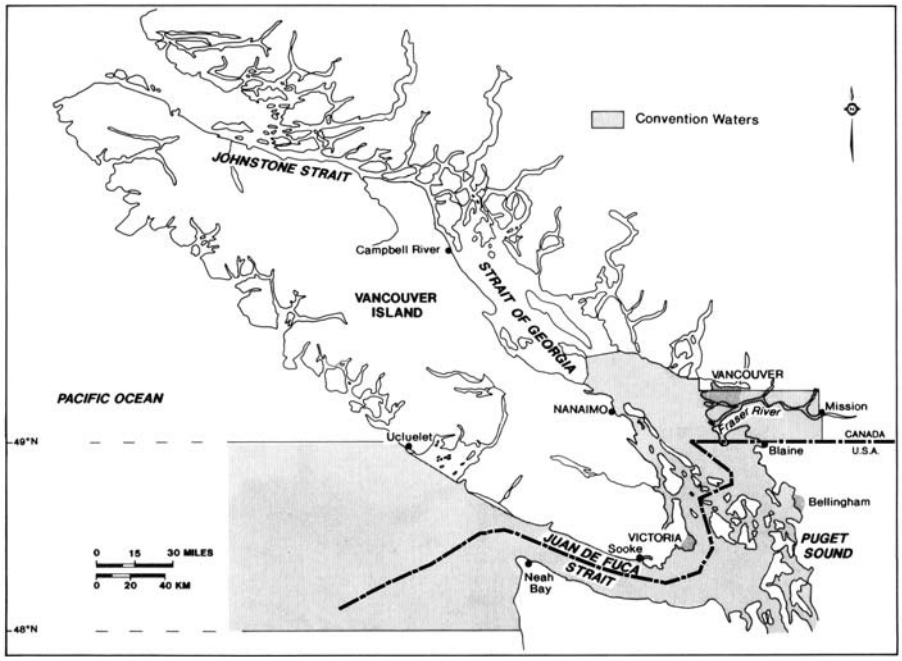
Human manipulation of the spawning environment has been a major source of change, but natural variations in both the ocean and freshwater environments also play a significant role in driving changes in salmon abundance. Long-term changes in ocean conditions have had profound impacts on the productivity and migratory behavior of several important stocks. These natural changes, together with changes caused by human activities, have altered the parties' bargaining objectives and expected payoffs from cooperation. Much of the recent turmoil in U.S. / Canadian relations over Pacific salmon management can be understood as the consequence of such changing circumstances.

III. History of bi-national cooperation

Canada's Fraser River system, with its abundant runs of sockeye and pink salmon, has long been a focal point of bi-national efforts to cooperate on Pacific salmon management. Although the Fraser River lies entirely in Canada, its mouth lies close to border between British Columbia and Washington State. A large portion of the salmon spawning in that system typically approach the river through the Strait of Juan de Fuca where, historically, they had been harvested by Washington State fishing vessels.

The Fraser River Convention, ratified in 1937, divided the harvest of Fraser River sockeye and pink salmon as well as management and restoration costs equally between the two nations (Munro and Stokes, 1989). Under the Convention, the International Pacific Salmon Fishery Commission (IPSFC) regulated harvests within an area designated as "the Convention Waters" which encompassed the traditional fishing grounds for those stocks (Roos, 1996) (Figure 2).

Figure 2



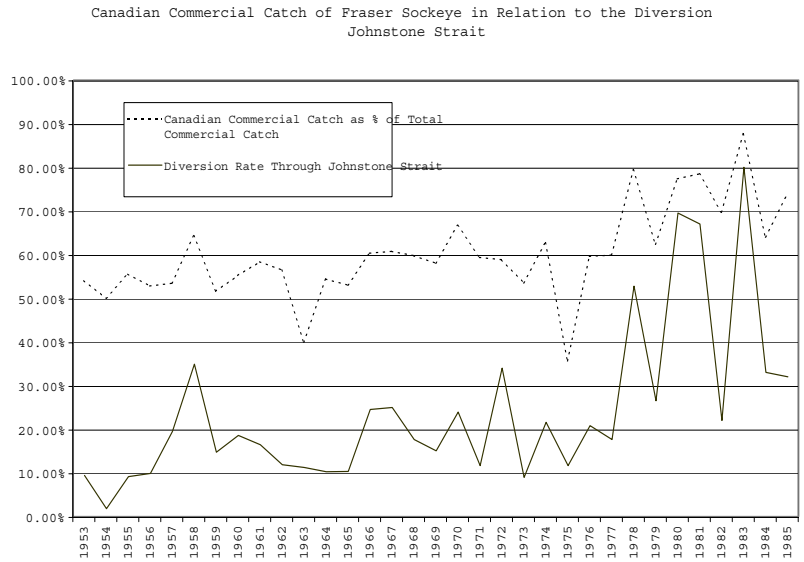
Convention waters fishing area under 1937 Convention

Support for the Fraser River Convention waned during the 1960s, when the Canadians became unhappy with their agreement to share one-half of the Fraser River salmon. Canadian harvesters also had discovered that they could circumvent the IPSFC regulations by fishing for Fraser sockeye in Georgia Strait, outside of the Convention waters. This was made increasingly possible and profitable by a change in the migratory habits of the returning Fraser sockeye.

As the Fraser sockeye return southward to spawn, the run splits as it rounds Canada's Vancouver Island. The (normally larger) fraction, that passes seaward of the island, must pass through the Strait of Juan de Fuca, between the U.S. and Canada. There it is accessible to harvest by both countries' fleets. The remaining fraction of the stock, returning by way of Johnstone Strait, stays shoreward of the island, entirely within Canadian waters, and accessible to the Canadian fleet outside of Convention waters (see Figure 2).

Toward the end of the Convention period, when negotiations were well underway for the subsequent Pacific Salmon Treaty (1985), a sudden shift in ocean conditions contributed to a marked increase in the average Johnstone Strait diversion rate. In the period 1953–1976, the diversion rate averaged 16.4%. From 1977 through 1985, the average diversion rate jumped to 46%.[5] This shift surely strengthened Canada's hand in the negotiations leading to the 1985 Treaty. In fact, Canada clearly took advantage of unusually high diversion rates in 1978, 1980, 1981, and 1983 to concentrate harvesting efforts outside of Convention Waters, and thus increase its overall share of the harvest (Figure 3).

Figure 3



In addition, Canadian harvesting effort intensified off the west coast of Vancouver Island, leading to increased interceptions of U.S. origin coho and chinook salmon heading south to spawn in the Columbia River system and other west coast streams. While these pressure tactics made the affected interests in Washington and Oregon eager for a settlement, Alaskans saw little potential benefit from entering into the proposed Treaty. Given the general north-to-south

migration pattern for returning salmon stocks, Alaskan fisheries are in a natural position to intercept many Canadian and some southern U.S. chinook stocks, while few Alaskan stocks are vulnerable to Canadian interception. Alaska yielded only when the U.S. Treaty tribes involved in the negotiations promised that as long as the Treaty remained in force, they would not sue to extend the landmark Boldt decision[6] to restrict commercial salmon harvests in Alaskan waters[7] (Yanagida, 1987; Munro et al., 1998).

The Treaty created the Pacific Salmon Commission whose primary task was to develop and recommend fishing regimes intended to govern the overall harvest and allocation of the salmon stocks jointly exploited by the U.S. and Canada. The body of the Treaty lays out a set of principles to guide the Commission in this task. Of central importance are the conservation and equity objectives or principles, which the Treaty expresses as follows:

> *...each Party shall conduct its fisheries and its salmon enhancement programs so as to:*
>
> *a) prevent overfishing and provide for optimum production; and*
>
> b) *provide for each Party to receive benefits equivalent to the production of salmon originating in its waters* (Pacific Salmon Treaty, Article III).[8]

The Treaty then advises the Parties to consider the following factors in the application of these objectives or principles: the desirability of reducing interceptions, the desirability of avoiding disruption of existing fisheries, and annual variations in abundances of the stocks. The Treaty attempted to establish a balance among competing objectives and interests, but it failed to resolve major tensions between individual rationality and strongly held perceptions of equity.

The bargaining framework implemented in 1985 called for frequent renegotiation of the fishing regimes. Negotiations were to follow a consensus rule in that the Canadian and American delegations were to agree on new regimes. Pursuant to the U.S. legislation implementing the 1985 Treaty, the American delegation was composed of three voting Commissioners representing Alaska, Washington/Oregon and the Treaty Indian Nations, and a fourth non-voting Commissioner from the U.S. federal government (U.S. Senate, 1985; Yanagida, 1987; Schmidt, 1996). In most circumstances, this arrangement gave each of the three voting U.S. Commissioners an effective veto over the work of the Pacific Salmon Commission in developing new regimes.

From the beginning, there were fundamental differences of opinion regarding the meaning of the so-called equity clause (Article III (1) (b)) and whether or not it should take precedence over other objectives and factors expressed in the language of the Treaty. (Shepard and Argue, 1998; McDorman, 1998a; Yanagida, 1987; Strangway and Ruckelshaus, 1998).

One major difficulty is that it is not an easy task to quantify the interceptions balance. Commercial harvest value is only one possible measure of the value of a salmon – and it is certainly not the most important measure in cases where individual stocks are threatened with extinction, support highly valued sports fisheries, or have significant cultural value to native communities that have relied on those stocks since time immemorial. Thus, while all interests recognized that the equity principle was meant to reflect economic values and did not amount to a simple fish-for-fish balancing rule, they could legitimately disagree on how the balance was to be measured. In order to reach agreement in 1985, the Parties chose to finesse the equity point by putting off any decision on measurement.[9] Their failure to firmly establish the content and

role of the equity clause allowed it to become a major bone of contention when incentives to continue cooperation changed.

For the first few years, the Commission could ignore the equity issue because Canada remained satisfied that interceptions were roughly in balance. Attention focused, instead, on designing regimes that would encourage enhancement and conservation efforts by guaranteeing that the party making the investment would be able to reap the rewards from the *expected* subsequent increase in production. The regimes established by the Commission relied heavily on the use of "ceilings." For example, the initial agreement specified a cap of 7 million fish over each of two successive 4- year periods for Washington State harvest of Fraser sockeye (Pacific Salmon Treaty, Annex IV, Chapter 4*)*. This approach was based on the notion that capping harvests in the intercepting fishery would allow any increase in run strength to primarily benefit the nation of origin – whose hatchery or habitat restoration investments had presumably caused the increase.

However, while enhancement and restoration efforts certainly can increase the number of salmon available for harvest, the effects of such actions easily can be dwarfed by the impacts of natural environmental fluctuations. Negotiators on both sides underestimated the power of such natural changes, and the optimistic assumptions on which they relied proved grossly incorrect.

During the negotiation period leading to the 1985 Treaty, changes were already apparent in the ocean environment that would contribute to the Treaty's later difficulties. In the mid-1970s, ocean conditions in the North Pacific changed dramatically. Significant warming of coastal waters was reinforced and sustained by a sequence of closely spaced ENSO (El Niño-Southern Oscillation) warm events from 1977 to 1998. Associated changes in patterns of upwelling, nutrient transport and related physical and biological processes led to favorable survival and growth conditions for salmon in the Gulf of Alaska, while survival rates plummeted for stocks that enter the marine environment along the U.S. west coast.

These climate-related changes contributed to a nearly ten-fold increase in Alaskan salmon harvests, with harvests rising from fewer than 22 million salmon (of all species) in 1974 to three successive record highs in 1993, 1994, and 1995 (Figure 4). At the 1995 peak, Alaska harvested close to 218 million salmon. Another high was attained in 1999 when Alaska harvested almost 217 million salmon.

Harvests of most salmon species in northern British Columbia fared well through the mid-1990s. However, by the late 1990s it had become apparent that many of British Columbia's southern and interior coho stocks were severely depleted (Pacific Fisheries Resource Conservation Council, 1999). In addition, British Columbia's chinook harvests have declined steadily (Hare et al., 1999; PSC Joint Chinook Technical Committee, 1999).

Southward, commercial chinook and coho catches in California, Oregon, and Washington dropped abruptly in the late 1970s, hitting El Niño-related lows in 1983 and 1984. A dramatic but brief recovery in 1986 and 1987 then gave way to a precipitous decline to record low harvests in the mid 1990s (Figure 5). Abundance declined to the point that some stocks faced a significant risk of extinction. The natural sources of low salmon survival and stock productivity in the south were compounded by other stresses, including habitat degradation, mortality at dams, water diversions, and questionable hatchery practices. By 1998 to early 1999, the cumulative effects of all of these stresses led the U.S. National Marine Fisheries Service to list a

number of these stocks as “threatened” under the Endangered Species Act (U.S. Federal Register, 2000).

Figure 4

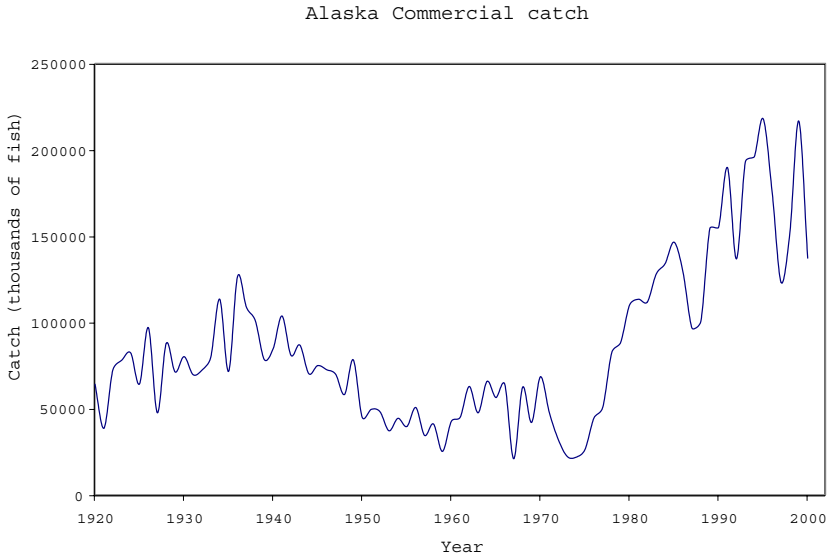
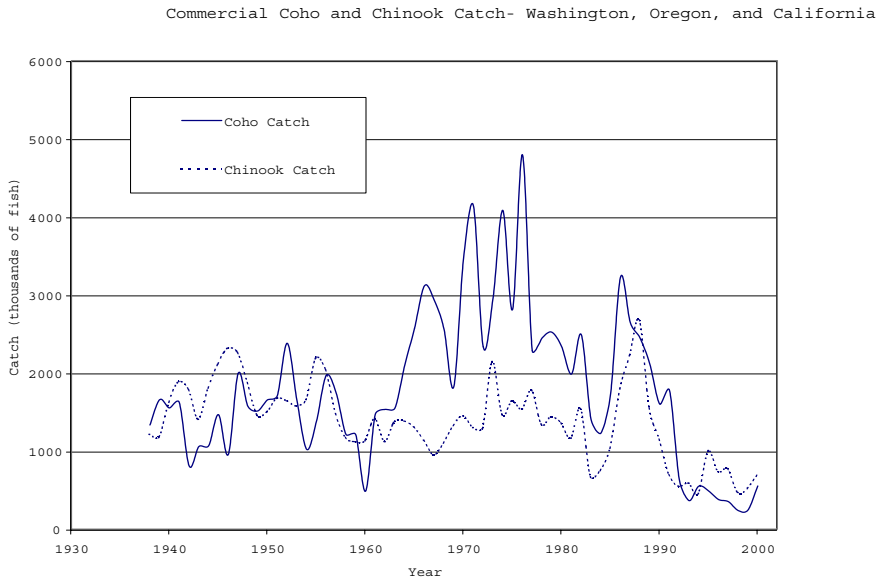


Figure 5



The explosion in salmon abundance in northern waters led Alaskan harvesters to fish harder in areas where British Columbian salmon are intermingled with Alaskan fish. In particular, the dramatic increase in pink salmon abundance in southeastern Alaska led to increased interceptions of Canadian sockeye from the Skeena, Nass, and other northern British Columbia rivers. The Canadians proved unable to redress the growing interceptions imbalance because declining southern coho and chinook stocks prevented Canadian harvesters from reaching the agreed-upon ceilings for harvests of those stocks along the west coast of Vancouver Island. At the same time, fishing interests along the U.S. West Coast claimed that Canada's efforts to reach the ceilings resulted in overharvesting of those fragile stocks.

From Canada's perspective, there appeared to be a mounting interceptions imbalance in favor of the U.S., but little U.S. willingness to make concessions to redress the imbalance. From Alaska's perspective, the requested concessions promised to entail only uncompensated costs. While the southern U.S. jurisdictions demonstrated a willingness to make further concessions on their harvests of Fraser River salmon in exchange for reduced Canadian harvesting pressure on southward-bound coho and chinook, they really had few bargaining chips to bring to the table.

By 1993, the growing frustrations caused cooperation to collapse when the parties proved unable to agree on a full set of fishing regimes. While clearly binding in a legal sense, the treaty-based cooperative resource management regime had nonetheless foundered, because it had not met the test of "time consistency".

The dispute festered for several years with occasional dramatic incidents, including Canada's adoption of an "aggressive fishing strategy," in 1994 (Fraser River Sockeye Public Review Board, 1995), and a three-day blockade of the Alaska Ferry by approximately 150 Canadian fishing vessels in the port of Prince Rupert in 1997. The two federal governments made several efforts to resolve the impasse, but it appears that they achieved a solution only after there was a significant shift in bargaining objectives coupled with a new-found willingness to try more flexible tools to achieve equity objectives.

Significant deterioration in the condition of Canada's fall chinook and coho stocks over this period (Pacific Fisheries Resource Conservation Council, 1999; DFO, 1998a,b) appears to have triggered a shift in Canadian bargaining objectives with respect to bi-national harvest management. The Canadian focus shifted radically from insistence on an equitable interceptions balance to the need to tailor harvesting efforts to protect the stocks that had become severely depleted. The ESA listings in the Pacific Northwest most likely colored the positions of the southern U.S. participants in the negotiations as well. This shift in focus was instrumental in breaking the previous deadlock.

Throughout 1998 and early 1999, federal negotiators from both sides worked to hammer out the details of the 1999 Pacific Salmon Agreement that was adopted on June 30. The vigor with which the two governments pursued the negotiations suggests that both sides recognized that they had much to lose if they failed to resolve their differences. The depleted condition of Canadian and southern coho and chinook stocks had caused the value of the remaining fish to increase dramatically – not as harvested fish, but as brood stock and for their contribution to symbolic, cultural and aesthetic values. It appears that fishery officials had come to the realization that the unfavorable shift in ocean conditions had substantially depressed the productive potential of these stocks, so that previous harvesting rates simply could no longer be sustained. In the end, both Canada and the southern U.S. parties made major concessions in the

negotiations, while they allowed Alaska's harvests to remain relatively unchanged under the new arrangements.

Organizational Structure and Decision-Making

As noted above, under the terms of the 1985 Pacific Salmon Treaty, each nation appoints a set of Commissioners and the two sides must reach consensus on any set of proposed regimes. However, on the U.S. side, the voting Commissioners, representing Alaska, Washington - Oregon, and the 24 Treaty tribes, must first reach internal consensus for a regime to take effect. In any event, the Commission is only empowered to recommend fishing regimes to the relevant authorities. Except in the case of the Fraser River sockeye and pink fisheries, state or federal authorities retain full power to enforce fishing regulations consistent with the regimes. In the U.S., the states have authority within three nautical miles of the coast and federal jurisdiction (exercised by regional management councils) extends from 3 to 200 n. miles offshore, as well as within three nautical miles where the fisheries in question are predominantly located outside three miles. In Canada, the federal government has authority over fisheries. When the parties failed to agree on new fishing regimes, each state or federal authority would independently develop and implement its own management regime.

The Commission's organizational structure involves three geographically oriented panels. The Northern Panel focuses on stocks arising in southeastern Alaska, northern British Columbia, and the transboundary rivers. The southern panel focuses on all stocks originating south of Cape Caution in British Columbia, other than Fraser River sockeye and pink salmon, which are the purview of the Fraser River Panel. As the successor to the older International Pacific Salmon Fisheries Commission (IPSFC), the Fraser River Panel has greater powers and responsibilities than the other panels. All three panels perform the functions of reviewing post-season harvest reports, pre-season harvest management plans, and salmon enhancement programs. The Fraser River Panel also has responsibility for active in-season regulation of Fraser River sockeye and pink harvests in the area designated as Fraser River Panel Area Waters (essentially the same as the "Convention Waters" depicted in Figure 2). In addition, prior to the 1999 Amendments to the Treaty, the primary task of the panels had been to provide recommendations to the Commission for the development of fishing regimes. Information obtained from interviews with former Commissioners and Panel members suggests that much of the actual negotiation over the details of the regimes took place in the Panel meetings.

Several joint technical committees report to the Commission and its Panels. There are currently joint technical committees for chinook, coho, chum, data sharing, and selective fishery evaluation. In addition, geographically focused technical committees provide analyses for the Fraser River, northern boundary, and transboundary areas (PSC, 2002). There had formerly been a Joint Interceptions Committee. Its few reports tended to document the wide range of uncertainty surrounding the estimates and the disparate views of the parties as to the magnitude and direction of interceptions imbalances (PSC-JIC, 1993). That committee ceased issuing reports when the dispute over equitable allocation escalated.

Procedural transparency has never been a hallmark of U.S./Canadian negotiations over Pacific salmon management. This observation applies equally to the pre-Treaty period, the activities of the Pacific Salmon Commission and its Panels and to the government-to-government negotiations leading to the new agreement. For example, it appears that some of the Canadian participants in the negotiations leading up to the 1985 Treaty were taken by surprise when the

U.S. instituted the internal consensus rule embodied in the subsequent U.S. implementing legislation (U.S. Senate, 1985; Interviews, 1998-2001). That rule put the Canadian side at a distinct disadvantage and proved to be a significant barrier to compromise in the work of the Commission.

Schmidt (1996) characterizes the rule as formally turning the negotiation process into a "two-level game" in which the U.S. side had to first solve an internal benefit allocation game before negotiating with Canada. Although the Canadian federal government exercised final control over Canadian positions in the negotiations, there was some evidence of such two-level processes on the Canadian side, as well. For example, in our interviews with Canadian fisheries officials, more than one respondent noted that it took many years of concerted effort to convince all of the B.C. fishing interests that coho exploitation rates were too high and needed to be reduced. Efforts by Canadian fishery officials to accommodate competition across harvesting groups kept coho harvest rates high until the late 1990s, to the detriment of both Canadian and U.S. stocks, ultimately requiring more drastic policy adjustments (Interviews, 1998-2001).

During the Treaty period, most of the meetings of the Pacific Salmon Commission and its Panels have not been open to the public. Prior to the 1999 Agreement, our interview respondents indicated that the Commission meetings tended to be large, and overly formal. They also reported that true dialog was hindered by the fact that each side would come to meetings with rigid, pre-set positions that had been worked out in internal national caucuses. This approach made it very difficult for the parties to negotiate compromises.

In the course of the struggle to find a solution to the crisis that prevailed from 1993 through 1998, the two national governments engaged in high-level negotiations, to which the members of the Pacific Salmon Commission were not privy (Interviews, 1998-2001). Early in the dispute, the national governments also invited a neutral third-party diplomat, Christopher Beebe of New Zealand, to act as a mediator (Reuters, 1995). His non-binding recommendations were to be kept secret if rejected by either side. The U.S. rejected his 1996 report, but an unknown party leaked its "secret" contents (favoring Canada's position on the equity dispute) to the region's newspapers (Westneat, 1997). That development only served to further inflame the quarrel. Following the failed mediation effort, the two governments experimented with a stakeholder process in which fishing interests on both sides of the border met to discuss options. They also commissioned a joint report by two eminent individuals from each nation, David Strangway of Canada and William Ruckelshaus of the U.S., on the sources of the dispute and potential remedies. The Strangway and Ruckelshaus Report concluded that both sides would need to make concessions in order to restore cooperation, and that the Parties should concentrate their efforts on developing a "practical framework for implementing Article III of the treaty [the Principles Article] leading to the establishment of longer-term fishing arrangements."[10] The Report also advised the governments to terminate the stalemated stakeholder process and to undertake a comprehensive review of the Pacific Salmon Commission to make it "a functional institution for the preservation and management of the Pacific Salmon."[11]

The two national governments then intensified their high-level negotiations (largely by-passing the Commission and the various stakeholder groups), and eventually concluded the 1999 Agreement. It appears that the national governments deliberately eschewed "transparency" during the final stages of the negotiation process. This may have been necessary to escape the traps into which the Commission's negotiations had fallen. As one interview respondent put it, "Broad participation can have a downside" (Interviews, 1998-2001).

However, the approach created considerable disappointment among the excluded Commissioners and stakeholders, and some expressed feelings that the process left them with little sense of "ownership" in the outcome (Interviews, 1998-2001). This was particularly true on the Canadian side, where major changes in domestic salmon harvest policies, to move salmon to sport and aboriginal fisheries and to protect weak stocks, had been implemented while the negotiations were in progress. The simultaneous loss in harvesting opportunities, and in access to the decision process, left some of the affected Canadian interests feeling disenfranchised (Interviews, 1998-2001).

Changes Introduced by the 1999 Agreement

The 1999 Agreement does not replace the 1985 Pacific Salmon Treaty, but rather places additional obligations on the Parties and replaces the expired short-term harvest management regimes, contained in an annex to the Treaty, with new longer-term arrangements (McDorman, 1998b; U.S. Department of State, 1999). In reaching the agreement, the two nations consented to temporarily set aside the dispute about equitable division of the harvest and to focus on implementing multi-year abundance-based harvesting regimes that would foster conservation and restoration of depressed salmon stocks. Rather than relying on short-lived, ceiling-based regimes whose frequent renegotiation provided ample opportunity for disagreement and brinkmanship, the new agreement establishes a long-term commitment to define harvest shares as a function of the abundance of each salmon species in the areas covered by the Treaty. For example, for 12 years beginning in 1999, the U.S. share of Fraser River sockeye will be fixed at 16.5% of the TAC (total allowable catch). This represents a decrease from the post-1985 average U.S. share of 20.5%, but an increase relative to the share actually attained by the U.S. fleet during the 1992–1997 salmon war period (DFO, 1999; O'Neil, 1999).

The new arrangements for chinook, which will be in effect for ten years, take account of the fact that the various fisheries along the coast differ considerably in the extent to which they rely on healthy or depressed chinook stocks (U.S. Department of State, 1999). Accordingly, the agreement designates two types of fisheries: 1) abundance-based management (AABM) fisheries will be managed based on indices of the aggregate abundance of chinook present in the fishery, without specific reference to any individual stock; 2) individual stock-based management (ISBM) fisheries, which are primarily located in fishing areas near the spawning rivers, will be managed based on the status of individual stocks or groups of stocks (e.g., on the basis of the evolving status of currently endangered or threatened stocks).

In accordance with this change in approach, the major work of the Commission has shifted from negotiating the terms of new management regimes to implementing the terms of the current long-term abundance-based regimes, and developing similar regimes for those stocks for which abundance-based regimes had not been worked out at the time of the signing of the 1999 Agreement. The Commission also defines its current mission to include improving scientific cooperation, and supervising joint efforts to assist the recovery of weak stocks, (PSC, 2002).

A major feature of the agreement is its provision for two endowment funds. Initial funding is to be provided entirely by the U.S., but either Party may make additional contributions, and even third parties may contribute, with the agreement of the two states. The annual investment earnings on the Northern Boundary and Transboundary Rivers Restoration and Enhancement Fund (Northern Fund), and Southern Boundary Restoration and Enhancement Fund (Southern Fund) are to be used to support scientific research, habitat restoration and enhancement of wild

stock production in their respective areas. The U.S. agreed to contribute $75 million to the Northern Fund and $65 million to the Southern Fund over a four-year period. The first installments have been made, and balance of the commitment is to be remitted in fiscal year 2003. Canada also contributed $250,000 (CND) to each of the two funds in November 2000 (PSC, 2002). Since the funds (at this stage) come overwhelmingly from the U.S., they can be viewed as implicit side payments from the U.S. to Canada. The funds, together with new U.S. federally funded vessel buyback programs and significant additional U.S. federal funding for salmon habitat restoration efforts (PSC, 2002), also constitute side payments from U.S. taxpayers to salmon harvesters.[12] To date, there has not been a sufficient yield from the endowment funds to finance any significant projects. In fact, the funds have incurred substantial losses as a result of recent stock market declines (Interviews, 2002). So, it will be some time before their potential can be realized.

IV. Progress and Prospects

The 1999 Agreement represents a significant step forward. The shift in focus toward conservation represents a broadening in the scope for bargaining, while the abundance-based management formulas still accommodate Alaska's strong interest in the commercial harvesting sector. Abundance-based management is better suited than the ceiling approach to maintaining appropriate levels of harvesting effort when there are large natural changes in salmon abundance. In addition, the experimental use of side payments in the form of the endowment funds opens the door for a more flexible approach to allocating the benefits of these fisheries.

Although these developments are laudable, the new agreement has not laid all sources of conflict to rest. A particular weakness is the fact that effective implementation of abundance-based management requires that the parties agree on the indices of abundance that will be used to set their harvest targets. Abundance, however, is very difficult to forecast in advance of the arrival of the runs. Forecasting models are imperfect, and data inadequacies and the uncertain and uneven impacts of variable marine and river conditions impair the accuracy of the forecasts. Precise estimates are likely to remain an elusive goal. The best that reasonably can be expected should be mutual willingness to accommodate uncertainty and to share the risks arising from imprecise abundance estimates. However, the new agreement leaves the Commission's institutions for decision-making largely intact, and has not dealt directly with the problem of unstable incentives to cooperate. Thus, scientific uncertainties may loom larger than ever as a source of conflict (McDorman, 1998b). One of the most pressing needs will be to find a way around this problem.

Already, there have been some disagreements between Alaska and the Chinook Technical Committee (CTC) regarding the abundance estimates to be applied in determining allowable chinook harvests (ADF&G, 2000). The abundance estimates generated by the CTC's chinook model are very sensitive to the data used to calibrate the model, and when a recalibration alters the abundance indices, catch limits are to be adjusted accordingly.[13] In 2000, Alaskan officials disputed the results of a recalibration that would have called for significant reductions in Alaskan harvests. Efforts are under way to re-assess and improve the forecasting model. However, for chinook, as for all of the other salmon species, the ability to forecast abundance and the stock composition of the fish harvested in any particular area is hampered by data inadequacies and by the uncertain and uneven impacts of variable marine and river conditions.

Despite these difficulties, the CTC model stands out as a good example of the advantages of scientific cooperation. Work on the CTC model began in the pre-1985 Treaty period. The model was subsequently refined, and continues to be improved. It allows the Treaty participants to work with a common, formal representation of a highly complex system. The model forces them to make their assumptions explicit, and allows each to replicate the results obtained by the others. While the model is not transparent to members of the general public, the professionals can use it to mutually explore the implications of any given set of assumptions. Some interview respondents voiced the opinion that shared, jointly-developed models and assessment methodologies are critical to fostering a common understanding of the state of the resource and the potential consequences of alternative management actions (Interviews, 1999; 2002).

The 1999 Agreement called for replacing the former Committee on Research and Statistics with a new Committee on Scientific Cooperation. In January 2001, the Commission adopted Terms of Reference for the new committee (reiterating the wording of the 1999 Agreement) and in February, 2001 each country appointed two scientists to serve on the committee (Agreement, 1999, Attachment D; PSC, 2002). At present writing, it is too early to evaluate its influence or effectiveness.

The need to come to agreement on measures of abundance is not the only challenge that lies ahead. The new agreement calls for the development of abundance based regimes for all relevant stocks. However, in some cases, the scientific information that would be needed to develop robust long-term regimes simply does not exist. For example the development of abundance-based regimes for coho stocks proved to be particularly difficult and time-consuming. The 1999 Agreement directed the Parties to "… develop and implement, beginning in 2000 and extending through 2008, an abundance-based coho management regime for Washington and southern British Columbia fisheries" (Agreement, 1999, Annex IV Chapter 5, para. 5). However, the 2000 starting date proved to be unrealistic, and it took until early 2002 for the two sides to develop a workable abundance-based approach for coho. A major reason for the delay was the fact that Canada had not actively managed its own coho stocks until very recently, and thus lacks much of the data that would be desirable for the design of long-term abundance-based regimes. Nevertheless, the parties have now agreed to a management system that defines maximum exploitation rates and sharing formulas for each of several "coho management units" which are groups of individual populations with similar characteristics. There are schedules relating the maximum exploitation rates and national shares to the current status of the unit as defined by its placement into one of three stock-status categories (Interviews, September 2002). The arrangements also specify sanctions that will come into force in the event of harvests exceeding the applicable ceilings. In addition, scientists from both nations are cooperating to develop a formal Southern Panel area coho management model to facilitate joint analysis of the impacts of harvesting on these stocks.

Cooperative management of coho harvests in the northern area has been hampered by differing assessments of the status of those stocks and causes for the decline of some of Canada's interior coho stocks (PSC- TCNB, 2002). For example, Alaskan scientists attributed the major decline of Canada's Babine coho stock after 1978 to an abrupt drop in carrying capacity associated with Canada's expanded sockeye enhancement program in that system, while Canadian scientists linked the declines to increased exploitation (PSC- TCNB, 2002). In addition, most of Alaska's coho stocks are healthy and able to withstand higher exploitation rates than some of the intermingled B.C. stocks. While most of Alaska's coho do not have to traverse

long distances in the freshwater to spawn, many of the weaker B.C. stocks spawn far inland and consequently have lower inherent productivity due to in-river mortality. So for northern coho, divergent conservation versus harvest goals still present challenges to effective joint management.

There is language in the new regimes for the Transboundary Rivers and Northern Boundary area that is intended to clarify accounting of the harvest balance and its relationship to domestic conservation measures.[14] The Northern Boundary regime calls for cumulative accounting and payback of "overages" and "underages"– with balances to be carried forward in the event of failure to renew the regime at its expiration. The Transboundary Rivers regime further specifies that "if a shortfall in the actual catch of a party is caused by the management action of that Party, no compensation shall be made"(Agreement, 1999, Annex IV, Ch.1, para. 4). This particular provision appears to address Alaskan charges that part of the alleged interceptions imbalance had been due to inept Canadian efforts to manage Canadian harvests of weak stocks intermingled with abundant stocks.

V. Lessons from Other Fisheries

In the Pacific salmon case, one of the most pressing needs will be to keep disagreements about the abundance estimates from turning into crippling disputes. In that regard, Canada and the U.S. could look to the Russian/Norwegian cooperative framework in the Barents Sea for guidance. There, an independent scientific organization ICES (the International Council for the Exploration of the Sea) facilitates bilateral scientific cooperation (Stokke, et al. 1999; Munro, 2000). The two nations actively contribute to the research efforts of this multinational organization. While each nation also conducts independent fisheries research, they coordinate their activities bilaterally and through ICES, and rely on the ICES Advisory Committee on Fishery Management for stock assessments and recommendations regarding harvest levels and practices. The author understands that the Barents Sea case will be presented at this Expert Consultation.

ICES provides scientific information and advice in support of other international fishery agreements as well, notably in the Baltic and North Atlantic. Its broad base and independence from direct government control allow the recommendations coming from ICES to be viewed as credible and impartial. The independence of the ICES Advisory Committee is the factor that most clearly differentiates it from the newly appointed Standing Committee on Scientific Cooperation under the Pacific Salmon Commission.

There is a similar independent scientific organization in the Pacific – PICES (the North Pacific Marine Science Organization). It is a much younger organization than ICES,[15] that has not yet assumed a prominent role in providing scientific advice to fishery managers, but it is serving to coordinate international research efforts on such topics as atmosphere—ocean—ecosystem interactions and specifically the ocean ecology of salmon populations. It seems possible that PICES could grow into the role of an independent (and neutral) provider of timely management-oriented stock assessments, if the Parties to the Pacific Salmon Treaty were willing to encourage and finance that development. At the very least, the engagement of such an organization in the ongoing assessment efforts of the Commission and the relevant fishery agencies could serve to enhance transparency and to curtail unproductive disagreements about abundance indicators.

Experience in other fisheries also suggests that Canada and the U.S. could potentially go much further in their use of side payments to promote an equitable balance of benefits and to improve the efficiency of harvesting and restoration efforts. Given falling prices for commercially harvested salmon and the high cost of current efforts to restore ailing salmon populations in Puget Sound, along the Oregon coast and in the Columbia Basin, opportunities may exist to use additional side payments to further reduce harvesting pressures on sensitive stocks (Shaffer and Associates Ltd., 1998). For example, we might envision payments from U.S. Pacific Northwest power, forestry, water-use, and development interests to compensate Canadian (and perhaps Alaskan) harvesters for further reducing harvests of the threatened and endangered stocks.

The efforts of the Iceland-based, and largely privately supported North Atlantic Salmon Fund (NASF) to reduce ocean harvesting of Atlantic salmon provides a model. Since 1991, NASF has worked in collaboration with other organizations to increase the number of Atlantic salmon returning to their natal streams by paying commercial Atlantic salmon harvesters in the Faroe Islands not to fish their allocated quota. Similarly, in both 1993 and 1994, the NASF reached a comparable agreement with the commercial salmon harvesters of Greenland. In February, 2002, NASF also collaborated with the government of U.K. to buy out English drift net licenses along the British east coast, with the goal of increasing the number of salmon returning to Scotland's east coast rivers (IntraFish Bulletin, 2002). In addition, NASF was instrumental in convincing the Irish government to institute district-based quotas to reduce Irish commercial salmon harvests (NASF, 2002)

Recently, NASF and the North-American based Atlantic Salmon Federation (ASF), with financial support from the U.S. Department of Interior and Department of State concluded a five-year agreement with KNAPK (the commercial harvester's organization in Greenland) that terminates all commercial salmon fishing by the Greenland fleet and allows only a limited annual subsistence harvest. In exchange, Greenland's harvesters will receive financial support for the development of alternative fisheries (ASF, 2002). This deal was precipitated by the fact that the North Atlantic Salmon Conservation Organization (NASCO) which is the international regional fisheries organization that governs commercial harvests of North Atlantic Salmon, had allocated a quota of 55 tonnes (20,000 salmon) to the Greenland fleet for the year 2002, despite an ICES recommendation that the quota be set at zero to protect imperiled North American and Southern European salmon stocks. The situation replicates an interesting dynamic that has developed between NASCO and NASF over the past several years whereby NASCO has granted quota allocations that conservation interests view as dangerously high, leaving NASF and its collaborators to scurry to gather funding to buy out the allocations. While some observers view the situation as evidence of a dysfunctional conflict (World Wildlife Fund, 2002), it could alternatively be viewed as accommodating Greenland's individual rationality position while allowing for efficient closures of those fisheries.

North America's Pacific salmon fisheries also could draw lessons from abroad on the subject of optimizing the location of harvesting effort. The Russian/Norwegian Mutual Access Agreement (1976) governing their Barents Sea fisheries for Arcto-Norwegian cod – along with haddock and capelin, provides an example of the use of an access agreement to rationalize the management of a bi-national fishery. In that case, the cod migrating between the Russian and Norwegian zones spend their juvenile life stages in the former zone, and their adult life stages in the latter zone. It makes good sense for the cod to be harvested as adults, and the agreement has

allowed the Russians to take a substantial portion of their cod quota in the Norwegian zone (Stokke et al., 1999).

In the North American Pacific salmon case, a cross-border access agreement could be used to prevent accumulation of imbalances in harvests relative to the agreed-upon formulas. For example, if an imbalance in favor of the U.S. were to accumulate in a specific fishery, the U.S. national government could acquire existing transferable fishing licenses and rent them to Canadian fishing vessels. Those vessels could then use the licenses to fish in U.S. waters, with their harvests credited to the Canadian "account".

VI. Conclusion

The current management arrangements for Pacific salmon are not perfect, and much could be learned from the experiences of other fisheries. Nevertheless, the 1999 Agreement represents a significant effort to come to grips with some of the major sources of instability in previous efforts to cooperate. In particular, the new long-term abundance-based approach reflects an increased appreciation of the need to make harvesting arrangements responsive to variations in stock abundance, while avoiding the costly and uncertain process of frequent renegotiations. As such, it serves to maintain time consistency. However, possible disagreements over abundance estimates have not been eliminated.

Ongoing efforts to enhance scientific cooperation and to further develop and refine joint management models should help to reduce the scope for such disagreements. The success of these collaborative efforts will depend importantly on the provision of adequate financial support and on the engagement of a community of credible and impartial scientists in these efforts.

In addition, the introduction of side payments, in the form of contributions to the endowment funds, enhances the flexibility of the agreement and may allow it to better accommodate the inherent asymmetries among the parties to the agreement. Such side payments provide another avenue for achieving an equitable balance of the benefits of these fisheries when an acceptable balance cannot be achieved through harvests alone. The full potential of this approach is yet to be realized and it remains unclear if the endowment funds, as currently conceived, will yield sufficient returns to make a difference.

Finally, it appears that the two nations have given voice to a broader range of interests in the management of their shared salmon resources. The new focus on conservation responds to long-standing requests by environmentalists, sport, and Native American/First Nations groups in both nations to reduce commercial harvests of weak stocks to allow them to rebuild to healthy levels.

Just as the Parties to the Pacific Salmon Treaty could learn from experiences in other fisheries, their experiences also can provide lessons. Chief among these is the critical importance of providing flexibility to respond to changing circumstances, and to do so in such a way that all parties perceive real gains from continued cooperation. Side payments can be a valuable tool in this regard. Another important lesson is the value of common scientific understandings regarding the status of shared resources. In the Pacific Salmon case, divergent views on stock status contributed to past conflicts, while increasing scientific consensus has been an important factor in recent progress.

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NOTES:

[1] Pacific Salmon Treaty, March 18, 1985, U.S.-Can., 99 Stat. 7 [codified at 16 U.S.C. 3631-3644 (1997)].

[2] U.N. Law of the Sea Convention, December 10, 1982 at art. 66 (1).

[3] Convention for the Protection, Preservation and Extension of the Sockeye Salmon Fishery in the Fraser River System, May 26, 1930, U.S.-Can., 8 U.S.T. 1058.

[4] As part of a research project funded by the U.S. National Oceanographic and Atmospheric Administration (NOAA), the author and collaborators conducted interviews with a large number of individuals who had been active in Pacific salmon management and policy, in the work of the Pacific Salmon Commission and in the negotiations leading to the 1999 Agreement. To protect the confidentiality of our respondents, material obtained from the interviews will not be tied to any specific individual in this report.

[5] During the post-Treaty period, it has continued to be higher than the previous norm. The average diversion rate for 1977-1998 has been 48.2%.

[6] *United States v. Washington*, [W.D. Wash. 1974]. This court decision guaranteed to the Treaty tribes the right to harvest 50 percent of the salmon that would have ordinarily return to their traditional fishing grounds.

[7] Agreement between Alaska and the tribes in *Confederated Tribes and Bands v. Baldridge* (W.D. Wash. 1985).

[8] Pacific Salmon Treaty, March 18, 1985, U.S.-Can., 99 Stat. 7 [codified at 16 U.S.C. 3631-3644 (1997)].

[9] Memorandum of Understanding to the Pacific Salmon Treaty: Pacific Salmon Treaty, March 18, 1985, U.S.-Can., 99 Stat. 7 [codified at 16 U.S.C. 3631-3644 (1997)].

[10] Strangeway and Ruckelshaus, 1998, p. 8.

[11] *Id.* at p. 8.

[12] On December 15, 2000, the U.S. Congress authorized full payment of the $150 million committed to the Endowment Funds plus $30 million for a vessel buy-back program and up to another $100 million per year for coastal restoration (PCS, 2002).

[13] U.S. - Canada Agreement Relating to the Pacific Salmon Treaty, June 30, 1999, Annex IV, at Chapter 3, section 6.

[14] U.S. - Canada Agreement Relating to the Pacific Salmon Treaty, June 30, 1999, Annex IV, Chapters 1 and 2.

[15] PICES is only 10 years old, while ICES is close to 100 years old.