The Alaskan Salmon Fishery: Managing Resources in a Globalizing World

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Introduction

In 1967, on the centennial of the Alaska Purchase, the newly-independent state (still less than a decade old) adopted its official motto: "North to the future." The journalist who coined the phrase declared that it was "a reminder that beyond the horizon of urban clutter there is a Great Land beneath our flag that can provide a new tomorrow for this century's 'huddled masses yearning to be free.'"[1] Subsequently, the state also acquired the nickname "The Last Frontier," which has been printed on its license plates since 1981. These two slogans illustrate the prevailing perception of Alaska as a land of rich resources, abundant opportunities, and untamed wilderness. A few years prior to adopting an official motto, the state also designated an official state fish, choosing the Chinook, or King Salmon. In doing so, it joined a short list of just five

[1] The motto was created by Richard Peter, a Juneau reporter.

other states which had officially adopted a state fish (compared to 45 with a state bird, and 47 with a state flower).[2] This symbolic pronouncement was a testament to the ongoing importance of salmon to Alaska's culture and economy.

The view of Alaska as a land of inexhaustible resources, and the role of salmon as a key component of that natural wealth, is a repeated theme in the history of human use of the Alaskan landscape. The emphasis on the economic value of salmon is also apparent in narratives regarding the fishery, which has variously been referred to as "Alaska's silver millions,"[3] and "the jewel in the crown of America's fisheries resources."[4] Further, because the Alaskan salmon fishery has avoided the catastrophic collapses of other fisheries, it is often held up as both an example of a successful fishery and a lesson in sustainable resource management. Yet despite lacking some of the more obvious threats to sustainability, such as resource scarcity, intensive industrialization, or population pressure, Alaska has faced significant challenges in navigating its development. The salmon fishery provides insight into the issues it has faced in managing resource extraction throughout its history. This case will also present specific examples from Bristol Bay, a region in south central Alaska famous for its sockeye fishery. These examples both illustrate some of the general problems faced by the Alaskan salmon fishery, while also examining unique regional specificities surrounding knowledge production, environmental risk, and collaboration. Taken as a whole, the Alaskan salmon case shows the impact of thickening connections and globalization on regional development, as well as the consumption demands that have increasingly driven Alaska's economy. It also highlights Alaska's long-term struggle to

[2] At the time of Alaska's state fish designation, 1962, these other states were Alabama, California, Kentucky, Oregon, and Wisconsin. Today, 46 states have an official state fish, but most of these designations date to the 1990s or later.
[3] *Alaska's Silver Millions*. 1936. Carousel Productions.
[4] Thomas Quinn, as quoted by CNN: https://www.cnn.com/2017/10/10/politics/bristol-bay-salmon-invs/index.html

balance the needs of its residents with its role as, in the words of one local politician, "a resource development state."[5]

Throughout the course of its human history, Alaska has moved from a period of low resource use, in which Native groups, particularly those of the Southern Coast, enjoyed a comparatively prosperous existence, to a series of rapidly rising demands on nature. Beginning in the 1700s, as Europeans moved into the region, the emphasis came to be the extraction (and sometimes exhaustion) of Alaska's natural resources. From Russian fur trappers to American salmon fishers to Yukon gold rushers, successive groups of incomers arrived to lay claim to Alaska's abundance. In 1867, Alaska was purchased by the United States, ushering in a new era of development for the region. In the late 1800s and beyond, Alaska experienced a period of rapid industrialization. Business enterprises took root in the region: notably salmon canneries, but also companies devoted to petroleum drilling, ore mining, and timber harvesting. These enterprises led to new questions and conflicts regarding which resources should be privileged over others, and Alaska's development during this period was heavily influenced by commercial concerns (often controlled by non-Alaskans). This was further exacerbated by Alaska's unstable trajectory of governance, from military administration (1867-1884), to Federal management (1884-1959), to independent statehood (1959 on).

As the 20th century progressed, Alaska found itself embedded in an ever-expanding system of supply and demand that often put outside desires over resident needs. This was particularly true of the salmon fishery, which faced pressure from outsiders both intranationally and internationally. In the years that followed, Alaskan stakeholder groups struggled to devise monitoring and regulatory systems that would preserve the fishery, and ensure that Alaskans

[5] Craig Fleener, American Society for the Advancement of Science Annual Meeting, February, 2017.

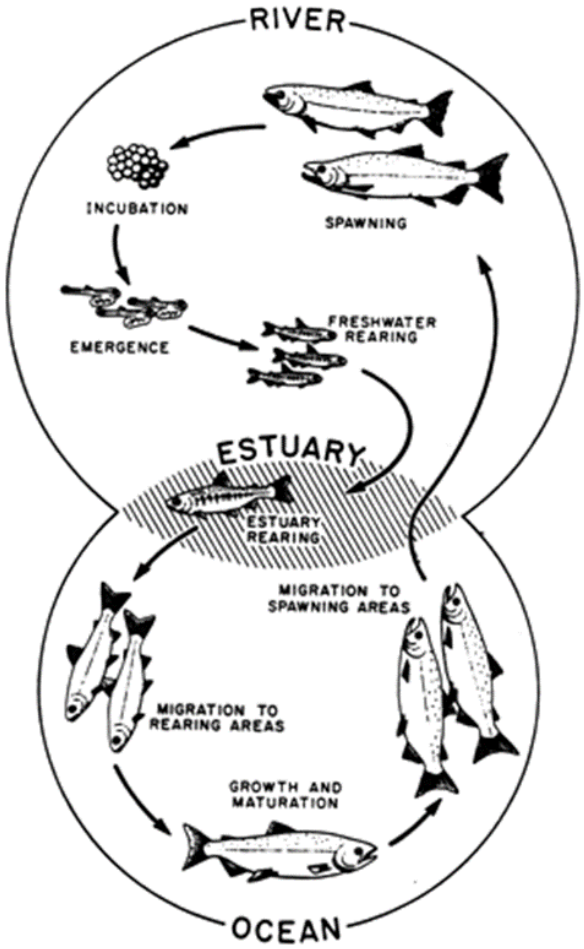
profited from it. This included founding research groups and regulatory agencies that determined catch and escapement limits for regional salmon fisheries, and creating hatcheries that supplemented salmon stocks by raising and releasing fry. The state also enacted strict regulations, banning specific fishing technologies, and instituting a system of limited-entry permits, to better control access to fishing grounds. Nevertheless, despite these measures, Alaska continues to face obstacles, both external and internal, in maintaining its salmon fishery. These include local challenges, such as mining proposals that threaten spawning grounds, fishing permit fraud, and budget shortfalls for monitoring and enforcement activities; and global ones, such as competition from aquaculture, pressure from foreign markets, and the hard-to-predict effects of climate change. Thus, an analysis of the social-environmental system of Alaska's salmon fishery should not stop at labelling it as "successful" or not. Instead, the historical narrative is deeply complex, encompassing moments of decline, expansion, and stasis, each coupled with impacts to, and from, Alaska's human residents. As such, the case provides valuable lessons regarding the importance of incorporating long-term histories into sustainability analyses.

Boundaries and Beginnings

Knowing that boundaries, both geographic and taxonomic, are ever-shifting, it may be helpful to briefly define the subject (salmon) and region (Alaska) covered by this case study. "Salmon" refers to a taxon of bony, ray-finned fishes that are native to the Northern Atlantic and Pacific Oceans.[6] The group comprises seven species, five of which are found in Alaska: the Chinook (or

[6] (Respective Genus being *Salmo* and *Oncorhynchus*)

King), Sockeye (or Red), Coho (or Silver), Pink (or Humpy), and Chum (or Dog).[7] Salmon are anadromous, meaning that they split their life cycle between fresh and salt water; this behavior is integral to human harvesting efforts. Salmon hatch in fresh water, grow to adulthood in the ocean, and, upon reaching sexual maturity, return to fresh water to reproduce.

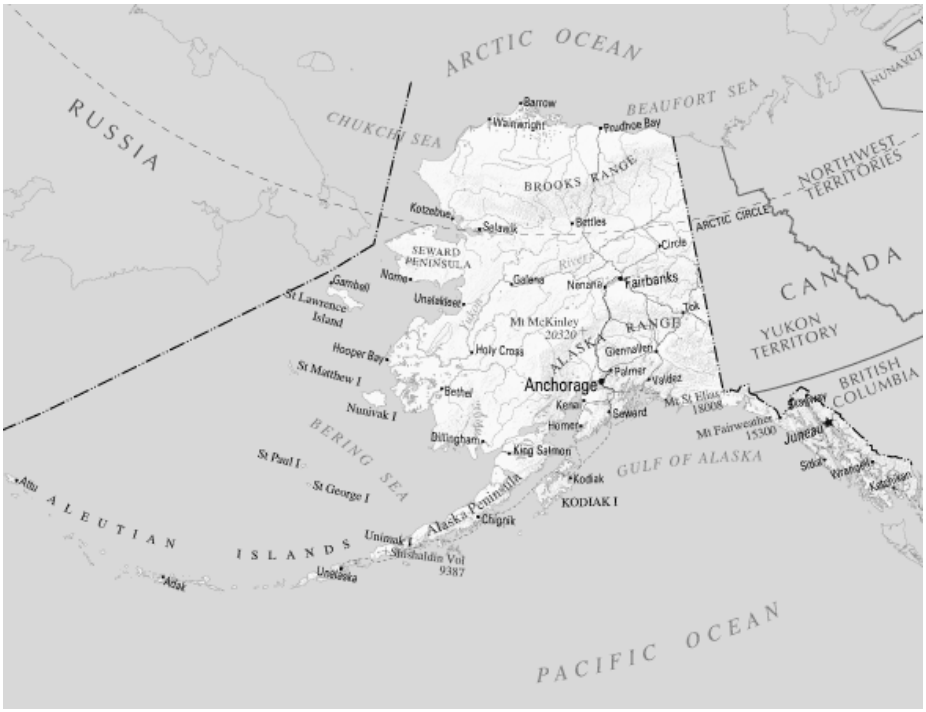


The span of their life cycle varies in length depending on species, but ranges between two to seven years. Salmon runs, which occur annually, refer to the period of time in which mature breeding fish return to their freshwater spawning grounds; in a process called "natal philopatry," most of them revisit the site where they were hatched. These runs take place in a relatively short time span, and are made up of thousands or even millions of individual fish. Most human fishing activities –whether commercial, recreational, or subsistence-level—take place during runs, when the fish are concentrated into massive schools and can more easily be taken.

In using the term "Alaska," this work is obviously indulging in a bit of retroactive boundary drawing, since the U.S. did not acquire the "Alaska Territory" until 1867, and the region did not become a state until 1959. Nevertheless, for ease of analysis, this history will use the same rough

[7] The remaining two are the Atlantic Salmon, found in the Northern Atlantic, and the Masu salmon, found in the Northern Asian Pacific.

geographic boundaries as modern-day Alaska. The region is comprised of approximately 1.5 million square kilometers of land, including some 2,500-plus islands, and encompasses a range of biomes, including tundra, taiga, and coastal rainforest. Alaska is bounded on three sides by ocean, and on the fourth by the Canadian province of British Columbia and territory of the Yukon. Its other nearest neighbor is Russia, just across the Bering Strait, and the islands that stretch between the two countries have often been contested territory.



It is nearly impossible to understand Alaska's landscape without examining the geologic forces which have shaped, and continue to shape it. The region lies at the intersection of the Pacific and North American tectonic plates, and the movement between the two has pushed up mountain ranges, created fault lines, and resulted in a string of active volcanoes along the Aleutian Islands chain. Indeed, Alaska continues to experience significant seismic activity into

the present day. Alaska's landscape was also molded by the Pleistocene ice ages, and the successive periods of glaciation that occurred across North America. The advance and retreat of these sheets of ice formed mountains and valleys, shaped bays and rivers, and affected the diversity and morphology of animal and plant species.[8] Biologists posit that the rapid and dramatic geographical changes during the Pleistocene had a significant impact on the evolution of Pacific salmon, particularly intraspecific diversity and the creation of subspecies.[9] Finally, one of the most significant impacts of Pleistocene glaciation was that it allowed the migration of humans into Alaska, and beyond that to the Americas at large. As the glaciers expanded, they caused sea levels to drop, and this resulted in what is often confusingly called the "Bering Land Bridge" –but is more is usefully thought of as a swath of land exposed by the receding sea which closed the gap between Asia and North America. Proponents argue that human beings used this "bridge" to cross from Siberia into Alaska between 14,000 and 24,000 years ago.[10]

Subsistence and Invasion

Following their migration from Asia, as humans spread throughout Alaska and settled into different landscapes, with different resource availability, they developed different modes of living on the land. Accordingly, to this day, Alaska contains a wide range of Native cultures. Based on language divisions, Alaskan Native peoples are often categorized into eight major groups (although each contains further diversity of cultures and dialects): Aleut, Athabascan,

[8] For an excellent look at the impact of glaciers on the biota of Alaska: Pielou, E.C. 1992. *After the Ice Age: The Return of Life to Glaciated North America*. University of Chicago Press.
[9] Waples, R., Press, G.R., Beechie, T. 2008. "Evolutionary history of Pacific salmon in dynamic environments" *Evolutionary Applications* 1(2): 189-206. As Waples et al put it: "These repeated pulses of dramatic environmental and physical habitat changes would have promoted evolutionary changes within Pacific salmon."
[10] The "Bering Land Bridge Theory" is still debated, a key point being whether humans walked across exposed land, or crossed on sea ice by boat and sled. Further, other experts argue for alternate theories of the human settlement of the Americas, positing other migration patterns. Nevertheless, it is generally accepted that a significant population of human migrants crossed from Siberia to Alaska and settled in the New World.

Eyak, Haida, Inupiaq, Tlingit, Tsimshian, and Yup'ik.[11] Despite differences between these groups, all relied on the resources offered by the landscape. Unlike other parts of North America, Alaska's climate is largely unsuited for agriculture, and therefore hunting, fishing, and gathering were the traditional subsistence activities. Typically, groups harvested a variety of seasonal foods, and the rhythm of their days were tied to the movements of whales and seals, the migration of fish, and the ripening of wild food plants. Salmon was a critical food source for most Native Alaskan groups, and the yearly salmon runs were an important part of their seasonal cycle. Groups used a variety of fishing methods, including weirs, stone fish traps, nets, baited hooks, and spears, to catch salmon as they returned to their spawning grounds. Enough salmon, caught and preserved by drying or smoking, could see a community through a full year. Indeed, for Southern Alaskan groups such as the Tlingit and Haida, their successful exploitation of this reliable and abundant food source meant that, compared to many other Native groups in North America,[12] they were less nomadic, forming sizeable permanent settlements with elaborate wooden longhouses. Anthropologists have also argued that the reliability of salmon allowed these cultures to maintain a higher

[11] It is worth noting that these categories have been, and continue to be, contested, and it has been argued that they represent a European attempt to "taxonomize" Native peoples. The "Athabascan" group, for example, contains several dozen subcultures within it.

[12] An exception to this would be the Native groups of the American Southwest, who engaged in intensive and sophisticated agriculture.

standard of living, with more leisure time. This in turn allowed complex artwork to flourish in these communities, in particular giving rise to the sophisticated woodworking for which they are still known. While there is some question regarding the detrimental impact of Native use on salmon stocks during this period, there is little evidence to suggest that they experienced serious decline due to human use.

The first major threat to this prosperous existence came in 1741, when Russian explorers arrived to chart the Alaskan coast. However, it was not fish, but fur, that first attracted their attention to Alaska. The expedition included naturalist Georg Steller, who documented the marine species in the area, including, critically, the sea otter. Soon after, Russian fur traders arrived in the Aleutian Islands seeking the pelts of sea otter and other fur-bearing mammals for export to Russian and Chinese markets. This was the beginning of what historians call the "maritime fur trade," which thrust Alaska and the Pacific Northwest into an international trade network that encompassed the Northern Pacific, and included Russia, China, Hawaii, and later Great Britain. Nevertheless, Russian settlements remained sparse, and there was little interest in the extraction of other resources. Despite the relatively small numbers of European migrants, as in other parts of the Americas, their impact was disproportionate: they brought with them diseases that resulted in a series of epidemics that devastated Native groups. Further, in the Aleutian Islands, this devastation was not accidental but deliberate: beginning in 1745, Russian traders attacked Aleut villages and enslaved the inhabitants, forcing them to hunt for sea otters and fur seals for the fur trade. The enslavement of the Aleut people would continue for more than a century.[13]

[13] This is obviously an extremely bare bones description of a horrific chapter in Alaskan history. For an excellent take on Aleut/Unangan culture, Ilarion Merculieff's *Wisdom Keeper: One Man's Journey to Honor the Untold History of the Unangan People,* 2016, North Atlantic Books, is worth a look.

In the decades that followed, Russia engaged in further conflicts with Native groups, as successive expeditions expanded into the Alaskan mainland. In 1799, Russia consolidated its efforts to extract Alaskan resources, with the formation of the Russian American Company (RAC). A governed-sponsored joint-stock company, the RAC remained the sole authority for commercial enterprise in Alaska for the next 60-plus years. The RAC was officially charged by the tsar with managing, developing, and exploring Alaskan resources, and this consolidation served as a clear indicator of Russia's continued interest in and dedication to establishing a North American presence. Under the RAC's management, Russia further extended its colonies into southeastern Alaska, giving rise to fierce conflicts with the local Tlingit and Haida peoples who already occupied the area. During this time, the RAC also parried competing claims from Spain and Great Britain (and later the newly formed United States) to Alaskan territory, as each of these countries sought to enter the lucrative fur trade. Indeed, although the RAC engaged in some other resource extraction, including mining, timbering, and fishing, their primary focus remained furs. This continued intensive exploitation began to result in rapidly declining stocks of fur seals, sea otters, and other furbearing mammals from the 1810s on.

Russian Influence in Bristol Bay

Russian explorers arrived in Bristol Bay area beginning in the 1800s. Within a few decades, Russian settlements had been established in the area to facilitate trade. In 1837, a Russian Orthodox mission was founded at one of these trading centers, Nushagak (now modern-day Dillingham). This mission, along with others across Alaska, were part of an overall effort on the part of the Orthodox Church to convert Native Alaskans to Christianity. Although the desire to save souls on the part of the missionaries was likely genuine, the RAC also supported conversion as method of assimilating Natives into Russian culture, and thereby pacifying them. For many Native Bristol Bay residents, missionary encounters represented their first major experience with an outside culture. While conversion efforts met with varied success, Native groups across Alaska continue to practice the Russian Orthodox faith today, and Russian culture has left an unmistakable stamp on the region.

Industrializing Seward's Icebox

These three factors: the depletion of fur stocks, continued conflicts with Native groups, and increased competition with the U.S. and Great Britain, ultimately contributed to Russia's eventual decision to divest itself of its Alaskan holdings. In 1867, the U.S. purchased the Alaska territory from Russia for 7.2 million U.S. dollars. The move was mocked by opponents of the purchase, who referred to Alaska as "Seward's Icebox," (after William H. Seward, the secretary of state who facilitated the decision) "Seward's Folly," and "[President] Johnson's Polar Bear Garden." This opposition was rooted in the belief that the U.S. had taken on a worthless landscape in the name of territorial expansion, and had merely purchased "icebergs, tornadoes, and earthquakes."[14] Nevertheless, the U.S. set about making the most of its new acquisition, and the latter half of the 19th century in Alaska was characterized by industrialization and population growth through migration.

Satirical cartoon showing Seward "soothing" President Johnson with the Alaska Purchase.

Salmon was a critical resource in the early development of Alaska, and arguably Alaska's first modern industry. While salmon salteries (salmon processors that preserved fish by salting it) already existed, they were generally small operations, with limited output. It was not until the first canneries were founded in Alaska that the salmon fishery became a full-fledged industry. The first cannery was founded in 1877, in southern Alaska, and was rapidly followed by more in the succeeding decades. Most of these canneries were founded by companies

[14] "Our Territorial Acquisitions," *Washington Evening Star*, December 21, 1867

from California and Seattle, and out-of-state processing companies came to dominate the salmon fishery; dictating the methods and technologies used in fishing, the types of fishers employed, and the benefits distributed. Most canneries used fish traps, or fixed gear fishing: a method which installed a system of fences and pilings to funnel returning salmon into a large net, which would then be emptied into scows, and transported to the cannery for processing. This method allowed huge amounts of fish to be taken with minimal effort. From the start, fish trap use was controversial: in 1899, the government banned using them to block spawning streams, and in 1906 forbade their use in narrow bays or rivers. Nevertheless, due to salmon's schooling patterns, fish trap use persisted; they continued to be extremely effective, and increasingly large catches of salmon (or, in the industry parlance, the yearly "salmon pack") were processed every year.

Manning the Canneries

As in other parts of Alaska, an out-of-state company, the San Francisco-based Alaska Packers Association (APA), became a dominant force in Bristol Bay. However, the area's unique geology and comparative remoteness resulted in distinct differences. Like many canneries, the APA preferred to hire outsiders over locals: the majority of their workers were brought from California for the season. Most fishers were Italian or Northern European immigrants, and most cannery workers were Chinese or Japanese. To bring these workers north, the APA operated the "Star Fleet," made up of tall ships which were remnants of the Northwest timber trade. The fleet saved the APA money: the ships, considered outdated, were cheaply acquired, and because they were powered by sail rather than steam, were cheaply operated. They could also be more dangerous: in 1908, the Star of Bengal was wrecked while transporting workers and processed salmon back to California, resulting in 110 deaths.

Unlike other parts of Alaska, Bristol Bay rarely relied on fish traps, which the bay's extreme tides and shallow, sediment-laden waters made unworkable. Instead, the APA and other processors maintained company-owned "double-enders," small sailing vessels which fished with two-man crews, using gillnets hauled in by hand. These too could prove dangerous: fishers who capsized or who lost their footing while hauling in the heavy nets could disappear into the bay's murky waters and treacherous tidal mud. But while Bristol Bay fishery workers faced an arguably more perilous existence than those in other regions; the salmon industry was, overall, dangerous business. In the race to extract and exploit salmon stocks, human welfare was often of secondary concern.

If salmon was Alaska's first industry, it would not be its last. As the 19th century progressed, other enterprises expanded into Alaska territory. Despite drastic declines in the stocks of wild furbearing mammals, the fur trade continued, shifting from hunting to farming (fur farming experienced two particular waves of expansion in the 1890s and 1920s, driven by consumer demand). New industries took root as well, including mining, drilling, and timbering. Although Russians had been aware of gold deposits as early as the 1840s, it was not until the 1870s that gold mining truly took off in Alaska, with the beginning of placer mining in the southeast.[15] In 1896, massive deposits of gold were discovered the Klondike region of Yukon, Canada, east of the Alaskan border, sparking the famous "Klondike Gold Rush" which drew thousands to the area. This was followed by further discoveries of gold deposits in Northwestern Alaska, which firmly established gold mining as part of Alaska's economy. By the turn of the century, other mineral deposits began to be explored, and eventually mining began for tin, copper, coal, mercury, platinum, and molybdenum. In 1902, the first commercial oil discovery was made in Alaska, rapidly followed by more. Alaska would eventually become the U.S.'s third-largest oil producing state (tied with California).[16] After 1907, in response to a combination of shifting regulation and rising demand, the timber trade increased in importance. Throughout this period of industrial expansion, the salmon fishery continued to grow, aided by technological improvements in fishing and processing technologies that allowed for more efficient extraction and export of larger and larger numbers of fish. Less than fifty years later, "Seward's Folly" was vindicated: Alaska seemed a land of boundless resources and opportunities.

This scramble for resources was not without pitfalls. As infrastructure within the region increased to support and facilitate these new industries –including canneries, railroads, telegraphs, and mines—it had marked impacts on the Alaskan landscape. In the case of the salmon fishery, these were particularly pernicious: gold mining, which often focused on alluvial deposits, impacted salmon spawning grounds, as

[15] "Placer mining" refers to mining alluvial deposits for minerals.
[16] Texas is the largest, followed by North Dakota.

did erosion runoff caused by timbering and transportation infrastructure construction. Outside commercial interests also impacted the governance of the region, as various industries pushed for their own concerns; their power and influence often meant that they overrode locals. This was further heightened by Alaska's shifting and unstable administration. Alaska was at first managed by the U.S. Army and U.S. Navy, but in 1884 the Federal government took over; managing it first as a District (1884-1912) and later as a Territory (1912-1959). These repeated shifts often meant that long-term industrial stakeholders, such as canneries, had more experience and continuity in a given region than government administrators. This was particular apparent in the salmon fishery, where large companies like Bristol Bay's APA were often able to outmaneuver beleaguered bureaucrats to make their own rules. Despite attempts to monitor and regulate the fishery –first through the aforementioned limitations on fish traps, and later with the 1924 passage of the White Act, which established strict opening and closing dates for salmon fishing—these measures proved difficult to enforce. Fisheries agents complained that they were spread too thin to effectively ensure adherence to regulations and practices. Long-time settlers and Native groups complained that canneries were taking all the salmon, often through the use of fish traps that captured too many fish. There was a general feeling that the industries controlled Alaska, and that their priority was rarely the well-being of Alaskans.

Salmon catch, Alaska Packer's Association cannery, Nushagak, AK

Statehood and Regulation

As Alaska moved into the 20th century, its development, which had seemed to proceed at a breakneck pace, began to experience a series of serious new challenges. In 1900s, the "Great Sickness," a combination of influenza and measles, decimated Native populations in Western Alaska. In 1918, the Spanish flu swept across the state (and had a particularly dire impact on Bristol Bay). In 1925, an outbreak of diphtheria in Nome became a media sensation across the U.S., when mushers crossed thousands of miles to deliver antitoxin to the ailing citizens of the community.[17] These episodes highlighted the fact that Alaska's comparative isolation and lack of transportation and medical infrastructure often resulted in higher mortality levels. Further, these epidemics, coupled with the manpower drain of the First World War, also meant that Alaska suddenly faced a shortage of labor for its various industries. In the 1930s, the Great Depression further impacted the fortunes of Alaska's industries, and consequently the capital infusions that had fueled its rapid growth. During this period, many of the shipping companies that Alaska relied upon to import and export commodities decreased operations or went out of business entirely. Progress on infrastructure and industry slowed significantly. For the salmon industry in particular, this economic downturn proved disastrous. Canneries were left with huge amounts of unsold canned salmon, and the threat of insolvency. By 1932, the Governor of Alaska had begun petitioning the U.S. Department of the Interior for help with the foundering fishery, noting that the state had a current surplus of 2.5 million cans.

Like many U.S. industries, the salmon fishery was ultimately resuscitated by the resource needs of World War II. As a portable and cost-effective protein, canned salmon was emphasized as part of the war effort, with one report from the period declaring, "Fish is a food peculiarly suited to wartime demands." However, if the war increased the demand for salmon, at the same time, it decreased the efficiency of the fishery itself, as workers left to serve in the military, and others were diverted to different industries.

[17] And made celebrities of the dogsled team that successfully delivered the antitoxin –particularly, the lead dog, the now-famous Balto.

Likewise, the fishery's infrastructure was negatively impacted by a lack of manpower for maintenance, resource shortages, and the conscription of vessels for military use. Nevertheless, the consumer demand for fish sparked by WWII would continue in the decades that followed, as postwar "food science" emphasized the nutritional value of fish, and it became increasingly marketed as an economical source of protein. This was coupled with new refrigeration technologies, which slowly shifted the industry's focus from canned salmon to frozen. The new postwar demand also brought with it with it new problems: notably, the problem of meeting it. Canneries and fishers adopted new technologies to streamline salmon harvesting and processing, to allow for increased production. The new demand also meant new international competition. Increased market interest in salmon, and improvements in large-scale fishing boats, heightened pressures on the salmon fishery. In the 1950s, Canada and Russia intensified their salmon fishing, and in 1952, Japan, which had long been a significant market for Alaskan salmon, launched its own high seas salmon fishery.[18] The resulting pressure on stocks began to show significant impacts, and annual catch numbers declined drastically.

New Demand, New Problems

In Bristol Bay, the post-war adoption of new technologies meant a shift from the cannery-owned fleets of double-enders to motorboats. While this improved efficiency and meant that fishers could be less subject to cannery control (and their preference for non-resident employees), it also required that they supply their own boats and equipment, which, despite economic programs designed to address this, required capital that many residents did not possess. As a result, many boat owners in the fishery remained out-of-staters, continuing the imbalance of resident fishers. Bristol Bay also suffered in the wake of the new international competition. While Japan's entry into the market affected salmon stocks across Alaska, Bristol Bay experienced disproportionate impact. In 1959, after several years of record low catches, the U.S. Department of the Interior closed the Bristol Bay fishery to all but subsistence-level fishing activities. The removal of the primary source of income and industry in the region was devastating. Locals petitioned for relief programs to be put in place to support Bristol Bay residents, and even urged President Eisenhower to formally declare the area a disaster zone.

[18] Japanese fishers had already clashed with Alaska, when in 1937, they entered Bristol Bay to conduct "scientific research" –and began harvesting massive amounts of salmon. Local outrage was swift, and by 1938, the U.S. and Japan had signed an agreement banning Japan from fishing in U.S. waters, which stood until WWII.

In 1959, Alaska became a state, and underwent the process of transitioning from Federal to state management between 1959 and 1961. This was in no small part due to events like the Bristol Bay fishery closure, and a sense that statehood was necessary to protect Alaskan resources from mismanagement and exploitation. Further, there were fears that the profits from Alaskan resources were primarily benefiting non-Alaskans. For example, the impact of Japanese fishing on salmon stocks became a key point of contention. Fishery administrators at all levels were barraged with letters from fishers and fishing companies, excoriating them for putting foreign interests ahead of Alaskan ones. Alaskan residents also argued that, across the region, industrial concerns were superseding local ones, and that Alaska's resources were being drained by corporate outsiders. Indeed, many out-of-state corporations, including salmon processors, explicitly opposed statehood, clearly driven by fears that their unfettered access to Alaska's resources would be over.

Statehood did indeed have immediate ramifications for the salmon fishery: under the new state government, there were significant changes in regulation and infrastructure. The use of fish traps was immediately banned, to the dismay of many processing companies.[19] The state also invested significantly in hatchery systems (some of which had already been put in place under the federal government), raising and releasing salmon fry to bolster wild stock –a system which continues to be used to this day. Perhaps most importantly, the state also turned its attention to increasing knowledge regarding the salmon fishery. As the Chief of the Branch of the Alaska Fisheries, noted in a 1950 report: "The system for collecting and compiling statistics on the fisheries of Alaska has been virtually unchanged during the last couple decades, and has thus gradually become outmoded by the evolution of a more complex industry." Alaska now took steps to remedy this gap, aided by the newly-created Alaska Department of Fish and Game (ADF&G), formed "to protect, maintain, and improve the fish, game, and aquatic plant resources of the state, and manage their use and development in the best interest of the economy and the well-being of the

[19] In many cases, this left processors with stranded assets, as the equipment used to build and maintain traps and the boats used to transport workers and gear to and from the trap sites became obsolete.

people of the state."[20] This new emphasis on research and data production drew upon work that had been conducted by fisheries scientists in Alaska since the early 20th century, and forged new connections and collaborations between academic scientists, government fisheries agents, and fishing companies. As a result of this ongoing research, Alaska's management strategy came to focus on maintaining "escapement goals," ensuring that an adequate number of salmon allowed to escape fishing and return to spawning streams to continue the population.[21] Escapement numbers are based upon historical data collection regarding fishery stocks, in order to balance harvesting levels with stock health. In order to ensure escapement, ADF&G managers closely monitor salmon numbers and movement patterns, opening and closing regional fisheries on a day-to-day basis, a system which continues to be used today.

Collaboration and Knowledge

Bristol Bay in particular became an important location for fishery research. In response to decreasing catches in the early 1900s, the salmon industry reached out to fisheries scientists at the University of Washington, offering to fund research aimed at better understanding factors contributing to the sockeye stock declines. Accordingly, in 1946, the university founded a salmon research program, establishing a series of research camps in the Bristol Bay watershed. The program was aimed at studying salmon biology, behavior, and ecosystems, which at the time were still poorly understood. While canneries and scientists may seem like strange bedfellows, the collaboration between the two was rooted in a common belief that increased knowledge would improve management of the fishery. In the decades that followed, UW's Alaska Salmon Program developed ground-breaking methods for sampling and studying stocks (many of which have been subsequently adopted by other fishery monitoring operations, both within Alaska and beyond), and through this produced critical data regarding biotic and abiotic factors impacting the Bristol Bay fishery. Today, the Alaska Salmon Program holds the distinction as the longest-running fishery study in the world, and Bristol Bay as one of the best-understood fisheries. Further, scientists from the program have often lent their expertise to other fisheries management efforts across the globe. The resilience of the Bristol Bay fishery has thus been deeply linked to knowledge production.

[20] The ADF&G was preceded by the Alaska Territorial Fishery Service (ATFS), which shared many of the same structures and employees. A key difference was that the ATFS had no official authority to enact regulations (this lay with federal authorities), while the post-statehood ADF&G did.

[21] This is something of a simplification of escapement, which can encompass multiple interpretations and strategies. For more information,

Despite these new approaches, salmon stocks remained under threat. By the 1970s, catches throughout Alaska and the Pacific Northwest had declined to record lows. While Alaska's fishery remained viable, stakeholders cast a nervous eye at the collapses of salmon stocks in California, Oregon, and Washington, as possible foreshadowing of its fate. The stock collapses in these regions were largely tied to land use – for hydropower, development mining, and agriculture—and overexploitation. Alaska's long history of intensive salmon fishing, coupled with new land use practices (in particular the new economic reliance on petroleum drilling) raised the specter that a similar situation could occur. Catastrophically low catches in formerly-rich fisheries such as Bristol Bay and Kodiak Island throughout the 1970s seemed to confirm these fears. Further, fishing vessel owners from states with collapsed salmon stocks increasingly began to travel northwards to fish Alaska's waters, heightening competition. Accordingly, the state redoubled efforts to preserve its stocks. In 1973, it enclosed the fishery, passing the Limited Entry Act. This established the fishery as a limited-entry permit system, restricting the number of users. The act initially focused on Bristol Bay, Cook Inlet, and Prince William Sound, as the three fisheries of greatest concern. Permits were awarded based on fishers' economic dependence on fishing, and their history of participation in the fishery, partly with the aim of prioritizing Alaskan fishers over outsiders. In order to manage the new system of the permits, the state founded the Commercial Fisheries Entry Commission (CFEC), which was responsible for handling applications for commercial fishing permits.

This move to enclose the fishery occurred at the same time that the U.S. was focusing on setting standards for fishery management across the nation. In 1976, Congress passed the Magnuson-Stevens Fishery Conservation and Management Act, aimed at reducing overfishing and preserving the nation's fish stocks through more centralized management efforts. Among other measures, the act established eight regional fishery management councils, responsible for the research and management of fisheries within a given region. Notably, an entire regional council –the North Pacific Fishery Management Council—was devoted solely to Alaska, and the act itself was co-named after Alaskan Senator Ted Stevens, a key proponent. Beyond the U.S., many nations began increasingly clashing over access to

marine resources. In a particularly extreme example, Britain and Iceland engaged in a series of "Cod Wars" between 1958 and 1973: militarized disputes over access to valuable cod stocks in the Atlantic. This conflict and others were factors in the eventual establishment of Economic Exclusion Zones (EEZs) –200-mile marine zones exclusive to a specific nation—under the United Nations' Convention on the Law of the Sea (UNCLOS) in 1982. In Alaska, the creation of EEZs in the Bering Strait and Gulf of Alaska, coupled with the Pacific Salmon Treaty, signed between the U.S. and Canada in 1985, established new boundaries for the fishery, and helped protect stocks from international fishing operations.

Global and Local Challenges

In the wake of this increased regulation, the Alaskan salmon fishery slowly recovered. Despite impacts from ecological regime shifts in 1977-1978 and 1988-1989, stocks rebounded, and catch numbers climbed. Nevertheless, the effects of Alaska's ties to the global community continue to resonate. As in the age of industrialization, pressure from other industries, and from outside demands, continue to impact the Alaskan salmon fishery. Some of the most significant environmental hazards to emerge in Alaska in the latter half of the 20th century were linked to the area's increasing reliance on mineral and petroleum resources. In an echo of the gold rushes of the 19th century, mineral development, particularly ore mining, threatened salmon fisheries through the twin dangers of erosion and pollution. Likewise, since the 1970s, there have been at least 20 major oil spills in Alaska's coastal waters.[22] Perhaps the best-known of these is the 1989 Exxon Valdez oil spill, which took place in the Gulf of Alaska's Prince William Sound, and discharged nearly 11 billion gallons of crude oil into the surrounding waters. The spill (which until 2010's Deep Water Horizon disaster, set the record as the largest in U.S. waters) had long-term impacts on the marine ecosystem, and on the economies of the fishing communities that depended upon it. Recent

[22] http://dec.alaska.gov/spar/ppr/bigspills.htm

studies have argued that even today, lingering traces of oil continue to have negative effects on herring and pink salmon populations in the region.

The Battle for Bristol Bay: Contesting the Pebble Mine Project

Beginning in the late 20th century, the Bristol Bay fishery has grappled with new pressures resulting from mineral development; most critically the Pebble Mine Project, which sought to establish mining operations for copper, gold, and molybdenum near Lake Iliamna, an important salmon spawning area. From 1987 to the early 2000s, a roster of changing corporate owners of the area's mineral rights (including Canadian, British, and Japanese companies) conducted exploration and feasibility studies. This culminated in a proposal for a series of mines in the region, with significant infrastructural development, including new roads, ports, and dams to contain slurry from the mining operations. The project became hugely controversial: opponents argued that the effluents from the mining operation threaten the Bristol Bay watershed as a whole, as well as its valuable fish stocks. Proponents countered that the mine would create jobs, and lessen the U.S.'s reliance on foreign sources of ore.

In response, fishers, environmentalists, scientists, NGOs, and Native groups from Bristol Bay came together to oppose the mine project, and "Save Bristol Bay" (as one organization was titled). These efforts represent a continuation of the trend of stakeholder collaboration that is particular to both Alaska and Bristol Bay. This local and state opposition, coupled with restrictions imposed by the EPA under the Clean Water Act, ultimately halted the project in 2014. However, beginning in 2017 (and partly as a result of the erosion of environmental regulation under the Trump administration), the Pebble project was resurrected, once again posing a threat to the fishery. Interestingly, the most recent argument made by proponents of the Pebble Mine is that the ores that it would provide are necessary for 'green' technologies such as solar and wind. These narratives tap into the language of sustainability, making the case that the potential threat to salmon stocks is an acceptable trade-off for low-carbon technologies.

In 2020, The U.S. Army Corps of Engineers released an Environmental Impact Statement (EIS) for the project, claiming that it posed no threat to the long-term health of the fishery. Response from opponents was swift and outraged. Stakeholder groups –at the national, state, and local level—pointed out numerous shortcomings and gaps in the EIS, arguing that it did not accurately assess the risk to the fishery. In part because of this continued pressure, in late 2020, the Army Corps of Engineers ultimately denied a permit to the project. This was met with jubilation by fishery stakeholders (myself included): after years of struggle, Bristol Bay had been saved, and Pebble vanquished.

In addition to the demand for Alaska's resources, the *lack* of demand caused by resources from competing markets has been just as problematic. Alaska's reliance on oil reserves, which once bolstered its economy, has in recent years become a millstone. Since 2014, the plummet of crude oil prices has drastically reduced state revenue, which has in turn impacted budgets for government agencies, including fisheries management. In 2015, a state senate bill was introduced to shut down the CFEC and transfer its responsibilities to the ADF&G, partially citing budget concerns. Although it ultimately failed, the agency's future remains tenuous. More drastically, in the summer of 2017, the state faced a government shutdown based on the budget crisis. In an assessment of the potential harm caused by the shutdown, the ADF&G noted that it would "coincide with the peak of the Bristol Bay sockeye season, which regularly occurs around July 4th," and severely impact the agency's ability to monitor the fishery. [23] Ultimately, the state approved a budget and avoided the shutdown, largely by drawing from dwindling state savings. Global market forces, including competition from oil producers such as Canada and Saudi Arabia, and decreased demand from foreign consumers such as Russia and China, seem likely to keep oil prices low for the foreseeable future, likely leading to further economic shortfalls for Alaska.

Competition in other sectors has also impacted Alaska's economy. Beginning in the 1990s, competition from aquaculture in Canada and South America had a disastrous impact on salmon prices in Alaska (with the lowest hitting around 2001). In response, Alaska's salmon industry made a concerted effort to re-brand its salmon, emphasizing the importance of a "wild" fishery and the superior quality of Alaskan salmon over that of farmed fish. Ultimately, the state banned finfish aquaculture, further emphasizing their commitment to wild fisheries. Nevertheless, the fishery has never fully recovered economically; to this day prices remain largely dictated by the wider global market (as one Bristol Bay stakeholder put it: "Our prices are set by Chile."), and Alaska's fishery has lost much of its market power.

[23] https://gov.alaska.gov/newsroom/2017/06/adfg-impacts-of-potential-government-shutdown/

New global industries have also emerged as significant factors in Alaska's development. In the aftermath of the Exxon Valdez disaster, many southern Alaska communities moved away from a fishing economy. In its place, many of these communities turned to a new source of income: tourism, which has become a rapidly-growing industry worldwide. In recent decades, Alaska has become a popular destination for tourists from across the globe, who come to see spectacular scenery of "The Last Frontier." Now the third-largest contributor of revenue to the state, Alaska's expanding tourism industry has had significant ecological and social impacts, particularly in southeastern and southcentral Alaska. As communities which traditionally relied on fishing have shifted to a tourist-based economy, local knowledge regarding fishing practices and technology has been lost. In addition, coastal communities such as Seward, Whittier, and Ketchikan have experienced increased traffic from cruise ships; critics argue that these massive ships may have unmeasured impacts on marine environments, through the discharge of sewage, bilge, and graywater, as well as the transmission of invasive marine organisms. Further, the popularity of Alaskan sport-fishing has placed additional pressure on fisheries across the state, as tourists arrive in increasingly greater numbers, seeking to land an impressive king salmon or halibut.

The COVID-19 pandemic has also had significant impacts on the Bristol Bay fishery, and Alaska as a whole. In an echo of the 2014 collapse of oil prices, the 2020 collapse of the tourism industry – particularly cruise ships-- has had a dramatic impact on the Alaskan economy. Alaskan communities that relied on tourist dollars have been left scrambling to deal with the economic shortfall. In 2020, partly in response to the economic downturn from the COVID-19 pandemic, the state's already-hefty budget deficit rose even further, to an estimated $2 Billion. Rural communities, like those in Bristol Bay, have also struggled to deal with the health impacts of COVID –a task made further difficult when the nearest fully-equipped hospital is often only accessible by plane. In the summer of 2020, the Mayor of Dillingham (home to one of the largest salmon processors) and the First Chief of the local tribal council, wrote to the state Governor, requesting that he consider closing the Bristol Bay fishery, due to the

potential risk of incoming workers bringing COVID into the community. Their request was not taken up. Analyses of COVID cases in the state of Alaska, and rural communities, suggest that the summer worker influx has indeed led to increased exposure and transmission of the disease.

Equity and Technology

In the 21st century, Bristol Bay faces a new set of challenges regarding stakeholder equity, as its salmon industry seeks to expand and prosper. Many of these echo previous conflicts over resources between locals and outsiders. Native fishers who often catch below quota find themselves at odds with fishers (many from out of state) who try to maximize their catches. In recent years, as the fishery has increasing focused on shipping fresh fish, rather than canned, processors have pressured fishers to adopt new technologies and practices. Many processors have stated that beginning in 2018, they will only purchase fish from boats that refrigerate their catch. Further, while the Bristol Bay fishery has long limited fishing vessels to a length of 32 feet, a series of recent proposals have sought to expand these limits. Both of these technological changes require significant capital outlay for fishing vessel owners, whether through the installation of refrigerated sea water systems, or the potential need to purchase a new vessel. This needed capital represents a significant barrier to many within the fishery.

Partly as a result of these issues, Bristol Bay has also struggled with the out-migration of fishing permits, in which residents sell the permits awarded to them under the Limited Entry Act to non-residents. While proponents argue that this is simply a free choice, others argue that it is a choice made in the face of economic disadvantage, and therefore no choice at all. This has led to questions regarding which groups, precisely, are profiting from Bristol Bay's salmon stocks, and whether that distribution of profit is fair.

These questions have in turn sparked action. In recent decades, a number of NGOs in the Bristol Bay area have focused on improving the lives of permanent residents of the local communities, with a focus on long-term improvements in well-being, including education, healthcare, and housing. Bristol Bay is increasingly embracing a new definition of "fishery health," that includes not just fish, but fishers, and other regional stakeholders.

Finally, perhaps the most potentially disastrous global-scale challenge faced by Alaska are the unpredictable impacts of climate change. Rising global temperatures have already had significant repercussions for the Alaskan landscape: from the disappearance of sea ice and permafrost, to shifts in vegetation patterns, to changes in biodiversity. Many Alaskan communities are directly threatened by rising sea levels; others face climate change-related challenges that include increased erosion, wild food scarcity, and impassable travel routes. Within the marine ecosystem specifically, changing ocean temperature, acidification, and loss of prey species, as well as other potentially unforeseen consequences, may have catastrophic impacts on the salmon fishery.

The story of the Alaskan salmon fishery is in many ways that of a balancing act, and, as noted previously, a microcosm of Alaska's overall sustainability struggles. Despite successes, like the defeat of the Pebble Mine Project, Alaska continues to face challenges that it has encountered again and again throughout its history: how to balance the demands for its resources, ensure equity, and make decisions regarding what trade-offs are acceptable in its ongoing development. In many ways, these issues can be distilled into in a single question, which runs throughout sustainability studies: "How much is enough?" In the context of the fishery, this means answering linked questions such as: how many fish should be harvested, by whom, and for whom? Who should make these decisions, and based upon what data? Who should enforce regulations, and how? Who should benefit from the profits? Who should be allowed to participate in the fishery, and who should be excluded? These questions are often at the heart of many resource management cases, and there are rarely easy answers. Likewise, the continued health of the fishery is due to the hard work of stakeholders, who have wrangled over these questions, and have deliberated, collaborated, and sometimes clashed, over how best to move forward. As Alaska forges into the 21st century, it seems likely that it will continue to struggle with these challenges for years to come.