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Historical Perspectives of Resource Development Branch Activities in Restoring Anadromous Fishes to the St. Croix River, New Brunswick–Maine

by
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Freshwater and Anadromous Division
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HISTORICAL PERSPECTIVES OF RESOURCE DEVELOPMENT BRANCH ACTIVITIES IN RESTORING ANADROMOUS FISHES TO THE ST. CROIX RIVER, NEW BRUNSWICK-MAINE

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INTRODUCTION

Since before 1825, the St. Croix River on the Canada-United States boundary has been exploited—to the detriment of once abundant salmon, alewife and shad fisheries—to power sawmills and textile mills, to turn hydroelectric generators, and to carry industrial and municipal wastes. Progress in rehabilitation has been slow because of the continuing complexity of coordinating numerous federal, provincial and state agencies in the definition, regulation and enforcement of guidelines necessary to stem the deterioration of this river system. Accomplishments and policies of the various agencies have frequently been forgotten in the slow pace of progress. This account principally reviews the involvement of the Fish Culture Development Branch (1948-66) and the Resource Development Branch (1966-76), within the Canada Department of Fisheries (1930-69), Department of Fisheries and Forestry (1969-72) and Department of Environment (1972-76).

FROM THE BEGINNING

The first dams on the lower St. Croix, dating from 1793,[1] either included "fishways"—square openings intended for sluicing logs at low river levels, or slight rolls on the top of dams over which fish might pass at high water—or were wing dams which only partially obstructed the river.[2] However, no declines in the abundance of anadromous stocks were recorded prior to the construction in 1825 of the lowermost and now non-existent Union Mill Dam[2] (Fig. 1). Despite the provision of the Justice of the Peace in the County of Charlotte on December 10, 1824, that the builder—a resident of Saint Stephen—"will cause a good and sufficient fishway to be made in each and every mill dam which may be erected...in the said river on the said premises",[2] no fishway was provided prior to 1869.[3] Only the ability of a few salmon to work their way over the dam during high water and a two-year respite following the washout of the Union Mill Dam in 1846 prevented the complete decimation of salmon stocks during this period.

Pollution of the St. Croix commenced with the first sawmills which, during the first three-quarters of the nineteenth century, were located on the many dams between tidehead and Baring, Maine. Wastes discharged into the river consisted of sawdust, edgings, slabs, shavings and bark. These covered the river bottom and created not only a navigational hazard in the estuary but a generally "foul condition of the water".[3] In 1871, a law was passed by the State of Maine which prohibited the discharge of all but sawdust, but which was largely ignored until 1883. Logs which sank upriver prior to reaching the mills, especially between Woodland and St. Stephen, also cluttered the bottom.[3]

Tanneries, located upriver at Vanceboro, Princeton and Grand Lake Stream, Maine, and Forest City, New Brunswick, released waste products such as salt liquids, lime liquor, skin scrapings, tan liquor and tan bark to the St. Croix. This situation instigated in 1865 an investigation by a British Royal Commission.[3]

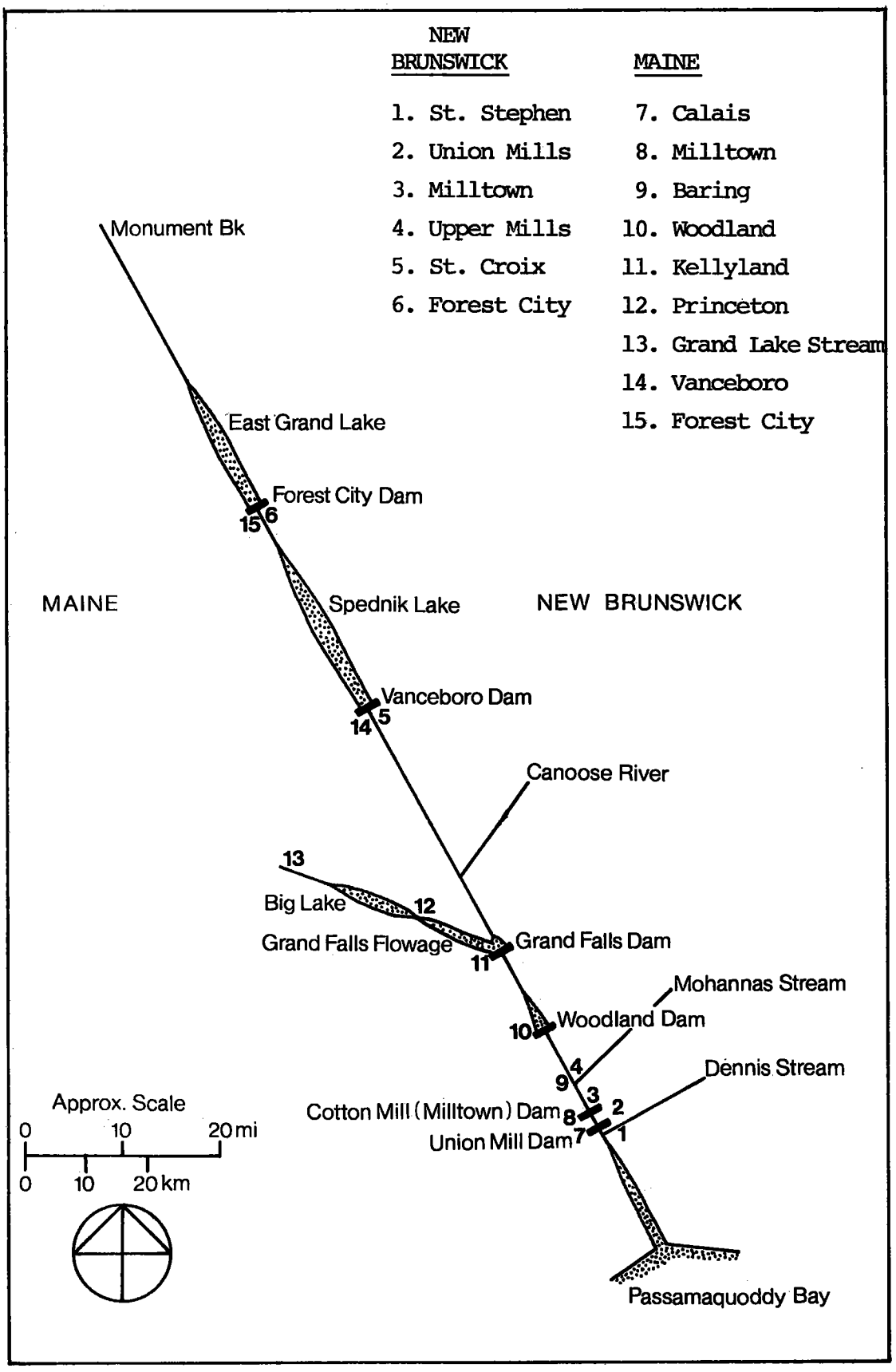

FIG. Schematic of dams, reservoirs and communities on the main stem St. Croix River, international and New Brunswick waters, circa 1930.

Interest in the nearly lost anadromous fisheries was revived in the 1860's by citizens of both New Brunswick and Maine. In 1869, two years after assumption by the Canada Department of Marine and Fisheries of the responsibility for enforcing fishway construction in any dam or obstruction where it was in the public's interest to do so, all dams including the Union Mill Dam were equipped with provision for passage of fishes.

With the "reopening" of the St. Croix, enthusiasm on the American side led to the stocking in 1881 by the United States Fish Commission[4] of 300,000 salmon fry into the headwaters of the St. Croix. Further plants of 200,000, 250,000 and 300,000 were made in 1886, 1887 and 1888. Canadian fry introductions of Saint John River origin consisted of 180,000 in 1888, 132,000 in 1890, 25,000 in 1891 and 40,000 in 1892. However, the questionable efficiency and maintenance of these fishways, combined with a riverbed choked with sawmill wastes, contributed to a very slow revival. Token sport and commercial fisheries existed through 1896, when findings of a joint commission investigating fisheries of the St. Croix were published.[3]

Recommendations by the Joint Commission numbered eleven, and included such remedial measures as prohibiting the disposal of any sawmill or tannery waste into the river, removal of sawmill deposits from tidal waters and maintenance in good repair of all fishways. The final reference suggested that in the event of the removal of all obstructions and polluting agencies, and the establishment and enforcement of suitable regulations, the two governments cooperate in increasing the supply of both anadromous and landlocked salmon by artificial means.[3] This last recommendation appears to have been the key to subsequent Canadian fisheries policy, and perhaps prevented in 1899 the liberation of 400,000 salmon fry, supposedly allocated for release into the St. Croix from the Saint John Hatchery.[4] One exception to the policy, however, was a plant of 144,000 salmon fry into the St. Croix in 1903.

Dams and fishways erected between the time of Confederation in 1867 and 1909 included the Cotton Mill Dam and fishway—built in 1881 and 1883,[4] respectively—and the Woodland Dam and wooden fishway of 16-ft width,[5] built in 1906. The textile mill associated with the former dam contributed significant chemical and biological wastes to the river. The latter dam provided power to the newly formed St. Croix Paper Company, which evolved as one of the major polluters of the St. Croix. By 1909, the cumulative effects of declining water quality, increasing numbers of obstructions and reduced plantings of salmon fry resulted in the near extinction of the salmon.

BOUNDARY WATERS TREATY

In 1909, the Boundary Waters Treaty by the Dominion of Canada and the United States established an International Joint Commission (IJC), complete with jurisdictional, investigative and administrative powers to carry out the aims of the treaty.[5] One

of the Commission's first tasks after public hearings in Calais in 1915 was to issue an Order of Approval, dated November 9, 1915, permitting the St. Croix Paper Company to operate a dam previously built at Grand Falls without a fishway. Operational water levels for Grand Falls flowage and discharge were defined, however; and surveillance was assigned by the IJC to an advisory and managing board, consisting of one official from each Canada and the United States, and named the International St. Croix River Board of Control. As for the absence of a fishway, the Commission apparently did not wish to override an unwritten pre-IJC agreement between the Maine Fisheries Department and St. Croix Paper Company. The Company had then agreed to "participate in the construction of screens at certain points to prevent the escape downstream of migratory fish" in lieu of incorporating a fishway in the new structure.[5]

A second Order of Approval was issued by the IJC on October 23, 1923, following a request by Canadian Cottons Ltd. for permission to make repairs to the mill and power plant at the Cotton Mill Dam. The result, at the insistence of the Commissioner of the Maine Department of Inland Fisheries and Game, was that the owners of the lowermost or Union Mill Dam and the upstream Cotton Mill Dam were ordered to reconstruct fishways in accordance with plans agreed upon by Maine and the Canada Department of Marine and Fisheries.[5] By 1929, the wooden fishway on the Woodland Dam was in such ill-repair that a hearing was called. At this meeting, the new Maine Commissioner, Mr. George J. Stobie, was less persistent than his predecessor; and agreed with officials of the Canada Department of Marine and Fisheries that abandonment of the Woodland fishway should be permitted, in view of the blockage at Grand Falls to upriver spawning grounds. No recommendations appeared concerning the continuing absence of an efficient fishway in the Cotton Mill Dam.[6]

DEPARTMENT OF FISHERIES, 1930

Letter files of the Canada Department of Fisheries between 1930 and 1949, when District Supervisors were required to submit fishway reports, provide information on the federal involvement in the St. Croix River. Much of the material concerns fish passage, screens and water levels, as well as flows at the Vanceboro and Forest City dams. The Vanceboro Dam at Spednic Lake, owned and operated by the St. Croix Paper Company, was the site of irregular gate closures in 1935, 1937 and 1942, which resulted in fish stranding and reported kills. The fishway was apparently reasonably well maintained through 1946, when it was first thought to require repair. By 1949, recommendations were to redesign the structure for more efficient passage of fish.

The Forest City Dam, owned by Eastern Pulpwood Company and the most upriver of the main stem dams (Figure), had fewer incidents of unwarranted gate closures between 1930 and 1949. The fishway was deemed in need of repair in 1941, and a letter

from the Department to the Company elicited a response indicating that repairs would be made in 1942. Correspondence does not indicate if the repairs were ever accomplished prior to the eventual rebuilding of the dam and fishway in 1949. The fishway design was the product of consultation between the Company, engineers of the Maine Department of Inland Fisheries and Game, and the Canada Department of Fisheries.

Some correspondence in the 1930's deals with the screening of lake outlets to prevent the emigration of landlocked salmon, which would subsequently be unable to return upriver because of the absence downriver of fishways. One such request was made by the State of Maine, on August 29, 1933, to share with the Province of New Brunswick the cost of screening East Grand Lake.[7] Included in that request, but never materializing, was the desire to share stocking responsibilities and to establish similar angling regulations in respective waters.

Between 1930 and 1949, little information is available on the water quality of the St. Croix. However, the joint report by Mr. C. Bruce, Fisheries Engineer, Canada Department of Fisheries, and Mr. Carl H. Crane, Engineer, Maine Department of Inland Fisheries and Game, noted in 1938 that portions of the river between the Milltown and Grand Falls dams were so filled with industrial wastes, particularly below Woodland, that no areas suitable as spawning grounds were present there.[6] District Supervisor Justason, Black's Harbour, New Brunswick, in attempting to initiate rehabilitation of the system in 1944, alluded to an earlier survey conducted in 1930, which determined the water of the St. Croix to be "non-fatal to salmon propagation".[8]

On the lower St. Croix in 1931, a representation was made by Mr. A.D. Ganong, M.P. from St. Stephen, that the Canada Department of Fisheries should give consideration to providing fishways for salmon at the Union Mill and Cotton Mill dams.[9] C. Bruce, Engineer of the Department, met with Mr. Wass, Supervisor of Fishways for the State of Maine, and Mr. Calder, Supervisor of Fisheries for the St. Stephen area, in Calais on August 4, 1931, and concluded that the efficiency of the concrete fishway on the American side of the Union Mill Dam could be improved considerably with a minimum of reworking. The Milltown Dam, however, was inadequate, because the only remaining provision for the ascent of fish consisted of a gate and wasteway on the downriver end of the spillway on the American side. A fishway, if constructed in the same general vicinity, was predicted to suffer from insufficient attraction water, while a potentially more efficient fishway at the tailrace of the turbines was deemed excessively expensive. Furthermore, the river remained completely blocked to fish passage only 8-10 mi above Milltown at the Woodland Dam.[9]

In the spring of 1934, the Union Mill Dam was breached by freshets, leaving but three dams on the lower St. Croix. By 1937, interest for a rehabilitation of the river was again heightened by Mr. Stobie, Maine Commissioner, who suggested

installing fishways in the three remaining dams.[10] Eventually, a meeting was convened in Ottawa between Canada Department of Fisheries officials and Mr. Stobie. This resulted in an agreement to have Messrs. Bruce and Crane—of Canada and Maine respectively—conduct a joint August survey of the St. Croix international waters, with a view to constructing fishways over dams at Milltown, Woodland and Grand Falls.[11] The resultant report concluded that:

1. With the installation of the best fishways practicable ($8-10,000 for the Cotton Mill Dam and $25-35,000 each for the Woodland and Grand Falls dams), there would be no assurance that they would be entirely efficient for the ascent of salmon;

2. The means available or possible for the descent of smolts and parent fish, particularly at Woodland and Grand Falls, were unfavourable; and

3. It was not economically feasible to make the river accessible for salmon under existing conditions.[6]

The conclusions were approved by both the Minister of Fisheries of Canada and the Commissioner of Inland Fisheries and Game for the State of Maine.

POST-WAR REHABILITATION, 1944

In August, 1944, the concept of a post-war rehabilitation of the St. Croix—specifically an order by the federal governments of Canada and the U.S.A. for the dam owners to install fishways and "put a stop to pollution"—was conceived by District Supervisor F.E. Justason,[8] Black's Harbour, and relayed by Col. A. Barry,[12] Chief Supervisor of Fisheries, Halifax, to the Deputy Minister of Fisheries, whereupon the idea was shelved. Another approach by Mr. Justason[13] to Deputy Minister Stewart Bates, in 1948, relayed the wish of the Schoodic Branch of the New Brunswick Fish and Game Protective Association to have fishways installed in the Woodland and Grand Falls dams. Although it is uncertain, Canadian Cottons Ltd. may have attempted to modify the rock-carved pools that comprised the "fishway" up the spillway of the Cotton Mill Dam. In 1954, that fishway was described by Mr. R.N. Gordon,[14] Division Engineer of the Canada Department of Fisheries, as an "attempt" which even with modification "could not be made efficient". In any event, a memo of July 13, 1949, by Dr. A.L. Pritchard,[15] Director of the new Fish Culture Development Branch of the Canada Department of Fisheries, delineated the progress to that date towards rehabilitation of the system. The essence was that officials of the State of Maine and the U.S. Fish and Wildlife Service (USFWS) were "looking over the whole situation". Mr. J. Catt of the Department was to meet with Dr. G.A. Rounsefell of the USFWS and Dr. W.H. Everhart, Fishery Division Chief, Maine Department of Inland Fisheries and Game. Engineers from both federal Services were to examine the

Cotton Mill Dam. Dr. Pritchard noted that the Fish Culture Development group within the Department was thus "co-operating with advice" but making no moves until a "final decision is reached".[15]

The files for 1949 contain no indication of a final decision, an absence which may or may not have been by design. The resultant action, probably politically rather than biologically expedient, was recorded in the Twentieth Annual Report, Department of Fisheries, 1949-50. In October, 1949, Canada cooperated with the USFWS and made an experimental planting of 100,000 fall fingerlings from the Saint John Hatchery into selected sites of the lower St. Croix.

Local interest in the rehabilitation of the St. Croix apparently subsided again until 1954, when Mr. R.N. Gordon, Division Engineer, Canada Department of Fisheries, described an inspection tour he took with Supervisor J. Catt and Biologist G. Wilson of the three dams on the lower St. Croix, following "recent agitation on the part of both American and Canadian groups for the revival of the once-important St. Croix River Atlantic salmon run".[14] Mr. Gordon made the following points:

1. Existing pollution in the river, which had prevented serious consideration for the construction of fishways, "had been removed".

2. State of Maine authorities had accepted the responsibility for installing fishways in the Woodland and Grand Falls dams, owned by American interests.

3. The State of Maine had advanced the position that, since the lower Cotton Mill Dam was owned by a Canadian company, a fishway installed there should be at Canadian expense.

4. Canadian Cottons Ltd. had ceased operations; and the dam was to be taken over by a new interest—New Brunswick Electric Power Commission (NBEPC) was unnamed at this date—which proposed to increase the head, thereby making any planning for a fishway in the existing structure premature.

5. A survey of the Cotton Mill Dam should be postponed until the future plans for the site were finalized or discarded.

In 1955, however, an article entitled "One major hurdle left in St. Croix campaign" appeared in the *St. Croix Courier*.[16] Contributed by Mr. Jack Ensor of the Schoodic Branch of the New Brunswick Fish and Game Protection Association, the article stated that the major obstacle preventing restoration of the St. Croix as a salmon fishing river was an inadequate year-round flow of water. Water pollution, Mr. Ensor related, had been

described as non-existent by federal officials; and the matter of providing adequate fishways in St. Croix dams would be investigated following the achievement of minimum water levels. He also noted that "in a few month's time, the International Joint Commission would make a study of the river from both power and fisheries angles".

REFERENCE TO IJC, 1955

On June 10, 1955, the Governments of the United States and Canada united in a Reference to the International Joint Commission to determine whether greater use could be made of the waters of the St. Croix Basin.[5] It was expected that the Commission would in its report indicate "what projects or regimes should be further considered to improve the use, conservation and regulation of the waters of the Basin"; "how the interests on either side of the Boundary would be benefited or adversely affected by any of the projects or regimes so indicated"; "the order of magnitude of costs..."; and the apportioning of costs.

In order to fulfil the terms of reference, the International Joint Commission on 9 September, 1955, established the International St. Croix River Engineering Board. One post each was accorded to the U.S. Corps of Engineers, the U.S. Power Commission and the U.S. Department of the Interior.[5] The Canadian appointments were Mr. J.D. McLeod, Chief Engineer, Water Resources Branch, Department of Northern Affairs and National Resources; and Dr. A.L. Pritchard, Director, Conservation and Development Service, Department of Fisheries. Two later appointments, on February 6, 1957, were a representative of the U.S. Public Health Service and Mr. J.R. Menzies, Chief, Public Health Engineering Division, Canada Department of National Health and Welfare.

To expedite field operations and to assist the Board, regional representatives of six associated federal agencies, and a state and a provincial representative were designated to an International St. Croix River Engineering Committee. Canadian representatives were Mr. J.E. Peters, Water Resources Branch, Department of Northern Affairs and National Resources; Dr. W.M. Sprules, Conservation and Development Service, Department of Fisheries; Mr. W.K. Sharpe, Department of National Health and Welfare; and Mr. K.B. Brown, New Brunswick Department of Lands and Mines. The representative for the State of Maine was Mr. R.H. Cobb of the Department of Inland Fisheries and Game. An alternate named for Dr. Sprules was Mr. J. Catt, Regional Supervisor, Department of Fisheries, Saint John, New Brunswick.[5]

Study sub-committees were initiated by the Engineering Committee to investigate and report upon specific aspects of the overall assignment. Sub-committees were established to consider fish and game, pollution, hydrology, power, land management and recreation; and were comprised of interested persons from both public and private sectors.

The Fish and Game Sub-Committee was first temporarily chaired by Mr. J. Catt of the Canada Department of Fisheries and later by Dr. W.H. Everhart, Maine Department of Inland Fisheries and Game. Membership included Dr. W.M. Sprules, Assistant Director, Conservation and Development Service, Department of Fisheries, Ottawa; Mr. R.H. Cobb, Commissioner, Maine Department of Inland Fisheries and Game, Augusta; and Mr. L.H. Bond of the latter agency. Biologists G. Wilson, N.E. MacEachern and K.E.H. Smith of the Fish Culture Development Branch, Department of Fisheries, provided biological and physical data from a 1956 survey of the main river and Canadian tributaries to the Sub-Committee.[17] Messrs. J.S. Fletcher and K.A. Havey of the State of Maine contributed similar information for the Maine tributaries.[18]

The Sub-Committee on Pollution consisted of eleven members, chaired by Dr. A.S. Campbell of the University of Maine.[19] Canadian members were Mr. A.J. Cameron, Department of Public Health, Fredericton; Dr. J.C. Medcoff, Atlantic Biological Station, St. Andrews; Mr. J.E. Peters, Department of Northern Affairs, Halifax; and Mr. W.K. Sharpe, Department of National Health and Welfare, Truro. Mr. Peters was also named to the hydrologic and power sub-committees.

Studies conducted by sub-committees in the summer of 1956 were reported to the Engineering Committee and, in turn, to the Engineering Board. Recommendations made by the Board to the IJC concerned:

1. Legal status of high water elevation at the dams on East Grand and Spednic lakes, installation of recording gauges and compilation of water-level data by the St. Croix River Board of Control;

2. "Favourable consideration to a plan for the redevelopment of hydroelectric power at the Milltown site";

3. Consideration of a "comprehensive program for the restoration of all fish and game interests within the terms of reference";

4. Early consideration to primary treatment of municipal waste, substantial (secondary) treatment of paper mill waste, with cost of reduction of pollution to be borne according to source; and

5. A plan for development of resources for recreation.[5]

In 1957, two uncertainties loomed on the horizon as having new impacts upon an already ailing river system. One was the proposal to modify the old Milltown Dam and generating station

or to construct a new dam and station below the existing Milltown Dam. Fishways for both projects were reviewed by the Canada Department of Fisheries. The second proposal was the plan announced by the St. Croix Paper Company in 1958 to increase its daily production of paper from 325 to 450 tons, with a sulfite pulp production increase from 65 to 115 tons a day.[5]

Efforts to implement the recommendations referred to the IJC in 1957—at least those relating to fish passage and water quality, which were the major concerns of the Fish Culture Development Branch, Department of Fisheries—are undocumented, possibly because no action was taken. The flow agreement at East Grand Lake and Spednic Lake was a condition of the permission by IJC to reconstruction of the Vanceboro Dam, dated 15 October, 1965.

A supplementary report on the pollution survey of the St. Croix in 1959[20] concluded that conditions resulting from pollution in that reach of the river from the St. Croix Paper Company mill at Woodland, downstream for a distance of about 8 mi, were worse than those detailed in the 1956 survey. The effects of chemical pollution were greater than in 1956, with DO's below the 5-ppm IJC objective for all main-stem waters downstream of the paper mill. As well, there was neither an improvement in the physical condition of the river bottom in the 4-mi reach downstream from the mill nor a decline in the grossly polluted conditions created by untreated municipal sewage.[20]

THE MILLTOWN FISHWAY, 1960

Correspondence between the Department of Fisheries and the New Brunswick Electric Power Commission between 1957 and 1960 is very sketchy. It is concluded that the NBEPC decided against the construction of a new Milltown power station or much of a modification to the existing facility. It appears that they rejected the fishway design agreed upon by all parties in the earlier report to the IJC[5] in favour of a less expensive, less permanent and less efficient fishway through the powerhouse. These plans were apparently not reviewed or approved by either regional engineers of the Department of Fisheries, or by Ottawa staff of the Conservation and Development Service. The independent construction of the fishway by the NBEPC in 1960 is related in the tone of a letter from Mr. A.J. O'Connor, Manager-Engineering, NBEPC, to Dr. A.L. Pritchard, Director, Conservation and Development Services, Ottawa.[21] He wrote, "We have now completed the construction of the fishway at our Milltown Plant ...we feel quite pleased generally with the final product. We should like to have some of your staff visit the site at their convenience, so that we may have your thoughts on the project". Whether or not an immediate inspection was arranged is unknown but, in any event, a viewing in July, 1961, took place during the "Annual Inspection of the Grand Falls and Milltown dams by the International St. Croix River Board of Control".[22]

With the completion of the Milltown fishway in 1960, the Fisheries Protection Branch, Department of Fisheries, placed a guardian on the site during the operational season, May-November, for the years 1961-64 inclusive. The Fish Culture Development Branch utilized fish counts and tagged-fish information provided by the guardian to estimate the effectiveness of the fishway in passing all species, and the survival of introductions in 1960 of 2,500 tagged smolts into a polluted section between Woodland and Milltown and 2,480 tagged smolts into Mohannas Stream[20] (Fig. 1). Further plants of salmon to the lower St. Croix River included: in 1961, 48,000 fingerlings and 11,386 yearlings and; in 1962, 15,530 yearlings.[23] Dr. P.E.K. Symons,[24] in a quick survey of the Mohannas, 1974, suggested that it may now have only 3-4 km of salmon-producing area; and that it must be rated among the poorest of the historically productive Canadian tributaries for salmon.

In the lee of various sub-committee activities, an informal "St. Croix River Study Group" evolved in 1960. According to Mr. L.E. Baker, Area Director of Fisheries, its function was to exert pressure on the United States and Canada to implement the recommendations of the IJC.[25] Attendees at the third meeting, held in June, 1961, included personnel from the St. Croix Paper Company, NBEPC, N.B. Water Authority, Mr. W.K. Sharpe of the Department of National Health and Welfare, Dr. W.H. Everhart from Maine, and biologist and Departmental observer Mr. N.E. MacEachern of the Fish Culture Development Branch. This third meeting provided the stimulus which eventually led to more comprehensive caged-fish tests conducted by the Fish Culture Development Branch in 1962.

POLLUTION SURVEYS

Caged-fish studies had been first conducted in 1960 by the Branch to assess suspected septic conditions between the St. Croix Paper Company's mill at Woodland and tidewater. Results for the low water conditions of August, 1960, indicated most of the stream was then lethal to underyearling salmon.[26]

In December, 1961, the IJC, through the Advisory Board on Pollution Control, requested the Public Health Engineering Division of the Department of National Health and Welfare to conduct a 1962 pollution survey as a sequel to those of 1956 and 1959. As a contributor to this survey, the Fish Culture Development Branch, under the direction of Dr. R.R. Logie, was requested to conduct caged-fish studies to supplement physical and chemical evaluations for toxic pollutants. The tests were supervised by Biologist H.E. Edwards and were conducted between August 6 and 16 at Woodland, Baring and Milltown sites. Up to 100% of caged salmon parr succumbed within 24 hr when exposed to waters on the Maine side of the St. Croix at the Woodland and Baring sites.[26]

The pollution studies in 1962 revealed that gross bacterial pollution, a result of the absence of domestic sewage treatment

in communities of the lower St. Croix, extended from below Woodland to the estuary.[27] Chemical pollution (sulfite waste liquor) and physical pollutants (coal ash and wood wastes) were more prevalent than in previous surveys (as measured by DO and BOD levels and the caged-fish tests). The only ray of hope was that the St. Croix Paper Company was eliminating the annual river drive and the barking mill operations; and was constructing a new wood room, a natural settling lagoon and a holding tank to equalize sulfite waste-liquor discharges. However, there was no expectation of a major improvement in the polluted condition of the St. Croix River as long as sulfite waste discharges were continued.[28]

Water conditions apparently deteriorated further between 1962 and 1963, with no beneficial effect on river conditions resulting from the use by the paper company of their new "equalizer" tank.[29] Industrial developments of that year included the planning by the St. Croix Paper Company to build a 500-ton kraft mill and to close the sulfite pulp-mill operation. As well, the communities of Calais, Milltown and Woodland, Maine, and St. Stephen and Milltown, New Brunswick, acquired preliminary engineering surveys and reports on costs of pollution abatement.[29]

FISHWAYS

In 1963, plans by the St. Croix Paper Company to rebuild the Vanceboro Dam and fishway were discussed and reviewed by the paper company; Mr. L.F. Decker, Chief Engineer of Maine Department of Inland Fisheries and Game; and Mr. J.P. Parkinson of the Fish Culture Development Branch, Department of Fisheries. Points agreed upon in meetings and correspondence between June and October included: the design of a Denil fishway to accommodate alewives, brook trout and landlocked salmon; the enlargement of fishway pool size, to accommodate anadromous Atlantic salmon that would gain access to the upper St. Croix via proposed fishways at Grand Falls and Woodland; and pollution abatement.[30]

During the same year, the Fish Culture Development Branch continued its monitoring of the Milltown Fishway (four salmon entered and one passed upriver) and conducted a 42-day fishway entrance test utilizing alewives.[31] The Maine Department of Inland Fisheries and Game also completed the planning of both the engineering and financing of Denil-type fishways for Woodland and Grand Falls dams. The cost was estimated at $300,000, with 25% to be paid by Georgia-Pacific Corporation, successors to the St. Croix Paper Company.[29] The projects were to be completed by the fall of 1964.

With the imminent "opening" of the St. Croix, Dr. W.H. Everhart, Chief of Fisheries, Maine, requested from Dr. R.R. Logie, Chief, Fish Culture Development Branch, Canada's plan for stocking of salmon (Maine was stocking alewives) and concepts for parallel sport and commercial salmon-fishing regulations in the St. Croix River and estuary.[32] In response, Dr. Logie[33]

suggested that there appeared to be a misunderstanding; and stated that he would recommend stocking not just when fishways had been completed but when pollution, principally that of the Georgia-Pacific Mill at Woodland, was satisfactorily abated. The pollution, he pointed out, was at that time increasing rather than decreasing. At Milltown, although more than 10,000 alewives succeeded in migrating upstream, no salmon were passed through the fishway. Under the existing pollution problems, no plans were made by the Fish Culture Development Branch to continue monitoring the fishway.

In June, 1965, the Denil fishways at Woodland and Grand Falls were officially opened. Alewives continued to be stocked by Maine into the St. Croix River at Grand Falls Flowage. By October, approval had been given to the Georgia-Pacific Corporation for reconstruction of the Vanceboro Dam and fishway; and, by November, the Corporation had begun plans to replace the Forest City Dam and fishway. Field activities by the Department of Fisheries in that year were confined to the placement, in July, of caged-salmon yearlings at Woodland, Baring and Milltown sites.[34] Rapid mortality was attributed to low dissolved oxygen concentrations at each location.

THE LAST DECADE

In the spring of 1966, the Atlantic Sea Run Salmon Commission planned to initiate, through an early release, the restoration of salmon stocks in the St. Croix.[35] Mr. C.P. Ruggles, Acting Chief, Resource Development Branch, emphasized the poor water quality detected in 1965 and the futility of operating the Milltown counting trap under such conditions.[34] Stocking by the Commission did not ensue, because it was becoming apparent that the traditional Miramichi stock previously used for restoring salmon to Maine rivers was less suitable than native stocks, and because native stocks were in limited supply and therefore reserved for restoration projects of high priority (R.E. Cutting, pers. comm.)*.

Principle activities in 1966-67 on the St. Croix involved the U.S. Geological Survey and the U.S. Corps of Engineers. In the former case, an automatic monitoring station for DO, temperature, conductivity and pH was installed at Milltown. The latter agency, in 1967, conducted a study on the volume, composition and cost of removal of sludge deposits (which averaged as much as 7 ft in depth) between Milltown, Maine, and Baring. The deposits generally consisted of coal ashes, sawdust, wood chips, bark and sunken logs, which, if not removed (at a minimum cost of $9 million), would continue to adversely affect DO's for years after the abatement of municipal and industrial discharges to the system.[36]

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*Cutting, R.E. 1976. Biologist with Resource Branch, Fisheries and Marine Service, Dept. of Fisheries and Environment, Halifax, Nova Scotia.

In 1968, fishway counts at Milltown were again conducted by the Fish Culture Development Branch, Department of Fisheries. The objectives were to measure changes since 1964, and to provide data prior to the anticipated primary treatment (clarifiers for each of color and settling of solids) of effluent from the Georgia-Pacific Corporation at Woodland. Fish counts remained essentially unchanged from 1964, and consisted of approximately 14,400 alewives and no salmon.[37] Again, the Branch collaborated with the Department of National Health and Welfare and conducted caged-fish tests (hatchery fingerling landlocked salmon and brook trout) between Milltown and Woodland. Maximum survival times indicated that conditions acutely lethal to juvenile salmon remained, as during the 1963 and 1965 tests.[36]

On June 20, 1968, the Advisory Board on Pollution Control, St. Croix River, met in Montreal. The Board at this date was comprised of Chairman, Dr. W.R. Edmonds, Chief, Public Health Engineering Division, Department of National Health and Welfare, Ottawa; Mr. W.K. Sharpe, Assistant Chief, Operations, Public Health Engineering Division, Department of National Health and Welfare, Ottawa; Mr. J.S. Bates, Consultant to the New Brunswick Water Authority, Fredericton; and three Americans—Messrs. Klasman, Hendrickson and MacDonald. The purpose of the meeting was to review the Sandwell Report, which had been commissioned by the Georgia-Pacific Corporation and which was described and approved by the Board as a "first-step" program to abate and control the paper company's waste discharges into the St. Croix River.[38] Deficiencies of the proposed treatment facilities included: lack of control of toxicity; probable inadequate reduction of BOD; and lack of predictability in reducing suspended solids, lignins, pH, color, foam and odors. The Board, however, advised the IJC to notify the State of Maine to have the Corporation complete the installation of clarifiers by December, 1969. After that date, the Board itself would conduct a comprehensive survey in cooperation with state and provincial regulatory agencies to assess the impact of the treatment operation in meeting IJC objectives for clean water in the St. Croix River.[38]

On September 17, 1968, a public international meeting was held in St. Stephen, to inquire into the adequacy and effectiveness of the United States and Canadian programs for abatement of pollution. The chief purpose was to ascertain why the water quality objectives recommended and approved by the several governments in 1959 were not being met.[39]

THE BRANCH'S TESTIMONY

At the public hearing, the Department of Fisheries was invited to "present testimony as to its interest and responsibilities with respect to the control of pollution in the St. Croix".[40] A brief prepared by the Resource Development Branch, Maritimes Region, and approved by Ottawa was presented at the hearing. It mentioned the Department's nearly 40 years of involvement with the St. Croix and its mandate in pollution control from the Federal Fisheries Act (Sections 33 and 34), which prohibits the disposal of deleterious substances into waters frequented by fish.[41] It was

stated that the Department had an active interest in Atlantic salmon restoration and had cooperated with the State of Maine in providing adequate fish passage facilities, but was not about to stock juvenile salmon into the river until pollution had been satisfactorily abated. The Department supported Georgia-Pacific's $4.5-million pollution abatement proposal as only a first step in reducing BOD and toxicity to acceptable levels, and strongly urged that an apparently previously rejected $8 million second treatment program (biological oxidation) be instituted to provide satisfactory pollution abatement.[41]

Although domestic sewage continued to be untreated through most of 1968, Milltown, New Brunswick, had scheduled a sewage collector and oxidation ditch for completion and operation late in that year. Calais, Maine, had a contact stabilization treatment plant under construction and scheduled for completion in late 1969.[36]

FOREST CITY DAM, 1968

In the same year (1968), talks continued on the reconstruction of the Forest City Dam. An Order of Approval issued by the IJC in October[42] for the replacement of the untreated timber dam and fishway was not acceptable to Georgia-Pacific[43] and was subsequently terminated. In the following year, correspondence between and among Mr. J.L. Ketner Jr., Chief Engineer, Department of Inland Fisheries and Game, Maine; Mr. J.P. Parkinson, Chief Engineer, Resource Development Branch, Ottawa; Mr. D.C. Riley and Mr. C.P. Ruggles, Resource Development Branch, Maritimes; and Mr. E.G. Wilson, General Manager, Georgia-Pacific Corporation, Woodland, unveiled a lack of desire by Georgia-Pacific to collaborate with the IJC and associated agencies in the same amicable fashion exhibited during talks on the previously rebuilt Vanceboro Dam and fishway. Notice of a rebuilding of the dam and fishway, without immediate prior approval, reached the Department of Fisheries Regional Headquarters in Halifax in November, 1969.[44] Inspection on November 25, 1969, confirmed that the fishway was constructed on the Canadian side of the river and complied with sketches submitted by the Corporation to the Maine Department of Inland Fisheries and Game, but did not comply with standards at one time sought by engineers of the Canada Department of Fisheries and Forestry.[45] Subsequent correspondence from Mr. C.P. Ruggles, with the backing of Ottawa and the International St. Croix River Board of Control, to Mr. E.G. Wilson of Georgia-Pacific reprimanded the Corporation for reconstructing the fishway without adequate prior consultation with technical staff of the Canada Department of Fisheries and Forestry.[46] The Corporation was informed that hydraulic assessment would be conducted in the spring of 1970, and that the results would determine "what corrective measures the Georgia-Pacific Corporation will be required to carry out to satisfy this Department's requirements".

Contentious issues on the operation of the Forest City fishway in 1970 failed to materialize. The engineering section of the Branch did direct, with the cooperation of the NBEPC, some repairs to the Milltown fishway. The Department of Fisheries and

Forestry as well conducted laboratory bioassays at the Saint John Hatchery, using effluent from Georgia-Pacific Corporation. As expected, salmonids exhibited little tolerance to diluted effluent or the associated reduction in dissolved oxygen.[47]

ADVISORY BOARD ON POLLUTION CONTROL, 1971

In 1971, tests under the direction of the Advisory Board on Pollution Control—conducted by the Canada Department of National Health and Welfare, the U.S. Federal Water Pollution Control Administration and the Maine Environmental Improvement Commission—determined that the water quality of the lower St. Croix, especially as influenced by the paper mill, failed to comply with IJC objectives.[47] This information was considered by the Advisory Board on Pollution Control, which since early in 1969 had consisted of Mr. R.E. Tait, Chairman of the Canadian Section and Chief, Public Health Engineering Division, Department of Fisheries and Forestry, Ottawa; Mr. C.P. Ruggles, Chief, Resource Development Branch, Department of Fisheries and Forestry, Halifax; Mr. J.S. Bates (by previous appointment); and three Americans. Recommendations to the Georgia-Pacific Corporation were for a massive clean-up of physical and chemical operations by December of 1972.[48]

With the exception of the St. Croix River estuary,[48] there was little field activity on the river in 1971. However, an inspection of all St. Croix fish passage facilities was made by an engineer of the Resource Development Branch, who observed that the Milltown fishway was beginning to show signs of deterioration and without improved ventilation would require replacement within two years.[49]

BRANCH REVIEW, 1971

A meeting on December 21, 1971, of Section Heads of the Resource Development Branch, Maritimes Region, discussed "our future course of action for restoration of anadromous fish stocks in the St. Croix River system".[50] Recommendations included: 1. exertion of pressure through the IJC upon the Woodland Mill to clean up its effluent by 1973, 2. assessment of existing adult fish passage facilities and determination of need for juvenile "protective works" in 1972, 3. determination of the overall fishery potential of the St. Croix through review and field investigations in 1972, 4. determination of a benefit-cost ratio for restoration—including effective juvenile protective works—prior to 1974, and 5. development of plans for a long-range hatchery stocking program. Optimistic as the recommendations may have been, the continuing pollution problem through 1972-73 served to table all Branch recommendations to later dates. The newly formed Environmental Protection Service assumed toxicity and pollution interests on behalf of Environment Canada. In 1972, they collaborated with the U.S. Environmental Protection Agency in a survey to obtain information on pollution of the St. Croix by Georgia-Pacific adequate for court proceedings against the Corporation.

POLLUTION, 1972

A meeting of the Advisory Board on Pollution Control, St. Croix River, held in August, 1972, summarized to that date the progress in meeting IJC objectives.[51] Municipal effluents on both sides of the border were finally receiving some form of treatment. Georgia-Pacific continued to discharge a substandard effluent and appeared somewhat inflexible, despite anticipated court action to establish clean-up standards advocated by the IJC. Logging operations and storage were as yet unresolved but flow regulations, as monitored by the Board of Control, were within the prescribed range.

BOARD OF CONTROL, 1972

The International St. Croix River Board of Control continued its duties to ensure that water levels of and discharges from East Grand and Spednic lakes, the water level above the dam at Grand Falls, and the water level and stop-log openings at Milltown were as approved by the IJC. While Mr. J.E. Peters continued as Canadian member of the Board, the Water Survey of Canada and Water Planning and Management branches of the Department of the Environment had principal representation. The Resource Development Branch continued an input to consider the implication resulting from increasing the minimum operating level of Spednic Lake.[52] Water levels in Spednic Lake continued to occupy much of the concern of the Board of Control through 1972.

SECONDARY TREATMENT FOR GEORGIA-PACIFIC

Through the fall of 1972, the position of Georgia-Pacific Corporation on the cleanup of their effluent softened; and they proposed to submit to the U.S. Environmental Protection Agency by October 8 a pollution control program which would obviate the need for further court action against them.[53] Subsequent reviews, by the Advisory Board on Pollution Control, of Georgia-Pacific's October proposal for secondary treatment of their effluent led to the drafting under the U.S. Environmental Protection Agency in 1973 of a National Pollutant Discharge Elimination System (NPDES) permit.[54,55] After a public hearing, July 29, 1973, and certification by the Maine Board of Environment Protection, the U.S. Environmental Protection Agency and Georgia-Pacific Corporation, a discharge permit was issued for the period September 13, 1973, through September 28, 1978. The permit required installation of effective secondary treatment (estimated cost of $6 million), capable of reducing BOD's, total suspended solids and heavy metals to the negotiated levels by April 19, 1976 (NPDES).[55]

With the negotiations on the NPDES permit and the feasibility studies for having the minimum water level of Spednic Lake raised by two feet occupying the concerns of the Advisory Board on Pollution Control and the Board of Control respectively, no

additional field programs were undertaken by participating federal, provincial or state agencies in 1973. Inspection of the Milltown fishway, however, by members of the Board of Control in June, 1973, raised the concern that in time the Milltown Dam might be the key barrier to a restoration program.[56] This impression prompted the Resource Development Branch to suggest to the New Brunswick Electric Power Commission in September, 1973, that "sufficient repairs should be carried out to enable the present facility to function effectively for at least three years".[57] The Branch at the same time announced its intentions to assess the present facility with regard to its ability to attract and pass fish and, by early 1975, to present to the Commission a proposed design to meet long-term requirements for fish passage".[57] Repairs were completed by April, 1974, and the Resource Development Branch proceeded with plans to assess the refurbished fishway.

NEW INTERESTS IN SALMON RESTORATION

Coincident with the impending cleanup of the St. Croix River, the Biological Station, Fisheries and Marine Service, St. Andrews, New Brunswick, and the North American Salmon Research Center (NASRC) surfaced in late 1973, with self-acclaimed interests in being "provider" and "coordinator", respectively, of biological expertise and products essential to expediting the reestablishment of Atlantic salmon in the St. Croix River.[58] The Biological Station had just been detached from Fisheries Research Board and prodded more towards management by objectives.[59] The NASRC—conceived by the largely American-funded International Atlantic Salmon Foundation and supported by both the Huntsman Marine Laboratory, St. Andrews, and Environment Canada—had seized upon the international appeal of the St. Croix as an ultimate test site for research into genetics and selective breeding of salmon.

Directed by Dr. J.R. Calaprice, the NASRC in 1974 proposed to coordinate the following activities: 1. a cost-benefit analysis of rehabilitating the system, 2. a critical view of fish passage facilities, 3. an evaluation of efforts to reduce pulp mill wastes, 4. a biological survey to measure existing habitat suitable to salmon and determine measures required to restore additional habitat and 5. a search for two study streams in which to assess stocking requirements.[59] The Biological Station, in its eagerness to fill a new mandate, proposed the commitment of efforts of five scientists.[59] The U.S. Bureau of Sport Fisheries and Wildlife, which was anxious to return benefits to its Denil fishways, made commitments through the Maine Cooperative Fishery Unit.

Despite the February, 1973, appointment of a St. Andrews-based coordinator for environmental studies conducted by Services of Environment Canada,[60] there was an initial suggestion to have one scientist of the Biological Station conduct fish passage studies. Results could only have paralleled those continuing

studies by the Resource Development Branch, which were designed to provide more pointed and essential input to the Board of Control and the IJC. This oversight, and the apparent assumption of leadership without representation on either of the two Advisory Boards which reported to the IJC tended to alienate the Resource Development Branch. The Maine Department of Inland Fisheries and Game assumed a relatively neutral position in the "power struggle".

ST. CROIX WORKING PARTY, 1974

A review of the position of the Resource Development Branch as of February, 1974, relevant to rehabilitation of the St. Croix, suggested a potential role of leadership through the establishment of a management committee.[61] The same approach, however, was conjectured by the North American Salmon Research Center; and, at the Center's initiative, a meeting was called for March 25, 1974, in St. Andrews.[62] The result was the formation of a St. Croix Working Party, with Dr. R.W. Gregory, Maine Cooperative Fishery Unit, elected as chairman. Appointed members included three from the Biological Station, St. Andrews, and two from the Resource Development Branch. The objective of the working party was to coordinate future surveys of the St. Croix. The general objectives of surveys were to: "(a) gather necessary data on the suitability of that river system for Atlantic salmon restoration, and (b) determine the criteria and methods necessary to assess any river's potential for salmon rehabilitation". Specific tasks in 1974 would be undertaken by three agencies. The Maine Cooperative Fishery Unit would catalogue and assess "relative abundance of fish species on slow water areas of the main stem...fishing pressure and harvest", drift insects, and limited physical and chemical data. The Resource Development Branch was to conduct spot-check electro-fishing in riffle areas and evaluate the fish-passage facility at Milltown for alewives. The Biological Station, with a revised commitment of two scientists, chose to study the overwintering of salmon fry and parr in selected Canadian tributaries, and to conduct a mechanical analysis of tributary and main stream gravel types.[63]

A review of the results from the 1974 summer investigations was held in St. Andrews in April, 1975. Reports were tabled by scientists of the Biological Station concerning potential spawning areas in the river,[64] and physical features and fish species in Canadian tributaries.[65] As well, research conducted by the Maine Cooperative Fishery Unit, under contract to the U.S. Bureau of Sport Fisheries and Wildlife, told of the existing light utilization of the river for sport fishing and a possible competitor problem (smallmouth bass, white perch, chain pickerel) for reestablishing Atlantic salmon.[66]

Studies at the Milltown Dam by the Resource Development Branch—pertinent to both the Working Party and the Board of Control—determined that water conditions below and in the

fishway were great deterrents to the upstream movement of alewives.[67] Only about 13.7% of alewives captured at a point about one mile below the dam reached the dam. Only about 0.4% of the alewives actually ascended the fishway.

The St. Croix Working Party meeting and the atmosphere set by the new director of the hosting North American Salmon Research Center, Dr. R.L. Saunders, revealed that the previously ambitious parties were considering a more cautious approach in restoring the system. The NASRC itself appeared open to redirecting its salmon development strategies to less complex systems.

Commitments for investigations in 1975 were made by the Biological Station, St. Andrews, to conduct gravel permeability studies, to stock eggs and parr into select study areas for competition studies, to artificially feed parr in a stream, and to enumerate smolts emigrating from Dennis Stream. The Maine Cooperative Fishery Unit (with USBSFW support) was to complete the 1974 biological survey; and the Resource Development Branch, Fisheries and Marine Service, was to determine the engineering feasibility of improving upon fish passage facilities at the Milltown Dam. Uncommitted, but undertaken at the initiative of the Resource Development Branch, was an extensive bio-economic feasibility study of restoring anadromous fishes to the St. Croix River.[68] This document will largely assist in establishing the priority of redevelopment on the St. Croix, relevant to ongoing and proposed Branch programs in the Maritimes Region.

THE EVE OF RESTORATION

At the time of writing, 1975 results had not been tabled. However, it seemed evident that efforts, particularly by the Biological Station, were in part diverted from the St. Croix. The feasibility study on the Milltown Fishway, however, suggested that the existing structure had no potential for accommodating forecast fish runs to a rehabilitated St. Croix River.[69] Costs of a new fishway were anticipated to be beyond that which the NBEPC would be willing to absorb in order to continue operation.

During the era of the St. Croix River Working Party, the Advisory Board on Pollution Control—largely through the participation of the Resource Development Branch—continued to be concerned about future water quality of the river. Even after the agreement by Georgia-Pacific to terms of the NPDES, the Board had continued to promote an upgrading of water quality, particularly dissolved oxygen levels and other parameters such as temperature and fecal coliform.[70,71] As well, it continued to follow the status of both municipal and industrial pollution abatement, and to survey and monitor DO levels, pH and temperature of the lower St. Croix.

In the closing days of 1975—nearly 20 years after concerted IJC involvement—we appear to be on the threshold of a significant water-quality improvement through secondary treatment of waste

from the Georgia-Pacific mills. Hurdles such as the Milltown Fishway remain, but the perspectives gained from this historical glance suggest that, relative to its 150-yr history, little time remains before the St. Croix will be unimpeded to returning anadromous fishes.

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