REMAKING HELLS GATE:

Salmon, Science, and the Fraser River, 1938-1948[1]

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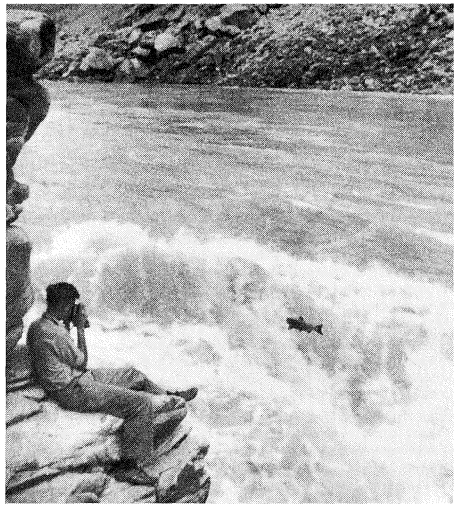


Plate 1: Dr. William Ricker at Hells Gate, 19 August 1938. Photo taken by A.J. Tubb. University of Washington Archives, William F. Thompson Papers, Acc. 2597-3-83-21, box 9, file photos.

THE ROUGH WATER is at Hells Gate, a granodiorite gorge in the Fraser Canyon, 260 kilometres from the river's mouth. At this point in 1912-4, railway construction triggered landslides that dammed salmon runs and led to short-term restoration efforts as well as tighter regulations on Native fishing in the canyon and beyond.[2] More than two decades later, in the summer of 1938, William Ricker, a scientist with the International Pacific Salmon Fisheries Commission, perches on the rocks and investigates the causes of the precipitous decline of Fraser sockeye. The remnants of the slides lie on the opposite bank.

[1] I would like to acknowledge the support of a Social Sciences and Humanities Research Council Doctoral Fellowship and a Canadian Forest Service Doctoral Supplement. Christopher Armstrong, Stephen Bocking, Richard Jarrell, Kirsty Johnston, Elinor Melville, H.V. Nelles, Anders Sandberg and Marlene Shore all read earlier versions of this paper and provided constructive comments. Audiences at University of British Columbia, York, McGill, Queen's, and a BC Studies conference sponsored by SFU helped me to sharpen the argument. Cole Harris and the anonymous reviewers provided constructive advice and criticism at the publication stage.

[2] I consider the original slides in Chapter 2 of my thesis, "Land *Sliding* at Hells Gate," in "Fish vs Power: Remaking Salmon, Science and Society on the Fraser River, 1900-1970," PhD thesis, York University, 2000. Other studies that treat the slides include: Derek Ellis, "Construction

A copy of the photograph is among the papers of William Thompson, who, in 1938, had recently assumed the directorship of the salmon commission's scientific investigations after a distinguished career with the North Pacific Halibut Commission and as chair of the University of Washington's College of Fisheries. Unlike Ricker, who left after

– Hell's Gate (Canada)," in his *Environments at Risk: Case Histories of Impact Assessment* (Berlin: Springer-Verlag, 1989), 17-36; E.S. Pretious, "Salmon Catastrophe at Hell's Gate," *BC Professional Engineer* 27,2 (February 1976): 13-18; Cicely Lyons, *Salmon Our Heritage: The Story of a Province and an Industry* (Vancouver: BC Packers, 1969); Geoff Meggs, *Salmon: The Decline of the British Columbia Fishery* (Vancouver: Douglas and McIntyre, 1991); Derek Pethic, *British Columbia Disasters* (Langley, BC: Stagecoach, 1978), 161-72; Bruce Hutchison, *The Fraser* (Toronto: Holt Rinehart, 1950). The two major reports on the slides and their initial restoration are: John Pease Babcock, "Conditions Above the Fishing Limits," in *Report of the BC Commissioner of Fisheries 1913* (1914): 20-38; and J.H. McHugh, "Report on the Work of Removal of Obstructions to Ascent of Salmon on the Fraser River at Hell's Gate, Skuzzy [sic] Rapids, China Bar and White's Creek during the year 1914, and the early portion of the year 1915," in *Annual Report, Fisheries Branch, Department of Naval Service 1914-15* (1915): 263-75. On the history of Nlaka'pamux fishing at Hells Gate, see James Alexander Teit, *The Thompson Indians of British Columbia, Jesup North Pacific Expedition*, vol. 2 pt. 4, American Museum of Natural History, *Memoirs* 2 (New York: Knickerbocker, 1900), 249-50, 293-4; Andrea Laforet and Annie York, *Spuzzum: Fraser Canyon Histories, 1808-1939* (Vancouver: UBC Press, 1998), 60 and 69; David Wyatt, "The Thompson," Deward E. Walker Jr., ed., *Handbook of North American Indians*, vol. 12, *Plateau* (Washington DC: Smithsonian, 1998). For a close study of the related fishing practices of the Lillooet, see Steven Romanoff, "Fraser Lillooet Salmon Fishing," in *A Complex Culture of the British Columbia Plateau: Traditional Stl'atl'imx Resource Use*, ed. Bryan Hayden (Vancouver: UBC Press, 1992), 222-65; and Michael Kew's excellent overview of the cultural implications of the resource in the same collection, "Salmon Availability, Technology, and Cultural Adaptation in the Fraser River Watershed," 177-221. Native groups protested the closure of the fishery, sought legal action, and expressed their views to the Department of Indian Affairs and the McKenna-McBride Commission. In 1916 a group from the Boothroyd Band advised Department of Marine and Fisheries officials as to the best means of clearing the gate. Their suggestions were considered but later dismissed. See "Indians Determined to Get Fish Supply," *Vancouver Sun*, 4 August 1914; NAC, Pacific Region Office, RG 23, vol. 2307, file 1-18, F.H. Cunningham to W.A. Found, 13 August 1914; RG 23, vol. 2307, file 1-18, Harris, Bull, Harrington, and Mason to Halliday, 18 August 1914; Commission testimony may be found in NAC, GR 123, Canada Department of Indian Affairs, BC Records, vol. 11025, file A-H-7; quotations are from pages 127 and 275. NAC, RG 23, vol. 678, file 713-2-2[6], J.H. McHugh to Cunningham, 16 October 1916; NAC RG 23, vol. 678, file 713-2-2[6], F.H. Cunningham to Found, 20 October 1916. Cole Harris considers this testimony within the broader context of encounter in "The Fraser Canyon Encountered," in *The Resettlement of British Columbia: Essays on Colonialism and Geographical Change* (Vancouver: UBC Press, 1997), 134. For an excellent survey of the legal aspects of the Native fishery, see Dianne Newell, *Tangled Webs of History: Indians and the Law In Canada's Pacific Coast Fisheries* (Toronto: University of Toronto Press, 1993). A further attempt to assess the implications of the slides and study possible restoration measures occurred in the late 1920s. See NAC, RG 23, vol. 679, file 713-2-2[8], J. McHugh, "Interim Report of the Engineers Enquiring into the Fraser River Conditions at Hell's Gate and Bridge River Canyon," n.d.; vol. 679, file 713-2-2[9]; C.A. Webb, "Interim Report on Hydraulic Investigations, carried out by Dominion Water Power and Reclamation Service on Hell's Gate, July 1927" [dated 9 July 1927]; and vol. 679, file 713-2-2[9], J.A. Motherwell, Chief Inspector of Fisheries, to W.A. Found, Director of Fisheries, Department of Marine and Fisheries, 15 March 1927.

Map 1: Hells Gate and the Fraser Basin.

his first year of study, Thompson devoted the better part of a decade to Hells Gate; his ideas about its role in obstructing salmon migrations would provide the rationale for the construction of fishways at this point in the mid-1940s – one prong of a major effort to restore the salmon runs. After the completion of the fishways, when Thompson set down his ideas about salmon and the gate for scientific scrutiny, his early charge, William Ricker, criticized them strongly and engaged in a prolonged controversy with Thompson that would come to involve the reputations of their respective scientific institutions and national fisheries science communities. But in the summer of 1938, none of these later controversies could be imagined. Ricker leaned over the edge, photographing salmon, and a lens captured him too.

The salmon commission's research program originated in the politics of the Pacific salmon fishery. Since the turn of the century, Canada and the United States had debated the division of the catch and engaged in periodic negotiations to pursue international fisheries management. Agreement was obstructed, however, by constitutional disputes in the US over states' rights and the fishery, conflicts within the fishing industry over catch levels and gear restrictions, and unequal bargaining positions created by the US majority share of the fishery. Not until the 1930s, after sharp declines in the fishery, the end of the American trap fishery, and a shift in salmon migration patterns that favoured Canadian fishers, did the United States and Canada successfully conclude a joint management and catch agreement – the Pacific Salmon Convention of 1937. The convention created the International Pacific Salmon Fisheries Commission (IPSFC) to carry out its mandate and conduct an eight-year scientific survey of the resource.[3] In the course of general surveys of the Fraser sockeye in 1938, commission scientists discovered blockage conditions at Hells Gate.

Political, social, and natural factors conditioned scientific knowledge of Hells Gate. Scientists' views were developed in the context of the national and institutional politics of the Pacific fishery and the salmon commission; their research practices involved a complex process of cultural and natural selection as scientists interacted with

[3] On the background and history of the 1937 convention see: Kurkpatrick Dorsey, *The Dawn of Conservation Diplomacy: US-Canadian Wildlife Protection Treaties in the Progressive Era* (Seattle: University of Washington Press, 1998), chap. 3, pp. 76-104; Jozo Tomasevich, *International Agreements on Conservation of Marine Resources with Special Reference to the North Pacific* (Stanford: Food Research Institute, 1943); and Joseph E. Taylor III, "The Historical Roots of Canadian-American Salmon Wars," in *On Brotherly Terms: Canadian-American Relations West of the Rockies*, ed. John Findlay and Ken Coates (Seattle: University of Washington Press, in press).

Native fishers and developed tagging methods; and their different conclusions about the fishways highlighted personal, institutional, and national divisions. This article asks how scientists remade Hells Gate, how they tried to understand this place and debated its meanings.

The analysis seeks to integrate sociological approaches to the study of science with recent work in environmental history: trying, on the one hand, to ground our understanding of science in a material world where the "field" of investigation changes and, on the other hand, to underline how natural knowledge is socially constructed in shifting political contexts.[4] My approach assumes that scientists not only frame nature according to dominant questions and concerns, but also that shifts in the natural world can affect the operation and implications of science. Scientific ideas are not simply discursive constructions; they also represent complex relationships between humans and the rest of nature. Hells Gate, in this reading, becomes both a site and metaphor of confluence and disturbance.

[4] A number of previous studies have examined the remaking of Hells Gate in the 1940s: fisheries scientist and historian John Roos provides a thoughtful record of the Hells Gate investigations in his history of the salmon commission, and fisheries scientist Tim Smith treats the Thompson-Ricker controversy as an opportunity to examine shifting ideas in the field of scaling fisheries. See John F. Roos, *Restoring Fraser River Salmon: A History of the Pacific Salmon Fisheries Commission, 1937-1985* (Vancouver: Pacific Salmon Commission, 1991); and Tim Smith, *Scaling Fisheries: The Science of Measuring the Effects of Fishing, 1855-1955* (Cambridge: Cambridge University Press, 1994). For a general introduction to the field of science studies, see Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science* (Cambridge: Cambridge University Press, 1998); and Mario Biagioli, ed., *The Science Studies Reader* (New York and London: Routledge, 1999). Bruno Latour and Andrew Pickering's separate and distinct attempts to restore a measure of agency to the natural world in social studies of science stimulated me to try to press matters further. See Bruno Latour, *We Have Never Been Modern* (Cambridge: Harvard University Press, 1993); Andrew Pickering, *The Mangle of Practice: Time, Agency, and Science* (Chicago: University of Chicago Press, 1995). A number of recent and important studies in environmental history treat the problems of scientific knowledge in changing environments. See Stephen Bocking, "Fishing the Inland Seas: Great Lakes Research, Fisheries Management, and Environmental Policy in Ontario," *Environmental History* 1997 2(1): 52-73; Stephen Bocking, *Ecologists and Environmental Politics: A History of Contemporary Ecology* (New Haven: Yale University Press, 1997); Richard H. Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Conservation, 1600-1860* (Cambridge: Cambridge University Press, 1995); Nancy Langston, *Forest Dreams, Forest Nightmares: The Paradox of Old Growth in the Inland West* (Seattle: University of Washington Press, 1995); Arthur F. McEvoy, *The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980* (Cambridge: Cambridge University Press, 1986); Joseph E. Taylor III, *Making Salmon: An Environmental History of the Northwest Fisheries Crisis* (Seattle: University of Washington Press, 1999); and Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1995).

ESTABLISHING A RESEARCH PROGRAM

Reflecting on the early years of the IPSFC, William Thompson noted in the late 1950s that the eight-year period when the commission was devoted solely to scientific inquiry allowed for uncommon latitude in charting new directions in fisheries research. "The Commissioners were, for a time, free from the job and glory seekers who were not interested in doubtful personal futures ... free from the demands of regulation according to this or that popular theory [and]... free from the pressure of immediate results." The treaty, he argued, provided a research opportunity beyond the clawing control of "small organizations" and national policy concerns.[5] Memory may be a salve, but Thompson's remarks do provide insight into the importance of institutional arrangements for the conduct of scientific research, particularly when such inquiry intersects with vested economic and political interests. Whether the IPSFC was as successful at deflecting the pressures of industry and of national policy as Thompson remembered is another question.

The commission established under the Pacific Salmon Convention was composed of three layers of organization and operation. The commission proper contained six members (three from each country) and was responsible for the general planning and implementation of the convention. Members of the commission were appointed by their respective national governments and were connected in some respect to the fishing industry or to regulatory bodies. The founding Canadian commissioners, for example, comprised a fisheries official (W.A. Found), an industry representative (A.L. Hager), and a politician (Tom Reid); two of the American commissioners, on the other hand, were fisheries officials (B.M. Brennan and Charles E. Jackson), while the third was a prominent Washington lawyer with expertise in fisheries matters (E.W. Allen). An advisory committee, made up initially of ten industry representatives, five from each country, performed an ad hoc role connecting commissioners to industry and organizational concerns. A third layer consisted of a professional and technical staff overseen by a director of investigations, separate from, but subordinate to, the chairman of the commission.[6] This group, the most important in identifying and carrying out restoration efforts in the commission's early years, is the focus of my analysis.

[5] UWA, William F. Thompson Papers, acc. 2597-3-83-21, box 3, "Fishery Treaties between the US and Canada," n.d. (but probably c. 1959), 8-22

[6] On the organization of the commission, see: Roos, *Restoring Fraser River Salmon*, 54-5.

The scientific activities of the early commission derived their main impetus and direction from William Thompson. Thompson might be considered one of the leading lights of the second generation of fisheries scientists on the Pacific coast in the twentieth century. A product of the Stanford fisheries program, he undertook important fisheries studies as the head of the North Pacific Halibut Commission in the late 1920s and developed a substantial research career in the area of scaling fisheries. He also acted as chair, starting in 1930, of the University of Washington College of Fisheries and oversaw the transformation of the school from a practically oriented program to an important research institute that attracted significant private, state, and federal research funds.[7] A better scientist than politician, Thompson probably agreed to become director of investigations under the Salmon Convention more for the research opportunity than for the prestige. He did not enjoy publicity and resigned within five years, embittered by the personal and political conflicts that had tainted his scientific mission. But during those five years he had led a research team to one of the most important single discoveries in fisheries management in BC history.

Thompson's responsibility was to gather and supervise a team of researchers to pursue investigations with a view to the restoration and regulation of sockeye salmon runs. Building an international scientific institution, however, also involved problems of national and international politics. To the consternation of Canadian commissioners, Thompson initially tried to base the work at the University of Washington. The Canadian MP and commissioner Tom Reid insisted that the benefits of the convention ought to be more evident in Canada, particularly in his riding of New Westminster. He also criticized Thompson's penchant for hiring Americans, and he asked why Canadians were not being hired for the research jobs. American commissioner B.M. Brennan replied that there were no qualified UBC graduates; better people, trained in fisheries science, were available in Washington.[8] The disagreement signalled Canadian fears that the commission would simply become an American research effort; from the opposing perspective, American commissioners believed that Reid

[7] UWA, Richard Van Cleve Papers, acc. 1683-71-10, box 4, RVC, "The College of Fisheries, University of Washington," n.d., pp. 1-2

[8] UWA, Thompson Papers, acc. 2597-3-83-21, box 7, file 1940, B.M. Brennan to A.J. Whitmore, 31 May 1940 (copy). Despite Thompson's preference for University of Washington-affiliated staff, he did, Brennan reported, advise UBC on how to improve its undergraduate program to bring it into line with the commission's requirements.

was bullying Thompson and "look[ed] upon the commission as an opportunity for patronage."[9] Thompson lost the battle over the location of the commission offices but managed to carry out substantial research in the University of Washington labs and to hire his own people. Some of these turned out to be distinguished Canadian researchers. Jack L. Kask, a UBC graduate and University of Washington PhD who had formerly worked under Thompson on the halibut study, as well as William Ricker and Russell Foerster, two Canadian researchers who had substantial experience on the Fraser and in sockeye research and who were based at the Nanaimo federal fisheries lab, joined the IPSFC in its first year. Ricker would conclude his relationship with the IPSFC a year later and, in the late 1940s, become its most outspoken scientific critic.

Rarely are large subjects like the sockeye salmon runs in the Fraser basin examined in integrated studies. Before the advent of the IPSFC research program, a range of provincial and federal fisheries scientists studied Fraser river salmon. Much of the early work had catalogued distributions and had sought to determine the validity of the home stream theory. Stanford zoologist Charles Gilbert had produced the most important work in this line by attempting to distinguish racial groups within species by means of growth ring analysis. In the 1920s, federal research had made advances in the study of fish culture with research at Cultus Lake on the returns of "wild" and reared sockeye. Other work concerned the control of predator populations. All of these projects were basic in different ways, but they were regionally segmented and of limited application.[10] The IPSFC research mandate allowed Thompson and his team to look at broader questions connecting the watershed as a whole and to suggest the basis for a sweeping restoration program. Other than the halibut commission and the pioneering International Council for the Exploration of the Sea, which coordinated research in the North Atlantic, few precedents for such a program existed internationally.[11]

One of the most important opening strategies of Thompson's research program was to maintain flexibility.[12] Research funds were

[9] UWA, E.W. Allen Papers, acc. 129-3, box 2, file 2-52, E.W. Allen to Charles E. Jackson, US Bureau of Fisheries, 1 July 1939 (copy).

[10] I have summarized and analyzed this early fisheries biological research in Chapter 1, "'Nature's Methods Have Been Improved Upon': The Scientization of Salmon and Water in British Columbia, 1900-1930," Evenden, "Fish vs. Power."

[11] For a discussion of the halibut commission, see Tomasevich, *International Agreements*, 125-209; on the science of the ICES and the halibut commission, see Smith, *Scaling Fisheries*, 110-229, and 202-14.

not allocated to particular projects of five years' duration; instead, IPSFC scientists pursued a problem-oriented survey approach in the first year to identify worthy topics of study. While the existing literature on the Fraser fisheries was collected and supplemented by historical material on past catch levels, the main emphasis of the initial field work was to differentiate the sockeye runs by tagging studies and spawning bed surveys. Early studies by Gilbert and others at the turn of the century had established that salmon populations were not homogeneous but could be separated into "races" with their own migration patterns and spawning areas. The racial theory was a cornerstone of the IPSFC's initial survey. By tagging sockeye in closed periods off the coast of Vancouver Island near Sooke, and at various stages upstream, statistics were collected on the characteristics of the particular racial groups. Contextual information was gathered as well: survey parties examined each of the major spawning areas in the watershed during the summer and fall runs, determined the number of returning spawners, and entered relevant environmental information into standardized notebooks for each spawning region. Incidental to this work, and with a view to regulation, some attempt was made to observe the Native fishery in order to develop some estimate of its annual take. And despite some initial reservations, Thompson decided to fund what had been the Canadian Department of Fisheries studies on the rate of sockeye returns at Cultus Lake.[13] This marked the transition in Fraser sockeye research from federal to commission control. Hereafter the field was dominated by the commission, while the federal department turned its attention to the Skeena River.[14]

In describing his approach, Thompson wrote: "I am holding the program open to change. It must not be allowed to crystallize before the direct utility of its several features is seen."[15] After the first summer of investigations some of those "features" were becoming apparent. One was the obstructions in the Fraser Canyon. In some sense, the problem was stumbled upon. Tagging experiments in salt water had determined that too few of these marked fish were surviving the entire

[12] Thompson's program is detailed in a memorandum to the commissioners. See UWA, Thompson Papers, acc. 2597-3-83-21, box 7, file 1938, Thompson to International Pacific Salmon Fisheries Commission, 18 May 1938.

[13] The outline of the IPSFC's research program is given in Thompson's memorandum to the commissioners. See UWA, Thompson Papers, acc. 2597-3-83-21, box 7, file 1938, Thompson to IPSFC, 18 May 1938.

[14] Kenneth Johnstone, *The Aquatic Explorers: A History of the Fisheries Research Board of Canada* (Toronto: University of Toronto Press, 1977), 175-6.

[15] UWA, F Thompson Papers, acc. 2597-3-83-21, box 7, file 1938, Thompson to IPSFC, 18 May 1938.

migration process to provide meaningful statistical data. Various upstream locations were chosen to tag fish and collect in-river migration data. One such location was near Yale, but it was shifted to Hells Gate in mid-season because fish were more easily captured there. From rocks and crags, and later from small scows, scientists fished with gill nets for sockeye, tagged them, removed some of their scales for racial analysis, and then released them. Findings based on this method would shape the course of the IPSFC's research mandate over the next decade.

Tagged fish, the scientists found, did not pass Hells Gate as expected. Frequently they were held up for days, turning up in the tagging nets more than once as "recaptures," and sometimes downstream, as far away as the river's mouth. Although some of the tagged fish were recaptured upstream and did provide evidence of the timing of migration to spawning areas, there were enough that did not get through for Thompson and his team to decide to focus more attention on the problem in subsequent seasons. Could it be, they asked, that the rumour about Hells Gate, so frequently dismissed by fisheries officials over the past two decades, was true? Did the gorge still contain material from the slides that made salmon passage difficult? From 1939 to 1941, the IPSFC placed a special emphasis on answering this question. Their main means of analysis was the tagging procedure contextualized by relevant data on water levels, catch statistics, and spawning ground counts of escapements. But given the centrality of the tagging method, it is well to consider the operation of this experiment more closely. How were small celluloid disks representative of shifts in nature?

FISHING FOR TAGS

By the 1920s fish tagging experiments were becoming a fundamental tool in large-scale fisheries studies. Thompson had used them in the halibut commission work, and they were a basic technique of the much-celebrated International Council for the Exploration of the Sea.[16] Joint Canada-US tagging experiments on salmon had provided part of the conceptual basis for the Salmon Convention by demonstrating the transnational migration patterns of Fraser sockeye. But

[16] On early plaice-tagging experiments, see Smith, *Scaling Fisheries*, 143-6. For an overview of marking studies in fisheries biology, see G.A. McFarlane, Richard S. Wydoski, and Eric D. Prince, "Historical Review of the Development of External Tags and Marks," in *Fish Marking Techniques* (American Fisheries Society Symposium) 7 (1990): 9-29.

before the commission experiments on the Fraser, tagging had been used most frequently to demonstrate the migration paths of ocean fish. It had never previously been used in a major study on the Fraser. Wilber Clemens of the biological board lab in Nanaimo had suggested such a project a decade previously during a Board of Engineers investigation of Hells Gate, but without result.[17] In-river tagging was only adopted by the commission when it appeared that too many of the fish tagged in salt water were being taken by the commercial fishery.

Fish tagging was a scientific exercise in differentiating populations and analyzing their movement through space. In the commission experiments, fish were captured according to a random fishing process, pierced with a nickel pin, and identified by two celluloid disks that were inscribed with a serial code and placed directly under the dorsal fin. The fish were then returned to their natural habitat, and scientists waited to discover where they reappeared. The assumption was that the tagged fish mirrored the experience of the larger population, at least in probability terms. Tags did not intrude upon or alter natural patterns; they reflected them.

Tagging, however, was not carried out in a hermetically sealed scientific space where natural relationships could be distinguished unproblematically from cultural contexts or ways of seeing. Data were meant to provide direct clues about natural change and salmon movement, but the very means of collecting tags placed filters between the scientist and the rest of nature. Collection methods as well as aspects of the "natural laboratory" introduced various forms of selectivity. The very tools of capture were selective: gill nets, which snagged certain sizes of fish more than others, were replaced by dip-nets in 1942.[18] More fundamentally, such nets were imprecise gauges of passing populations. The disjuncture between an ideally constant tagging pressure and a variable rate of salmon passage meant that when a large cohort passed, or was delayed, a different proportion of the population was sampled than at other times.[19] What this meant for the nature of the sample and the resulting data was unknown. Beyond the gate, in the upper basin spawning grounds, the collection of data created further problems. All tags were not retrieved. On some streams, river flow carried the carcasses of spawned fish away, taking their precious tags

[17] NAC, RG 23, box 679, file 713-2-2[9], J.A. Motherwell to W.A. Found, 19 April 1928.
[18] Thompson, "Obstructions," 97.
[19] G.B. Talbot, "A Biological Study of the Effectiveness of the Hell's Gate Fishways," *Bulletin* 3 (New Westminster: International Pacific Salmon Fisheries Commission, 1950), 12.

with them.[20] On others, tags were discovered, but after the spawning was complete. Judging when the fish arrived became a guessing game that was only compounded when intermediaries turned in the tags. There were oddities that could not be wholly explained: many of the tagged fish collected in the spawning grounds bore scars. Thompson stated in his final report that the proportion of fish thus affected was "relatively high." He suggested that Native gill nets might be the cause.[21] But, as with all of these anomalies, it was difficult to say. Commission scientists knew these problems existed and acknowledged them in their published findings. They did not attempt, however, to account for them statistically or to publish quantitative analyses of how the data might be affected by any or all of them. Such problems would provide the basis for subsequent critiques of the commission's science and of its conclusions.

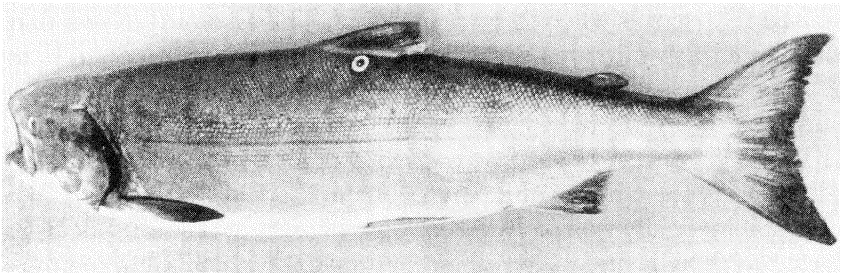


Plate 2: Tagged sockeye salmon from the Hells Gate investigations. Notice the placement of the tag below the dorsal fin. Photograph courtesy of the Pacific Salmon Commission Library.

Perhaps the most blatant problems with the data collection showed up in the interaction of commission scientists and Native fishers. On the face of it, the commission's plan to study Native fishing on the Fraser blended perfectly with its tagging experiments. Natives were asked to return fish tags taken in the seasonal fishery to the commission. This would provide scientists with data about fish movement as well as about fishing pressure. As with commercial fishers in saltwater experiments, Native fishers would be paid fifty cents per tag. A simple arrangement no doubt, but one complicated by the long history of antagonism and unequal power relationships between Native fishers and fisheries regulators in the canyon. Native peoples did not return the tags as expected, but sometimes saved them or turned

[20] Talbot, "Biological Study," 22.
[21] Thompson, "Obstructions," 98.

Plate 3: IPSFC scientists fishing at Hells Gate, 1941. Photograph courtesy of the Pacific Salmon Commission Library.

them in far from the point of catch. The problem was not that Native fishers were necessarily setting out to sabotage research, but that they were collecting tags for their own reasons. One person's data were another's fifty cents.

Whereas the tags were a marker of fish passage for scientists, inscribed with data and representative of natural change, they became a "fungible" in the economy of Native fishers in the canyon. Karl Polanyi defines a fungible as a durable object that can perform the functions of money – as a means of payment, a standard of value, a store of wealth, and a means of exchange.[22] Although no statistics were published by the commission concerning the number of tags collected by Natives, in the 1941 season Thompson estimated that, due to a lack of commission tag collectors on the spawning grounds, over $1,000 would be paid to Natives searching the spawning grounds alone.[23] That works out to 2,000 tags, more than 10 percent of the total number of tags used in that year. In the seasonal fishery, tag collection became a lucrative byline and, sometimes, an end in itself. Fish tags turned into local currency.

[22] See Karl Polanyi's "Money Objects and Money Uses," *The Livelihood of Man*, Harry W. Pearson, ed. (New York: Academic, 1977), 102-3.

[23] UWA, Thompson Papers, acc. 2597-3-83-21, box 7, file 1941, Thompson to IPSFC, 4 August 1941.

The fungible quality of fish tags was a lesson that commission scientist Jack L Kask learned, with much frustration, in the fall of 1940.[24] After recording peculiar patterns of tag returns in the canyon – returns that did not correspond to commission expectations – Kask was sent to investigate how tags were collected and returned. At the First Nations reserve near Anderson Creek, Kask questioned Chief Joe Brown about tags and discovered, to his displeasure, that tags were captured by a variety of people, some without fishing permits, who subsequently took them to places as far away as Lytton before returning them (if they returned them at all). Besides confiscating some illegal gaffes that he found in the vicinity, Kask collected eight tags from Chief Brown and tried to insist on the importance of prompt tag returns. Kask was one of a long tradition of salmon officials who told Native fishers of the canyon how to fish and then expected their cooperation. He shared his frustration and prejudice in a memorandum to his superiors: "A thorough search of the Indian villages would probably unearth many more [tags], although the Indians do not hand in the tags until they are good and ready and as long as there are stores and other centres where cash can be obtained for tags it will be difficult for any commission employee to get to them."[25]

Stores accepting tags? This was a key problem, said Kask. The commission had hired a scattering of individuals in the canyon to collect tags directly from Native peoples and record these returns promptly. Commission scientists did not envisage the emergence of middlemen. In order to study the methods of tag collection, Kask accompanied one such commission employee, Tom E. Scott, a retired federal fishery agent based in Hope, during his round in the lower canyon.[26] While insisting that he collected all tags directly from Native fishers, Scott led Kask to several general stores. At Yale, he confessed that the majority of the tags from the lower canyon ended up in the cash register of the local Chinese-Canadian shopkeeper. Natives used tags in the store as cash equivalents. The proprietor held the tags, and Scott reimbursed him for the stated price of fifty cents per tag. Or that is what Scott said. After visiting the Spuzzum general store (where a similar transaction occurred) and then Alexandra Lodge (where dealings were carried out beyond Kask's view in the kitchen), the commission scientist

[24] PSCA, file 2550.2-21, J.L. Kask, "Indian Fishing for Tags in the Closed Area Above Hell's Gate," 4 November 1940.

[25] Ibid.

[26] PSCA, file 2550.2-21, J.L. Kask, "Trip Made with Thomas E. Scott to Recover Tags and Remove Weirs in Nicola Valley," 4 November 1940.

had a fair idea of how the wily Scott operated. "Scott's great enthusiasm for collecting tags can be explained in this way. In 1938 and 1939 tags were redeemed at his appointed centres of tag collection at a reduced rate. As they were turned in to the Commission at the full rate of 50 cents per tag, it is conceivable that a small rake-off was made by the store-keeper and Scott."[27] In view of Scott's activities, said Kask, it would be best to stop employing tag collectors who used further middlemen and did not keep accurate records. A commission scientist, he argued, ought to be employed full time to ensure accuracy and prompt collection.

Because tags were stores of value for Native peoples, they attracted a different kind of fishery: a strategically aimed fishery that bent "normal" fishing pressures in new directions and frustrated commission statisticians. The shiny white disks with a red bullet at their centre could be seen by a skilled fisher. Native peoples fished selectively for salmon because they contained use value in food and exchange value in celluloid.[28] Only in 1947 was a new kind of disk used – one that was less visible under water. In that year, commission scientists reported a significant drop in Native tag catches.[29] Commission scientists also suspected that fish that were unable to pass Hells Gate and drifted downstream to die were monitored and collected by Native fishers. Given the haphazard recording system for tags, at least in the first few years of tag collection, it is entirely possible that such tags were mixed up with those of different catch dates or carried north up the canyon and exchanged in a store beyond Hells Gate, giving commission scientists erroneous data from which to measure the passage of fish. Moreover, selective fishing may have exaggerated the extent of the Native fishery. For perhaps the first time since restrictions were imposed on Native fishing after the Hells Gate slides, Natives were reaping some material return from the regulatory process. In so doing, they were causing enormous problems for commission scientists.

Kask's views were taken seriously. Beginning in 1941, commission scientists were detailed to collect tags directly from Natives in return for the fifty-cent price. The middlemen were gone and surveillance was intensified. In 1944 G.V. Howard wrote a guide for commission tag collectors that explained the best method:

[27] Ibid.

[28] PSCA, file 2550.2-3, A. Welander and Peterson, "1941 Indian Fishery Report, Lower Fraser and Canyon."

[29] Talbot, "Biological Study," 31.

> Visit all the Indian fishing stations in your district as often as possible, and acquaint yourself thoroughly with these localities. Acquaint yourself with these Indians and attempt to gain their confidence. In this way you will be able to determine the number of Indians who actually engage in fishing. From these fishermen obtain the following:
>
> 1. Name
> 2. Permanent Address
> 3. Number of dependents
> 4. Occupations other than fishing
> 5. Reliability of volunteered information[30]

Collectors were instructed to record whether they collected fish counts verbally or whether they made them themselves, to specify types of gear used, to determine the placement of fish stations, and to note how fish were preserved and consumed. Cards were kept on each fisher and daily reports filed. Salmon scientists cum ethnographers were attempting to gain a comprehensive sense of the Native fishery not only to control it and set limits on the catch, but also to ensure the purity of their data. While Native fishers experienced the most intensive surveillance of their fishery to date, commission scientists were coming to believe that their data were solid. Their ethnographic research was validating their tags as mirrors of nature. Of course, for Native peoples the tags were still worth fifty cents.

ANSWERS

After a number of field seasons, the commission scientists concluded that water levels were a primary cause of fish problems at the gate. The tagging experiments provided enough data on the time it took fish during periods of "normal" passage to pass the gate and turn up in spawning beds to enable the spotting of anomalies. At water levels between twenty-six and forty feet in Hells Gate, the number of fish recaptured below the gate after tagging climbed sharply, leading observers to conclude that few fish were passing – a conclusion that that seemed to be substantiated by the low recovery of fish upstream after these "blocked" periods. The increases in recaptures showed a strong correlation with periods when water levels were at a middling

[30] PSCA, file 2550.2-56, G.V. Howard, "Instructions for the Collection of Indian Fishery Statistics," 1944.

level in the annual fluctuation. They did not seem to correspond to other factors. The gate's unevenness under water seemed to create high turbulence at certain levels and make passage increasingly difficult when the water dipped into the danger zone. It was as if the gate were shaped like an hourglass and fish were trying to pass – but failing – when water coursed through the narrow middle section.[31] By the beginning of the 1941 field season, commission scientists assumed that water levels were the primary problem, an assumption that an expanded experimental program in the upcoming season provided an opportunity to test.

The 1941 field season was as unusual as it was revealing. From early July until the end of October, Hells Gate appeared to be blocked to migrating salmon. In previous seasons blocks lasted for up to a week. In 1941, they lasted for months. William Thompson, a scientist who was not fond of superlatives, was astounded, and he said so in his memoranda to the commissioners.[32] It was as if, he wrote in a later report, the whole drama of 1913 were being played out again in front of the scientists' eyes. Just as in 1913, when John Pease Babcock had surveyed the slide scene, salmon gathered in a confused traffic directly below the gate. They stretched down the river for six miles, and, as the season progressed, matured into the famous red of the spawning sockeye. Few passed through in the late summer months. Hardly any passed in September. For much of the season, water rumbled through the gate within the middling zone. A few respites in July, early September, and late October allowed for some fish to pass through. Some of the fish were tagged, but few of them were discovered later on the spawning grounds.[33]

The spectacle of blocked salmon impressed the scientists and led to a rapid re-deployment of scientific effort. At the beginning of the season Thompson had laid out a research program that included studies of the Native fishery, the long-term consequences of a dam built at Quesnel Lake, and the expanded work on tagging at Hells Gate.[34] But, as the salmon numbers began to mount below the gate, these plans were remade. "Every available man from the other

[31] I borrow the metaphor of the hourglass from T.G. Northcote and P.A. Larkin, "The Fraser River: A Major Salmonine Production System," in *Proceedings of the International Large River Symposium*, ed. D.P. Hodge (Canadian Special Publication of Fisheries and Aquatic Sciences) 106 (1989): 196

[32] UWA, Thompson Papers, acc. 2597-3-83-21, box 7, file 1941, Thompson to IPSFC, 31 October 1941.

[33] Thompson, "Obstruction," 92-6.

[34] UWA, Thompson Papers, acc. 2597-8-83-21, box 7, file 1941, Thompson to IPSFC, 4 August 1941.

divisions of the work," Thompson informed commissioners, "was concentrated on [the Hells Gate problem,] including some of the Director's time. No other question could possibly arise which would equal the importance of this Hell's Gate blockade and ordinary arrangements were ruthlessly sacrificed accordingly."[35] By late August two teams of fish taggers handled 150 fish per day. Over 13,000 sockeye would carry tags by the end of the season. The project was, Thompson noted with pride, "one of the most extensive tagging programs of its kind ever undertaken."[36] Other projects risked not being completed, but the opportunity provided by unusual conditions had not been missed. Now the problem was to tie all of the data together. "Unmistakable as the indications are," Thompson stated, "the returns must be tabulated and analyzed with care."[37]

As the drama unfolded, Thompson thought he foresaw the process that lay ahead. The press was beginning to publish stories about the massive build up, and journalists wanted interviews.[38] By contrast, Thompson, as he told the commissioners, wanted to be "protected."[39] He did prepare a preliminary release on the problems at the gate, but he argued vigorously within the commission that the press coverage should not seek to arouse alarm.[40] The risks were too great that publicity would force political decisions on the commission, thereby disrupting the research. Conclusions, he advised Miller Freeman, the publisher of *Pacific Fisherman*, were premature.[41] The commissioners acceded to his request.

Part of the reason why Thompson did not wish to attract attention to the apparent blockage at Hells Gate was that he thought the most likely solution required further study. In order to restore the gate and release the blockage conditions, a fishway of some kind would be needed. This was not a problem that could be handled quickly. The commission scientists were biologists, not engineers. New expertise would be needed in order to proceed. Furthermore, any building

[35] Ibid., Thompson to IPSFC, 31 October 1941.

[36] UWA, Allen Papers, acc. 129,129-2, box 3, file 5, Thompson to IPSFC, 14 November 1941.

[37] UWA, Thompson Papers, acc. 2597-3-83-21, box 7, file 1941, Thompson to IPSFC, 31 October 1941.

[38] See, for example, Bruce Hutchison's epic article on the blockade: "International Sockeye Board Inspects Fraser River Blockade," *Vancouver Sun*, 21 September 1941; "Salmon Blockade," *Vancouver Sun* editorial, 21 September 1941; and "Salmon Board Declares Hells Gate Must Be Cleared," *Vancouver Sun*, 5 December 1941.

[39] UWA, Thompson Papers, acc. 2597-3-83-21, box 7, file 1941, Thompson to IPSFC, 31 October 1941.

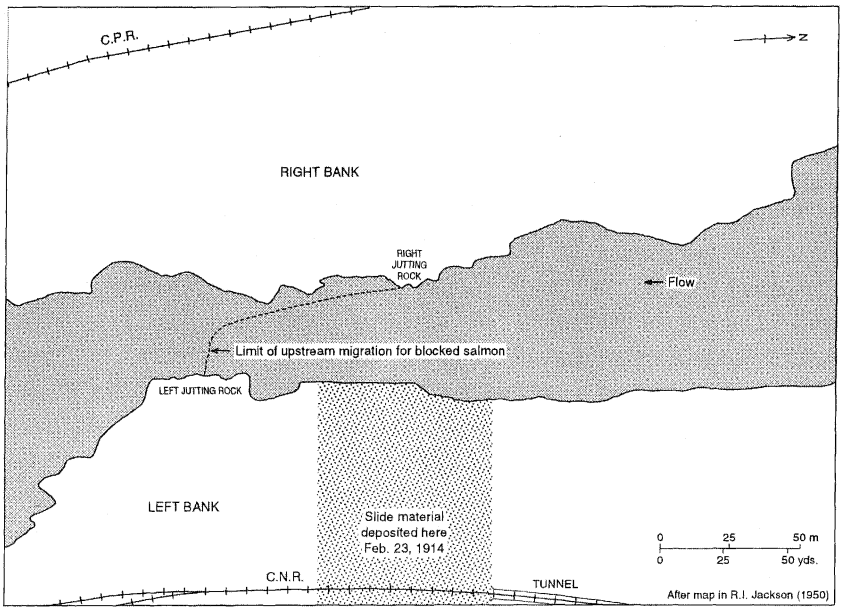
[40] UWA, Allen Papers, acc. 129-3, box 3, file 5, Thompson to IPSFC, 14 November 1941.

[41] UWA, Miller Freeman Papers, acc. 1038, box 2, file 2-38, Thompson to Freeman, 5 September 1941.

project would require a special disbursement from the national governments, and that might not be easy to procure. Better, he thought, to control the flow of information as much as possible so that the request for a fishway, when it came, would not be prejudged.

FISHWAYS

Early in the century fishways were simple in design and crude in execution, but by the 1940s the technology had developed substantially.[42] These advances occurred principally as a by-product of developments on the Columbia River where, from 1931 to 1941, main stem dams were raised at Bonneville, Rock Island, and Grand Coulee.[43] The Bonneville project included an extensive fishway system as an integral aspect of the design, while the Grand Coulee Dam, designed without fish in mind, had fishways added after the main



Map 2: Hells Gate and the slides. After R.I. Jackson, *Variations in Flow Patterns at Hells Gate and Their Relationship to the Migration of Slamon Sockeye Bulletin III*, New Westminister: International Pacific Salmon Fisheries Commission, 1950.

[42] For a brief review of the history of fishway designs, see C.H. Clay, *Design of Fishways and Other Fish Facilities* (Ottawa: Department of Fisheries Canada, 1961), 14-8.

[43] Courtland L. Smith, *Salmon Fishers of the Columbia* (Corvallis: Oregon State University Press, 1979), 78; Paul C. Pitzer, *Grand Coulee: Harnessing a Dream* (Pullman: Washington State University Press, 1994), 223-7; White, *Organic Machine*, 89-98.

project was completed. Although it was unclear by the 1940s how well these fishways would operate over the long term, at least at Bonneville they appeared capable of passing fish. Thus the blockage at Hells Gate was imagined in an atmosphere within which dams were the problem and fishways the technical solution.

In 1941 preliminary work on the fluvial dynamics of the passage at Hells Gate established that two "jutting rocks" on either side of the river created obstructions to fish and increased the fall of the water at the problem levels between twenty-six and forty feet.[44] Creating safe passage would require the alteration or circumvention of these points. With a special one-time disbursement of $45,000 from the two national governments, the commission engaged a number of hydraulic engineers to study the problem and recommend a solution. These engineers drew on experience from the Columbia River dams and employed established river modelling methods following pioneering investigations by the US Army Corps of Engineers during the 1930s.[45] At Hells Gate, Milo Bell, formerly of the Washington State fisheries department, took on primary responsibility for engineering investigations and contributed his experience, which was gained as a designer of the Bonneville and Grand Coulee Dam fishways.[46] At the University of Washington, hydraulic engineering professor Charles W. Harris oversaw the construction and testing of a Hells Gate model, with the assistance of Walter Hitner, also of the University of Washington, and UBC engineering professor Ted Pretious.[47] At all points during their studies a team of biologists was at hand to advise on the physiological and behavioural capacities of salmon.

By 1943 they had a prototype.[48] The fishways were unlike those previously created for dam structures that carried fish up and over obstructions; instead, they were designed to operate at different levels of the gate on both banks, assisting fish only at problem water levels. They would not surmount the gate but work through it. Positioned directly behind both of the "jutting rocks," the conduits would provide salmon with alternate routes around high-velocity points with a steep fall. At safer water levels, the fishways would be either submerged or

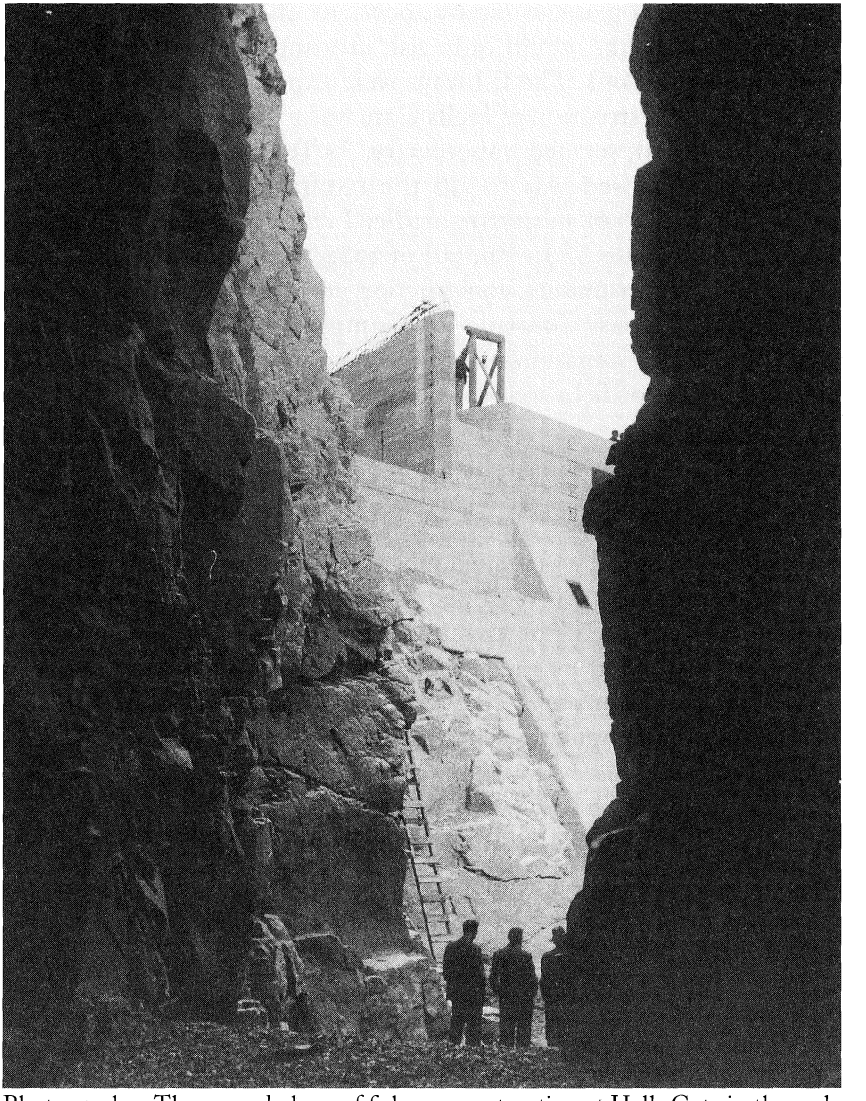
[44] This description of the engineering studies is based on Milo C. Bell, "Report on the Engineering Investigation of Hell's Gate, Fraser River," *Annual Report of the IPSFC* (1944): 15-22.

[45] Martin Reuss, "The Art of Scientific Precision: River Research in the United States Army Corps of Engineers," *Technology and Culture* 40, 4 (October 1999): 292-323

[46] "Famed Engineer on Hell's Gate Project," *Vancouver Sun*, 8 February 1944.

[47] UWA, Thompson Papers, acc. 2597-3-83-21, box 7, file 1942, Thompson to International Pacific Salmon Commission, 27 May 1942.

[48] For a discussion of the hydraulic studies, see Bell, "Report on the Engineering."



Photograph 4: The second phase of fishway construction at Hells Gate in the early 1950s. Vancouver Public Library, photograph no. 44474.

above surface. Novel to the design was the use within the fishway flumes of vertical slot baffles to slow the water speed to a consistent and manageable level.[49] There was a deliberate attempt to disturb the existing site as little as possible. The tests on the model had shown that more radical plans to remove portions of "jutting rock" on the east and west banks would only risk creating new and potentially damaging conditions. The fishways were experimental enough that a thorough reconstruction of Hells Gate was too risky to contemplate and, in any event, seemed unnecessary. As Ted Pretious later put it, "the scheme devised was to aid the natural river to perform its function, rather than substitute artificial features where the natural ones were adequate."[50] In the fall of 1944, with the support of the two national governments, construction crews began to excavate the site.[51] Built by Coast Construction Company under the supervision of Bell and the commission, the fishways cost over a million dollars.[52] By 1945 one set of fishways was complete; the second was operable the following year.

A JUSTIFICATION AND A TREATISE

Although Thompson was in no doubt about the causes of the seasonal blockages of salmon, his reasoned justification for the commission's building program did not appear in print until the fishways were complete. Published as the first bulletin of the IPSFC in 1945, his analysis of conditions at Hells Gate was a major statement on the history of salmon populations in the Fraser basin, and it drew together a wealth of material developed over six years of commission research. Completed after Thompson had quit the commission in 1943 in frustration over political and personal disputes, the bulletin repre-

[49] Clay, *Design of Fishways*, 13. Clay describes the operation of the vertical slot fishway as follows: "This fishway is constructed by installing a series of baffles at regular intervals between the walls of a flume. The baffles are so shaped as to partially turn the flow from the slots back upstream, with the result that if the slots are properly shaped and dimensioned, energy dissipation is excellent over a wide range of levels and discharges. It has the added advantages of permitting the fish to swim through the slots from one pool to the next at any desired depth, since the slot extends from top to bottom of the flume."

[50] E.S. Pretious, "Salmon Catastrophe at Hell's Gate," 17

[51] The rationale for participation in the project was spelled out by Department of Fisheries staff in NAC, RG 23, vol. 681, file 713-2-2[18], "Memorandum Re: Permanent Fishway Facilities – Hell's Gate Canyon, Fraser River," 22 February 1944.

[52] For a description of the building project, see "Preparing to Open Hell's Gate," *Pacific Fisherman* 43, 1 (January 1945): 63. The total cost of fishways at Hells Gate, including later extensions, was $1,351,00. See International Pacific Salmon Fisheries Commission, "Hell's Gate Fishways," pamphlet, New Westminster, 1971, p. 5.

sented his personal commitment to, and pride, in the commission's scientific work.[53]

Thompson cast the analysis of the problems at Hells Gate within a wide context. He offered a long-term explanation for shifts in the populations of Fraser sockeye, premised on the logic of racial analysis applied to historical data. The long view was enhanced by the specific knowledge of the timing of migration and the effect of obstructions gained through the Hells Gate investigations. Recent shifts in salmon populations were analyzed with a particular focus on the differential effects of Hells Gate on distinct racial units in the upper basin's various spawning grounds. As a whole, the analysis suggested a new race-based approach to future fisheries regulation and justified the construction of the Hells Gate fishways as the only reasonable way to restore Fraser sockeye to past levels.

In Thompson's view, sockeye runs on the Fraser River were comprised of a set of once healthy racial units that had been buffeted by a series of significant and sometimes regionally specific environmental insults. Dividing the history of the fishery into five periods of decline and recovery since 1872, Thompson created a serial index of past sockeye populations based principally on catch records. He supplemented these data with other evidence and allowed statistically for changing rates of fishing pressure. Alongside the population index, Thompson examined changing regional escapements as evidenced in spawning ground surveys and remaining hatchery records. This allowed for a specific analysis of the racial units that had plummeted in years of decline or that were responsible for general declines in the fishery four years later.[54] The first decline of the fishery, for example, he traced to the Quesnel Lake Dam, which was without an operational fishway from 1899 to 1903. Although Thompson allowed that over-fishing might have added to the declines after 1903, he placed the primary emphasis on habitat destruction.[55]

Thompson identified a second major decline in salmon populations, also rooted in a specific environmental change: the building of the

[53] Thompson's resignation in 1943 followed on disputes with colleagues, particularly J.L. Kask, and continued problems with Tom Reid. Kask resigned in the same year, after the blow-up with Thompson. Thompson was also generally frustrated with the amount of time required for executive duties. See UWA, Thompson Papers, acc. 2597-3-83-21, box 7, file "Correspondence (re: Thompson's Resignation)," Thompson to A. L. Hager, Canadian Fishing Company, 3 August 1943 (copy). Thompson also complained in his diary about personal disputes and the politics of his position. See box 1, file "Diary 1943."

[54] Methodological considerations are treated in Thompson, "Effects of Obstruction," 22-39.

[55] Ibid., 50-5.

Canadian National Railways (CNR) through the Fraser Canyon, beginning in 1911. This second event, however, had a broader impact across the basin and a longer-term, if variable, set of effects. Whereas the Quesnel Lake Dam was specific to a number of racial units, the Hells Gate problem affected all racial units in the upper basin (and, thus, the vast majority of the Fraser sockeye population). But, as Thompson and the commission scientists had discovered in the Hells Gate tagging experiments, the obstruction changed daily. At some water levels it blocked fish, at others it provided passage. Thompson specified the consequences of this shifting impact by integrating different environmental data: water level (recorded at Hells Gate since 1912 and extrapolated from Hope data for earlier periods), racial unit and size of run (based on the latest data concerning typical migration dates and past spawner escapement information), and qualitative reports of regional population cycles. Viewed through the optic of racial analysis, these different strands combined to explain what had formerly appeared to observers like John Pease Babcock as wild upper basin fluctuations.[56]

Consider the Adams River runs, which had experienced a number of puzzling patterns in the two decades after the slides. Thompson charted the population history of the river's sockeye runs in relation to two key environmental events: the creation of a lumber splash dam in 1907 and the Hells Gate slides in 1912-3 and after. The earliest impact was the easier to explain: a river blockage affected all Adams River runs but was specific to that river because no parallel declines were experienced in other spawning grounds. The Hells Gate effect was more complicated. Just as different upper basin runs experienced Hells Gate's variations differently, so too did the temporally distinct runs to the Adams River. The region received both early and late season runs of distinct racial units. In 1913, Thompson suggested, early runs survived, while later ones were diminished, some becoming extinct. Thereafter, problems remained, though they changed with seasonal water flows. Some runs experienced a precipitous decline, while others began to expand. In the course of ten years these shifts were registered in a transformation of the pattern of quadrennial dominance. Whereas before the slides the 1913 cycle year was responsible for the greatest volume of spawners, after ten years the 1922 cycle year had replaced it as the dominant run. In lay terms, this meant that salmon numbers peaked on a different four-year cycle

[56] Ibid., 84-156.

than they had before 1913; Hells Gate was shaping the success and failure of upper basin spawning runs by blocking some and favouring others. Overall, the aggregate population had declined.[57]

This explanatory framework held a certain common sense appeal. It pointed to obvious episodes of environmental destruction and explained their importance. It suggested why lower basin stocks, below Hells Gate, had remained steady over the first three decades of the century, while upper basin runs fluctuated. But the analysis was closely tied to the tagging experiments. These studies supplied relatively precise data about how long it took specific races to complete their run to the spawning grounds in normal and delayed conditions, how resilient they were to delay, and how different migration times were affected either more or less than others. These experiments gave Thompson the confidence to state that the Hells Gate obstruction – and not over-fishing – was the primary cause of the decades-long decline in Fraser River sockeye.

CONFLICT

But what if his assumptions were false? Thus did William Ricker put the question in a 1947 article in the *Journal of Wildlife Management* entitled, "Hell's Gate and the Sockeye."[58] Ricker was then a professor of zoology at Indiana University and a well respected student of the sockeye and of West Coast fisheries. Holding a PhD from the University of Toronto, Ricker began his career at the Pacific Biological Station at Nanaimo and assisted Russell Foerster in his studies of sockeye at Cultus Lake. He had departed for Indiana in 1938 after working one season for the IPSFC at the time of the first discoveries of blockages at Hells Gate. It is unclear whether personal disputes had any role in his departure.

Starting from the position that Thompson's analysis required careful debate and scrutiny, Ricker wrote an empirical and interpretive critique of the Hells Gate study and raised serious doubts about the necessity of the fishways. He started by focusing on a key empirical finding: during periods of blockage only 20 percent of delayed sockeye were able to pass. This was an important point because it underlay all of Thompson's claims about the rate of passage and the impact of

[57] Thompson, "Effects of Obstruction," 20, 62-6.

[58] William E. Ricker, "Hell's Gate and the Sockeye," *Journal of Wildlife Management* 11, 1 (January 1947): 10-20

delay on different racial units. The problem, claimed Ricker, was that, while the figure reflected the data, the data were so selective as to be unreliable and misleading. For one, the sample taken at Hells Gate almost certainly did not represent a cross-section of the population but likely contained a disproportionate representation of "weak" fish. Since strong fish could pass the obstruction quickly, taggers would catch them less frequently than weak fish. Moreover, the weakness of the fish forming the major component of the sample was intensified by the very process of tagging. Netting a fish, placing it in a box, clipping it, and returning it to water caused stress and sometimes split a fin – minutes before fish were tested by the most difficult stretch of the river. Both of these problems, Ricker stated, could have been accounted for by more precise methods of data collection and by simple shifts in experimental design (changing the location of the tagging stations or using control fish, for example). As it was, Ricker judged this shortcoming in the data to be important: "With regard to the possible magnitudes of the effects of the above two sources of error, it can be said without hesitation that they *may* be sufficient to completely invalidate the conclusion that the Gate has been (1938-1942) a serious obstacle to migration."[59] Change some of the assumptions about the strength of the sample group, Ricker proposed, and the tagging may have sampled 80 percent of weak fish and only 20 percent of the stronger migrants.

Thompson's findings were questionable in other ways. Why, asked Ricker, was it plausible to assume that a correlation between problem water levels at the gate and spawner success in any given year amounted to a cause-and-effect relationship? Climatic conditions, after all, have variable effects across space. While high river flow levels might prove beneficial at the gate, they were likely associated with flood conditions in upper basin watersheds, which would scour spawning grounds and reduce the success rate of the spawn. Water conditions at Hells Gate should not be considered as an independent variable but should be placed within a wider context.

Moreover, there was no discussion in the report of the sex ratio of migrants past the gate. Given that it was widely understood that male spawners were more powerful swimmers than females, it logically followed, Ricker wrote, that a blockage would create a preponderance of male returns to the spawning grounds. Spawning ground surveys in the years of blockage, however, provided no evidence of abnormal

[59] Ibid., 13.

sex ratios. Did this mean that the appearance of a block at the gate was false? Possibly, Ricker said; at least, it required explanation.

What, then, was one to make of the fishways? If the proof of blockage conditions was in doubt, then so too was the necessity for this expensive conservation measure. If, in the absence of other conservation measures, upper basin spawning grounds were rebuilt, then, Ricker judged, the fishways would surely be deemed worthwhile. He worried, however, that they were more likely to serve as an excellent excuse to avoid problems of over-fishing. Although Thompson's report discounted fishing as a primary cause of declines, he did report, Ricker underlined, that "the commercial fishery may take about 80 per cent of the sockeye returning from the sea; and tag returns show that 50 per cent is the absolute minimum."[60] What if the fishways were not about to save sockeye spawners? Would it not be worth considering stringent catch controls, at least to enhance the fishways' possible success? It would be a "gamble," Ricker concluded, to leave the task of conservation only to the fishways.[61]

Ricker's paper was framed as a scientific critique of an admirably complex study. It did not shy away, however, from drawing strong conclusions about the wisdom of the IPSFC's research and building program, and it questioned William Thompson's capabilities as a scientist. If it were intended as a disinterested critique, then it was not received in that spirit. The paper led to a major scientific controversy in the fisheries research community that spilled into the fisheries press and was cast by its participants along national lines. The international cooperation inherent in the IPSFC program seemed, for a time, to be in tatters.

The depth of feeling that Ricker's paper aroused is revealed in the correspondence between Thompson and some of his closest colleagues in the fisheries research community. Days after the journal was printed, Richard Van Cleve, the IPSFC chief biologist and a professor in the College of Fisheries at the University of Washington, registered his dismay to Thompson.[62] Van Cleve did not comment on the scientific aspects of Ricker's paper but judged it as the expression of a "personal grudge" against Thompson and the IPSFC, though with wider implications. Van Cleve argued that Ricker's article was "in effect an attack on all biological fisheries work on the Pacific coast and will result in

[60] Ibid., 19.
[61] Ibid.
[62] UWA, Van Cleve Papers, acc. 1683-71-10, box 4, file "Thompson, WF. 1932-1969."

casting a doubt on the validity of any of our work, especially that on salmon." In order to counter this effect, he urged Thompson to respond with an accessible piece that would win over a general audience.[63] Thompson appeared to agree with Van Cleve's reading of events. Writing to Fred Foster, formerly the regional director of the US Bureau of Fisheries in the Pacific Northwest, he explained that the controversy was more political than scientific. Ricker was formerly a member of the Biological Board of Canada, he explained. The board had not discovered the problems at Hells Gate; its policies were abandoned in the light of the IPSFC's work and, as a result, were made to look ill advised. Ricker, he thought, was salvaging the reputation of the past board and its research. "These Canadians," he wrote, "are somewhat in the position of a man who sat on a powder keg while the fuse burned, telling the world that it could not blow up."[64] Already, in 1946, improved returns through the fishways were showing that the commission had been right. It was his duty, Thompson explained, to air the debate for what it was.

Thompson's subsequent response to Ricker's paper shifted the controversy from Hells Gate to the credibility of Canadian fisheries science. Rather than focusing on Ricker's published criticisms, he reviewed the history of research on the Fraser sockeye and judged it wanting. Even the work carried out at Cultus Lake, which had been widely hailed as the most exacting examination of the efficiency of artificial propagation (and in which Ricker had had a hand), was cast in the same light. "None of these investigations led to positive remedial action, successful or otherwise." The Hells Gate situation, meanwhile, went unstudied. The Canadian Fisheries Research Board, he claimed, "either tacitly, or actually, acquiesced" in the "official view" that nothing was amiss at Hells Gate after the initial clean up. "Either the problems at Hell's Gate were not appreciated by the Research Board and Dr Ricker, or as often may happen in governmental work, an 'official' view was allowed to modify the research program, consequently its results." Either possibility was a stinging indictment of Canadian scientists: in this representation they were fools, or lackeys, or both. Thompson reserved some space to attempt to dismantle each of Ricker's critical arguments, but much of his defence rested on the spawning

[63] Van Cleve later read a preliminary version of Thompson's reply: PSCA, file 1180.1-74, Van Cleve to Thompson, 5 May 1947 (copy).

[64] UWA, Thompson Papers, acc. 2597-77-1, box 15, file 29, Thompson to Fred Foster, 14 February 1947.

returns after the construction of the fishways. Fish numbers were improving; therefore, the fishways were necessary and a success.[65] The reply was mimeographed and sent to over fifty scientists in the United States and Canada, to the main fisheries dailies, to the IPSFC commissioners, and to select politicians.[66]

Two fisheries journals featured the reply and spun out the story as a significant battle between national fisheries science communities. The *Pacific Fisherman* defended Thompson's position entirely. The editor of the journal showed a preliminary version of the story to Thompson and heaped scorn on Ricker, who was cast as a "scientific sharpshooter."[67] In a subsequent article, aiming to provide equal space to the opposition, the editor derided Canadian scientists as defensive and evasive.[68] He said that Ricker's role was personally motivated and political. The release of Ricker's article shortly before Canadian parliamentarians were to reassess IPSFC funding was said to be "significant" and deliberately destructive. Like all of Ricker's critics, the journal stated, "The proof of fishways is in the fish which pass them."[69] The *Canadian Fishermen's Weekly*, by contrast, seemed to side with Ricker initially, or at least it seemed to give him a platform.[70] Subsequently, the journal published a filtered conversation between Ricker and Thompson, as they sparred back and forth in public view. The journal also reported the views of commissioners, such as Tom Reid, who lashed out publicly against Ricker's statements, and it allowed members of the Canadian Fisheries Research Board the opportunity to defend their research record.[71]

Members of the board were personally affronted by Thompson's public remarks and conducted a campaign to defend the reputation of their institution and themselves. Wilber Clemens, who had been

[65] BCA, GR 1378, BC Commercial Fisheries Branch, box 3, file 5, William Thompson, "Hell's Gate Blockade and Salmon," March 1947.

[66] UWA, Thompson Papers, acc. 2597-77-1, box 15, file 29, B.M. Brennan, Director of IPSFC, to Thompson, 1 April 1947. Brennan's letter lists forty-seven individuals and institutions to whom Thompson's paper was sent and included twenty-five more reprints for Thompson to send personally.

[67] UWA, Thompson Papers, acc. 2597-3-83-21, box 8, file "Ricker's criticism," Stedman H. Gray, Executive Editor, *Pacific Fisherman*, to Thompson, 10 April 1947; "Scientific Sharpshooting," *Pacific Fisherman* 45, 5 (May 1947): 37.

[68] "Do Nothing Biology," *Pacific Fisherman* 45, 7 (June 1947): 30.

[69] "Scientific Sharpshooting," 30.

[70] "Hell's Gate and the Sockeye," *Commercial Fishermen's Weekly* 13, 8 (14 March 1947): 90-1.

[71] The key articles are, "Salmon Commission Hits Back at Critic," *Commercial Fishermen's Weekly* 14, 10 (28 March 1947): 111, 113; "Review of Evidence Suggested by Ricker," 13, 12 (18 April 1947): 135-7; and "Research Board Said Not Open to Charges," 13, 13 (25 April 1947): 152-3.

director of the Pacific Biological Station in the period of alleged negligent research, prepared his own mimeographed response for wide circulation. In it, he reviewed the research projects of the decades before the commission came into being and pointed out that none of them aimed specifically at rehabilitation activities, as Thompson had suggested. To fault life history research for not turning up the Hells Gate problem was misleading and unfair, he charged. More to the point, Canadian research had been held up because of the interminable delays in ratifying the Pacific Salmon Convention: "The Fisheries Research Board was not asked to undertake a general investigation of the Fraser River with the objective of rehabilitating the sockeye runs because from the time of the establishment of the International Fisheries Commission (Halibut) in 1923, negotiations were almost steadily in progress for the establishment of an International Commission for dealing with the sockeye salmon problem of the Fraser River."[72] In personal letters both Wilber Clemens and Russell Foerster criticized Thompson for drawing the Fisheries Research Board into the debate.[73] Foerster described Thompson's views as "totally incorrect and misleading."[74] Thompson responded by standing by his remarks and pointing out that the many activities carried out by the biological board in the years before the IPSFC had done little for the rehabilitation of Fraser sockeye. He had heard that Ricker had aired his views to Canadian scientists before publication and that he had been encouraged to proceed. Why, Thompson asked, had he or the commission not been contacted before such destructive criticism was unleashed? Thompson stated plainly that he would not stop criticizing Ricker until his point was understood. "There are deeper issues at stake than mere argument."[75] In 1948 the executive of the Fisheries Research Board passed a special resolution in the proceedings of its annual meeting condemning the IPSFC for Thompson's criticisms of the Fisheries Research Board of Canada's (FRBC's) past research, and it called on Canadian commissioners to state publicly whether they agreed with the allegations. Dr. Dymond of the University of Toronto sponsored the item, and it was seconded by Wilber Clemens.[76]

[72] BCA, GR 1378, BC Commercial Fisheries Branch, box 3, file 5, W.A. Clemens, "A Statement Regarding the Memorandum 'The Hell's Gate Blockade and the Salmon,' by W.F. Thompson," April 1947.

[73] UWA, Thompson Papers, acc. 2597-77-1, Clemens to Thompson, 8 April 1947.

[74] UWA, Thompson Papers, acc. 2597-3-21-83, Foerster to Thompson, 10 April 1947.

[75] UWA, Thompson Papers, acc. 2597-3-21-83, Thompson to Clemens, 8 May 1947 (copy).

[76] NAC, RG 23, box 682, file 713-2-2[26], Fisheries Research Board, Extract from Executive Minutes, 9-11 June 1948, Vancouver, BC.

The actions of the FRBC executive in calling on Canadian commissioners to dissociate themselves from Thompson's views suggest something of the complex national and international politics that developed in the Hells Gate debate. Whereas before the controversy the most obvious signs of national antagonism occurred within the IPSFC, after Ricker's critique a remarkable solidarity developed within the commission against the perceived external threat. Tom Reid, for example, a frequent critic of Thompson within the commission and a reputed cause of Thompson's departure from the directorship of scientific investigations, defended Thompson's work in his position as commission chairman. Ironically, Ricker's critique and Thompson's crude attack on the FRBC and Canadian science had the effect of lessening national differences within the IPSFC. Such a drawing together would increase in the 1950s, when the threat of dam building created another common cause.

There were no doubt personal, national, and scientific aspects to this debate. Thompson was bitter over the personal and political conflicts within the commission, particularly those involving Jack Kask and Tom Reid. Although the nature of these disagreements is unclear, their depth is not: in 1943 both Thompson and Kask resigned, citing their poor relationship as a key reason.[77] Thompson's certainty that Ricker's critique was primarily a grudge was born of the paranoia he had developed while operating within such a politicized scientific environment. Although it would appear that Ricker's motivations were more properly scientific than Thompson allowed, he also intensified the controversy by using provocative statements in his paper and to the press. Personal and national antagonisms seemed to share some common ground. Thompson's relationships with each of the Canadian scientists originally hired in 1938 had soured by the time of the controversy. At a more fundamental level, his low opinion of past Canadian fisheries research reflected a divergence in national styles of fisheries management. Whereas after 1935 Canada opted not to employ hatcheries as a management tool, following studies that suggested their negligible effect, in the United States their importance only grew.[78] Here lay the basis for Thompson's disparaging comment about the poor remedial work of Canadians.

[77] For a biography of Kask and mention of the dispute with Thompson, see Kenneth Johnstone, *The Aquatic Explorers*, 208-9.

[78] Joseph E Taylor III, "Making Salmon: The Political Economy of Fishery Science and the Road Not Taken," *Journal of the History of Biology* 31, 1 (Spring): 37-59.

These personal and national tensions ensured that the underlying scientific issues in the debate were overshadowed by the perceived motivations of its participants. Tim Smith, a fisheries scientist and historian, claims that at the heart of the debate was a fundamental disagreement about the role of over-fishing in fisheries depletion.[79] Yet Thompson was so bent on defending his reputation that he rarely engaged with Ricker's point that the IPSFC's conservation program was primarily aimed at restoring habitat rather than controlling fishing. Nor did he launch a detailed justification for his belief that fishing pressure exerted a much less serious effect on fish populations than others claimed. After Ricker's contention was dismissed, the debate became political rather than scientific and did not focus on these key questions. In future research, Ricker would develop what became known as the spawner-recruit theory to establish the effects of spawner success on fry development.[80] His concerns were not merely a reaction to the fishways project or to Thompson's bulletin; they were also part of a longer-term consideration of the limits of sustainable fisheries.

Resentment over the allegations and counter-allegations in this debate lasted for years in the BC fisheries science community.[81] But the controversy did not delegitimize fisheries science as a whole, as Richard Van Cleve had feared. The public perception of the Hells Gate research program was, to the contrary, almost entirely positive. The public favoured the idea of restoring the Hells Gate site once and for all; moreover, salmon populations had increased.

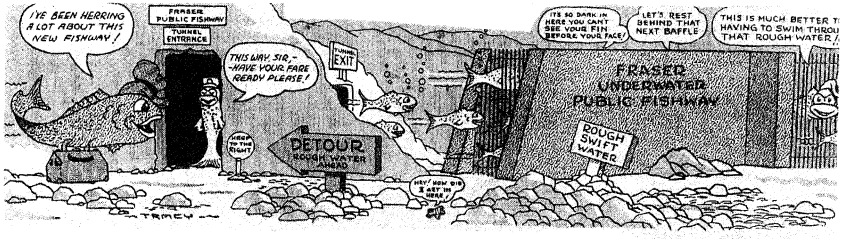
The fishways were greeted publicly as a miraculous exercise in technical mastery over nature. Completed in the euphoria of war's end, journalists described the fishways as one more battle won, a great public works project linking Coast and Interior. Hells Gate was a door unlocked and pushed ajar, a barrier overcome with a highway, a staging ground for the "invasion" forces of salmon. Scientists were miracle workers with keys, "tough men," freedom fighters.[82] The connections

[79] Smith, *Scaling Fisheries*, 276-85.

[80] Ibid., 285-92.

[81] Roos, *Restoring Fraser River Salmon*, 306.

[82] Clippings were found in NAC, RG 23, box 682, file 713-2-2[21], "Fish Travel Modern Highway," *Province*, 28 October 1944(?); "Hell's Gate Soon Ajar for Salmon," *Western Business and Industry*, 19, 10 (January 1945): 8-9; "Ready for Salmon Invasion," *Province*, 2 June 1945; *Vancouver Sun*, 6 August 1945, cartoon; "Hell's Gate a Job for Tough Men," *Province*, 11 August 1945; "Hell's Gate Unlocked by Science," *Seattle Times*, 30 September 1945; "Freeing of 'Hell's Gate,'" *Ottawa Citizen*, 28 January 1946; and "Hell's Gate Aids 'Miracle' of Nature," *Province*, 2 October 1946.



—Original drawing by Ray Trevy.

Plate 4: Hells Gate as Metaphor: "Fish Travel Modern Highway." *Province*, 28 October 1944(?), (see footnote 82).

in these representations between the commission scientists and armed struggle suggest not only the saturation of military metaphor in public discourse, but also the ideas of science as liberator and scientists as hard-working soldiers. In praising the Hells Gate studies in 1942, a *Vancouver Sun* editorial described the scientists' work as "definite and clear, completely proven – checked a score of times to prevent the possibility of error."[83] The virtues of an idealized science became the virtues of the fishways. In the ultimate representation of the transformation of Hells Gate from turbulent passage to domesticated space, one cartoonist drew passing salmon as ordinary citizens involved in a commute. The fishway was a modern transportation system. Salmon passing through were dressed in the attire of businesspeople and laypeople. "I've been herring [sic!] a lot about this fishway!" declared one, toting a brief case. "Let's rest behind the next baffle," said another. Beside this kind of public enthusiasm, the debate between Thompson and Ricker had little broader resonance.

It is also important to note the extent to which the fishways appeared to be "working." G.B. Talbot's study of the efficiency of the fishways in passing fish at problem water levels judged it to be high. Using the same tagging methods to gauge the passage of fish as were used in the original experiments, Talbot found that the fishways eliminated the periods of seasonal delay that had played such an important role, in Thompson's view, in diminishing the capacity of salmon to spawn successfully. Furthermore, the commission's counts of returning spawners, the so-called escapement figure, showed a marked increase following the final completion of fishways in 1946. "After installation of the fishways," Talbot summarized, "the mortality rate between Hell's Gate and the spawning grounds was reduced approximately

[83] "Ottawa Cover Up on Bygone Errors," *Vancouver Sun*, 9 February 1942.

20 per cent to 30 per cent."[84] Notwithstanding other factors (and there were many) the fishways appeared to have provided the basis for a rise in Fraser sockeye populations in the postwar period. Commission scientists spoke publicly of the possibility of restoring hitherto forgotten and depleted runs. Although the enhanced regulations of the fisheries played an important role in this expansion of sockeye populations, commission scientists marshalled significant data to suggest that obstructions were much less serious than they had been in the past. Fishways were added in the late 1940s at Hells Gate, the Bridge River Rapids, and Farewell Canyon.

CONCLUSION

Hells Gate haunted fisheries scientists, regulators, and Native and commercial fishers for decades. It imposed a burden on fish populations that seemed crude and simple but that was mysterious and difficult to substantiate. For years questions surfaced as to whether the gate was cleared. One of the major proponents of the Pacific Salmon Convention, John Pease Babcock, consistently argued that the problem was solved. A convention was needed, he argued, to control fishing, the real culprit of fisheries depletion. Ironically, the scientific investigations carried out under the auspices of the commission found the opposite to be the case.

The investigations centring on Hells Gate under William Thompson's leadership operated within a nature-culture nexus. Scientific data did not simply represent nature; they helped to create it by methods that produced various forms of natural and cultural selection. The confusion of scientists collecting tags from Native fishers followed and reproduced established patterns of interaction between fisheries officials and Natives in the canyon. The identification of problems at Hells Gate had rippling effects in local communities, as celluloid disks became currency equivalents – with effects on the final data that are impossible to know.

No single environmental event was as important in fixing the judgment of Thompson and his research team as the water conditions in the canyon in 1941. The spectacle of six miles of mature sockeye turning red below the gate convinced Thompson that Hells Gate was an obstruction that must be cleared. Through the prism of this event and the data collected in the tagging experiments, he analyzed the

[84] Talbot, "Biological Study," 77.

history of sockeye populations in the basin as a saga of fish and dams. Correlations between an index of population size and environmental insults demonstrated, in his view, that the primary causes of fisheries decline were to be found in episodes of habitat destruction. A healthy fishery needed clear passage.

The fishways constructed in 1945-6 to bypass turbulence at Hells Gate were said to restore the river to its natural condition; rather, however, artifice had been placed upon artifice. An unnatural dam was deposited in the gorge in 1912-4, and the fishways were an unnatural response to it. Science tamed the gorge, as the newspapers never failed to suggest, and made a rough passage into a salmon highway. Subsequent studies argued that the fishways facilitated significant expansions in upper basin spawning runs in the postwar period.

The remaking of Hells Gate, however, raised various questions – some scientific, some national, and others personal. William Ricker asked whether the IPSFC data could be trusted. William Thompson replied that Canadian scientists were carping after realizing their own errors. The dispute ripped apart whatever collegiality was left in the fisheries community after years of national tension within the international commission. It also strengthened the internal coherence of the IPSFC. The science of Hells Gate remade careers, reputations, and institutions as well as water and fish.

The undamming of the gate had lessons for scientists, politicians, and the fishing industry about the dangers of dams – lessons that required increased prominence in the late 1940s. The counter-example of the Columbia, which had three major main stem dams by 1941, modelled the dangers but also produced the knowledge to create the fishways. Proposals in British Columbia to dam the Fraser gained credence by the end of the Second World War and were proposed by a variety of private interests. Hells Gate could stand as a monument against these proposals, but it also raised expectations: if scientists could tame this beast, why not another, human-designed dam, where fishways would be integral to the design? The enigma of Hells Gate was reproduced in the fish-versus-power debate of the following decade. Its meaning could not be fixed.

In a parting salvo in his critique of the commission's science, William Ricker had raised an intriguing idea about the possible rationale for the fishways. Maybe, he mused, the IPSFC wanted a fishway to ensure that the Hells Gate site, and the canyon around it, would be safe from hydroelectric power developers. For once the fishways were built,

publicity created, and salmon apparently saved, who then would think it permissible to sink this binational investment under the placid waters of a reservoir?[85] Ricker was not alone in this suspicion. BC Water Branch officials fretted that the fishways would destroy their plans for major postwar water developments in the canyon.[86] The fishways not only saved fish, they also claimed territory.

[85] Ricker, "Hell's Gate and the Sockeye," 19.

[86] BC Water Management Branch, Department of Lands 'O' Files, file 5254, Davis to Minister of Lands, 11 April 1942; BCA, GR 1378, BC Commercial Fisheries Branch, box 3, file 3, George Alexander to Commissioner of Fisheries, 30 May 1942 (copy); E. Davis, Comptroller of Water Rights to Alexander, 7 July 1942; Deputy Attorney General to Alexander, 16 July 1942; H. Carthcare, Deputy Minister of Lands to Alexander, 17 July 1942; Alexander to Commissioner of Fisheries, 20 July 1942 (copy). Alexander's correspondence here cited pointed to his irritation with the IPSFC for not advising the provincial commissioner of fisheries. Other items discuss how best to counter or condition the fishways application.