

Kodiak's Setnet Salmon Fishery in the Context of Alaska's Limited Access Management System

Joseph Zelasney

Fishery Officer, Food and Agriculture Organization, Rome, Italy

Abstract

The seafood industry is a cornerstone of Alaska's economy. By all measures, salmon are responsible for the greatest economic impact (jobs, income, and total value) in the Alaska seafood industry. This case study presents the Kodiak salmon set gillnet fishery in the context of Alaska's statewide salmon fishery. It provides a brief history of the development of the modern Alaska salmon fishery following the Klondike gold rush in 1890 through the adoption of the Limited Entry Act and enclosure of the salmon fishery in 1973 under a limited entry permit system. An overview of the Kodiak salmon set gillnet fishery, and its management is presented. This is followed by a discussion of how the limited entry system has supported utilizing salmon resources for the "maximum benefit" of Alaskans, as required by the Alaska Constitution, both in terms of long-term sustainable use of the salmon resource and toward ensuring the socioeconomic viability of the fishery. Finally, the case study explores challenges and shortcomings of Alaska's limited entry permit system for salmon and considers next steps for improving the contribution of the rights-based approaches to achieving sustainability goals.

1. INTRODUCTION

1.1 Description of the fishery

1.1.1 Alaska Seafood and Salmon

Salmon are the cornerstone of Alaska's seafood industry, and they underpin a traditional subsistence lifestyle in rural communities across the State. Seafood is the second largest sector of the Alaska economy, after Oil and Gas and ahead of Tourism and Mining. By all measures, salmon are responsible for the greatest economic impact (jobs, income, and total value) among all species caught by the Alaska seafood industry.

Currently, the harvest in Alaska represents about 80 percent of the total wild-caught North American harvest of salmon, Canada's harvest accounts for about 15 percent, and harvests from Pacific Northwest states (Washington, Oregon and California) make up the remaining 5 percent.

Alaska's 2016 seafood harvest of 5.6 billion pounds had a total ex-vessel value¹ of USD 1.7 billion. Processors produced 2.7 billion pounds of Alaska seafood products in 2016, worth a first wholesale value² of USD 4.2 billion. Seafood directly created an average estimated 26 800 full-time equivalent (FTE)³ jobs in Alaska in 2015/2016⁴. Alaska fisheries employed an average of 29 200 commercial fishermen in

¹ The dollar amount received by fishermen for their catch when delivered to a processor. This includes both initial payments and any bonuses or year-end adjustments paid by processors.

² The value of seafood products when sold to buyers outside a processor's affiliate network. This is the value of the raw fish delivered to the processor (ex-vessel value) plus the value added by the first processor.

³ Many seafood industry workers are employed in seasonal jobs or earn a year's worth of income in less than a year. FTE employment figures in this report represent an annualized estimate of jobs created in each study area, allowing comparison to other industries.

⁴ Due to biological and environmental factors, harvest of wild seafood is inherently volatile. For example, total odd-year harvests of Alaska pink salmon can be double or triple even-years. In order to reduce this volatility, figures have been averaged or otherwise combined from the two most recent years (2015-2016) where appropriate.

2015/2016, including 16 500 Alaska residents. The processing sector employed an average of 24 500 workers in 2015/2016, including an estimated 7 200 Alaska residents.

The average 2015/2016 harvest of salmon was 792 million fish with an ex-vessel value of USD 418 million and first wholesale value of USD 1.36 billion or 32.4 percent of the seafood industry's first wholesale proceeds. The statewide salmon fishery's contribution to the economy included approximately 16 600 direct FTE jobs or 61.9 percent of total seafood jobs in Alaska.

Alaska also has important sport and subsistence fisheries for salmon. Many Alaskans depend heavily on subsistence-caught salmon for dietary needs and as well as deeply rooted cultural and religious purposes. Fishery management plans in Alaska give top priority to the subsistence use of fish resources.

1.1.2 Alaska Salmon Management

The State of Alaska and the Federal Government manage commercial fisheries from zero to three nautical miles (nm) and three to 200 nm offshore, respectively. In state waters, the limited entry permit program regulates access to most commercial fisheries, including salmon. Salmon fishing in Alaska is managed under the jurisdiction of the State, in cooperation with Federal Government and relevant international fisheries bodies. Salmon fishing in Alaska occurs primarily in State waters or in one of three historical State-managed fishing areas, which extend beyond three nm offshore into federally managed waters - Cook Inlet, Prince William Sound, and the Alaska Peninsula – but that are managed under the jurisdiction of the State of Alaska.

Management of salmon fisheries occurring beyond three nm offshore in Alaska is guided by the Federal Fishery Management Plan for the Salmon Fisheries in the EEZ off the Coast of Alaska (AK Salmon FMP). The AK Salmon FMP allows a commercial troll fishery in federally managed waters off Southeast Alaska and closes the remaining Federal waters off Central and Western Alaska to commercial salmon fishing. The AK Salmon FMP does not include the three historical State-managed areas (which are managed under State FMPs), and it defers management of the commercial troll fishery in Southeast Alaska to the State of Alaska and, under the Pacific Salmon Treaty, the U.S.-Canada Pacific Salmon Commission.

Table 1. Alaska Salmon Permit Fisheries by Gear Type and Area.

Alaska Salmon Permit Fisheries by Gear Type and Area																
GEAR TYPE	AREA	(A)	(B)	(D)	(E)	(F)	(H)	(K)	(L)	(M)	(P)	(T)	(W)	(X)	(Y)	(Z)
		Southeast	Statewide	Yakutat	Prince Wm Snd	Atka	Cook Inlet	Kodiak	Chignik	AK Pen/Aleut	Upper Yukon	Bristol Bay	Kuskokim	Kotzebue	Low Yukon	Norton Sound
Seine																
01	purse	S01A			S01E		S01H	S01K	S01L	S01M						
02	beach							S02K								
Gillnet																
03	drift	S03A			S03E		S03H			S03M		S03T				
04	set			S04D	S04E	S04F	S04H	S04K		S04M	S04P	S04T	S04W	S04X	S04Y	S04Z
Troll																
05	hand		S05B													
15	power		S15B													
Fish wheel																
08	fish wheel										S08P					

Source: <https://www.cfec.state.ak.us/bit/MNUSALM.htm>

Salmon may be commercially captured in Alaska between 1 June and 31 October. There are 27 commercial salmon fisheries in Alaska, prosecuted across 15 management areas using seven gear types: purse and beach seine, drift and set gillnet, hand and power troll, and fish wheel (Table 1).

Alaska has directed management plans for five species of Pacific salmon (Figure 1): *Oncorhynchus gorbuscha* commonly known as pink or humpback salmon; *O. nerka* commonly known as sockeye or red salmon; *O. keta* commonly known as dog or chum salmon; *O. kisutch* commonly known as silver or coho salmon; and *O. tshawytscha* commonly known as king or chinook salmon. Two other Pacific salmon species spawn exclusively in Asian river systems and are not caught in Alaskan waters.

1.1.3 Kodiak Management Area and Salmon Fisheries

Kodiak is a remote and isolated archipelago of volcanic origin located in south central Alaska. The archipelago lies in the North Pacific Ocean and is made up of 28 islands that cover an area 285 km long and 67 miles 108 km across. Kodiak Island is the largest island in the archipelago, other major islands include Afognak, Shuyak, and Raspberry.

Kodiak is awash in spectacular natural beauty, including glaciers, steep mountains, rushing rivers, deep, clear bays and inlets, and an abundance of terrestrial and marine wildlife, including the world-famous Kodiak brown bear. A strong oceanic current, known as the Kuroshio, brings mild, wet weather year-round. Kodiak has been called the "Emerald Isle" due to the lush green vegetation that carpets the land in summer months.

The marine waters around Kodiak are among the most productive in the North Pacific. Offshore upwelling combines with abundant freshwater runoff to make near shore waters rich in nutrients. There are over one hundred species of marine fish native to the waters of Kodiak, including the five species of Pacific salmon. A majority of the archipelago's lands are protected wilderness; ensuring critical fish and wildlife habitats are preserved.

The Kodiak Management Area (KMA) includes State waters of Alaska south of a line extending from Cape Douglas (58° 51.10' N. lat.), west of 150° W. long., north of 55° 30.00' N. lat., and north and east of a line extending 135° southeast for three miles from a point near Kilokak Rocks at 57° 10.34' N. lat., 156° 30.22' W. long. (the longitude of the southern entrance of Imuya Bay), then due south (Figure 2).

In the KMA salmon may be commercially harvested using the following gear types: purse seine, beach seine, and set gillnet. This case study focuses on Kodiak's set gillnet salmon fishery.

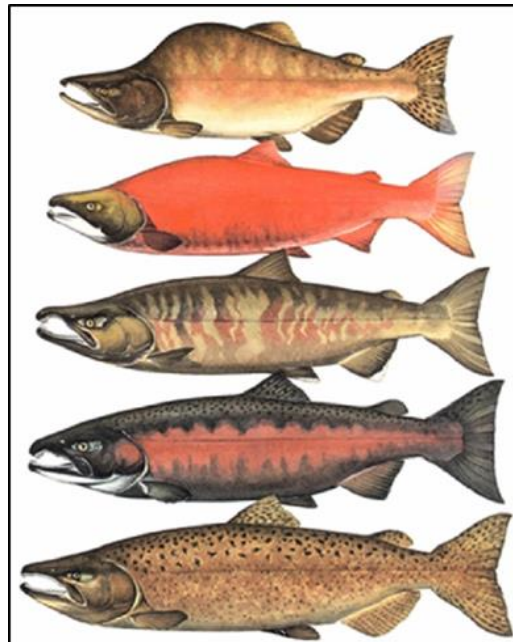


Figure 1. Pacific salmon species.

Source:

https://www.reed.edu/biology/professors/srenn/pages/melati_website/kaye_home.html.

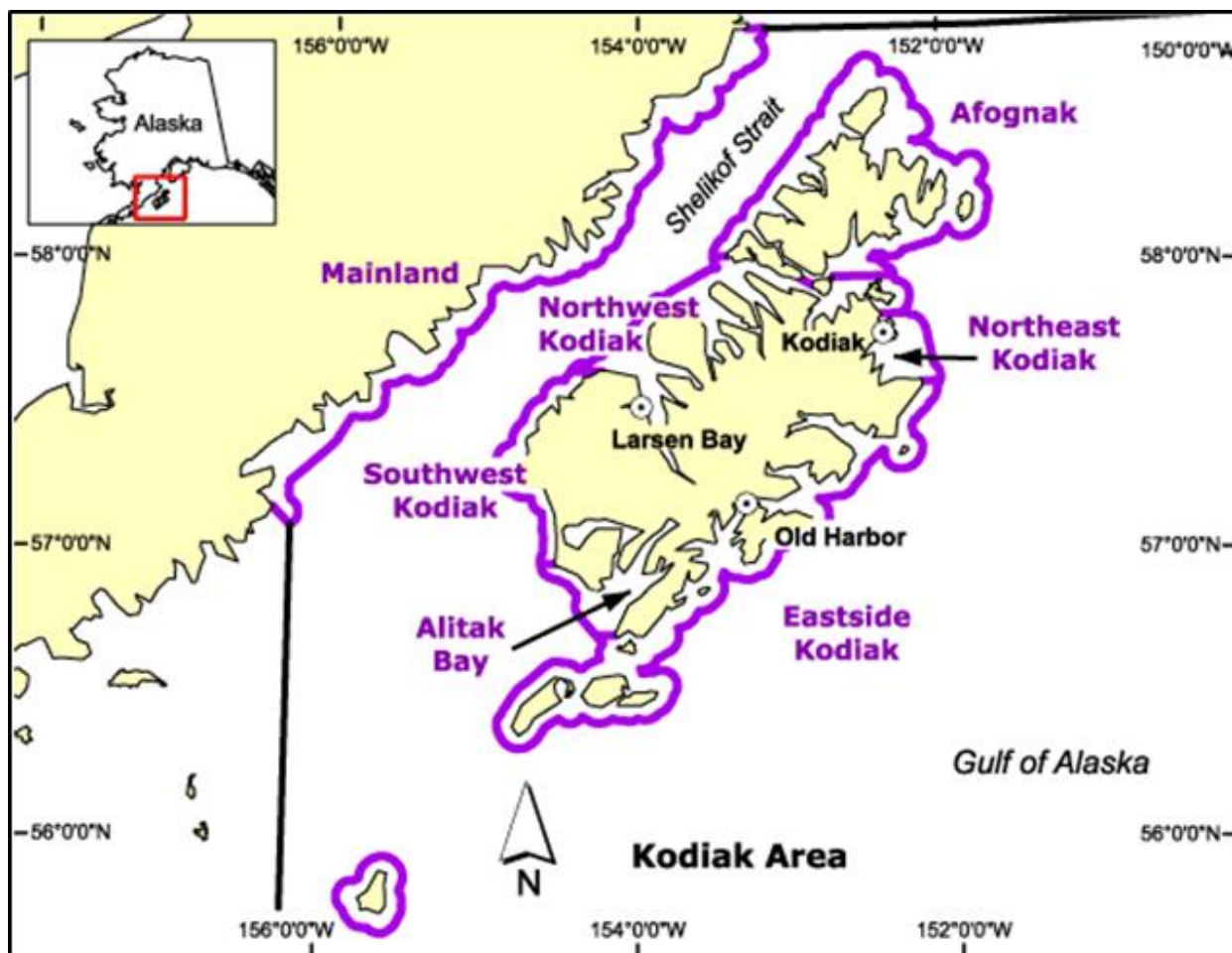


Figure 2. Map of Kodiak.

Source: <https://www.adfg.alaska.gov>.

1.1.4 Set Gillnet Salmon Fishing

Set gillnet fishing for salmon in Alaska predates Western contact. While the principles of set gillnet fishing have not changed over the years, nylon has replaced nettle and cedar netting, and stone anchors have been replaced with steel and concrete. Today, set gillnet fishing remains an effective, low-cost, labour-intensive method of fishing for salmon.

There are 188 State issued set gillnet permits in the KMA. Set gillnet operations in Kodiak are land-based, perhaps because of this fishing with immediate and extended family members is common. Set gillnet operations are commonly referred to as 'fish camps' as they are only inhabited seasonally during salmon fishing. The vast majority of Kodiak set gillnet fish camps are in remote and isolated locations. Lodgings consist of simple wood cabins and outbuildings or sheds where fishing equipment is stored when not in use.

Fish camp residents typically include the captain or permit holder as well as one to two additional crew members. These crew frequently consist of relatives, close friends and associates of the permit holder and their family. Though less common, captains also contract individuals where no connection or previous relationship exists. Spouses, small children, and others that are not part of the fishing crew (i.e. going out to pick the nets) are often present at fish camp and occupy various essential roles in the day-to-day work.

In the KMA set gillnets are placed near shore in submerged lands. Typically, a series of anchors and lines are used to secure one end of the set, while the other end is fixed to a rock near the tide line. The gillnet is then hung on the set. As salmon move along the shore, fish are entangled or caught by their gills in the net. Salmon are harvested from the net using an open skiff with outboard engine.

Several times per day fishers work their way along picking the fish that have been captured. Salmon are either delivered directly to a tender vessel or temporarily stored in totes with slush ice or in refrigerated seawater holds until the tender arrives. Tender vessels are an essential middleman between set gillnet fishermen and fish processors. Tender vessels are contracted by fish processing plants and dispatched at regular intervals to remote set gillnet sites, typically based on season-long contracts that are negotiated before fishing begins. The tender boat weighs and purchases the fish, loads it into their hold, and transports the fish back to the contracted processing plant where they are cleaned, packed, and ultimately sold. The tender boat also provides a critical lifeline, resupplying fish camps with food, fuel, and anything else they need to stay out and keep fishing.

Every time a set gillnet fishermen sell or deliver fish, typically to a tender vessel, they are required to submit a fish ticket, the fish ticket must indicate the number of fish of each species and the total weight by species for each delivery. Because of the fixed nature of set gillnet gear, a permit holder's reporting area (statistical area) is usually consistent between landings. In the event that a set gillnet is moved into a new statistical area, fishermen must make sure that information is reflected and reported on their fish tickets.

A person who holds a limited entry permit for set gillnet gear must be physically present at the fishing site during fishing operations. An individual may hold only one permit. A permit holder may operate no more than two set gillnets, with no more than 150 fathoms of set gillnet in the aggregate. No gillnet may be more than 125 meshes deep. Seine webbing no greater than 3.75 inch mesh size, or polypropylene webbing 3 mm or greater in diameter, may be used on the shoreward end of a set gillnet and the length of the seine webbing used may extend not more than 50 fathoms seaward of the beach at the lowest tide of the current day. Set gillnets must be operated in a substantially straight line, except that no more than 25 fathoms of a set gillnet may be used as a hook in any configuration. The shoreward end of a set gillnet must be attached to a point of land that is exposed at the lowest tide of the day or to a rock that is within five feet of the surface at the lowest tide of the day.

The owner and operator of a set gillnet must place the name of the fisher operating it, together with the fisher's five-digit permit serial number, in a conspicuous place on or near the set. In addition, the owner and operator shall plainly and legibly mark the fisher's five-digit permit serial number on kegs, buoys or clusters of floats associated with the set with.

1.2 Economic contribution and social implications of the fishing activity

1.2.1 Composition of Alaska's Salmon Industry – Markets and Products

Seafood is Alaska's biggest export, topping USD 3 billion in sales, and targeting over 120 countries in 2015. Alaska accounts for 55 percent of U.S. seafood exports by value. In this section, the context about which species, product types, and markets drive value in Alaska's salmon industry is presented. This information is assumed to be largely consistent with species, product type, and market destinations for fish produced by the Kodiak set gillnet salmon fishery. Comparisons represent an average of 2014 and 2015 because pink salmon harvests in odd and even years tend to fluctuate substantially, leading to skewed percentages based on analysis of single calendar year data.

1.2.1.1 Ex-vessel value by species

Sockeye and pink salmon account for the largest share of harvest volume and ex-vessel value –a combined 84 and 78 percent, respectively, over the past two years. Keta (i.e. chum), coho, and chinook salmon accounted for the other 16 percent of harvest volume and 22 percent of the fishery’s ex-vessel value.

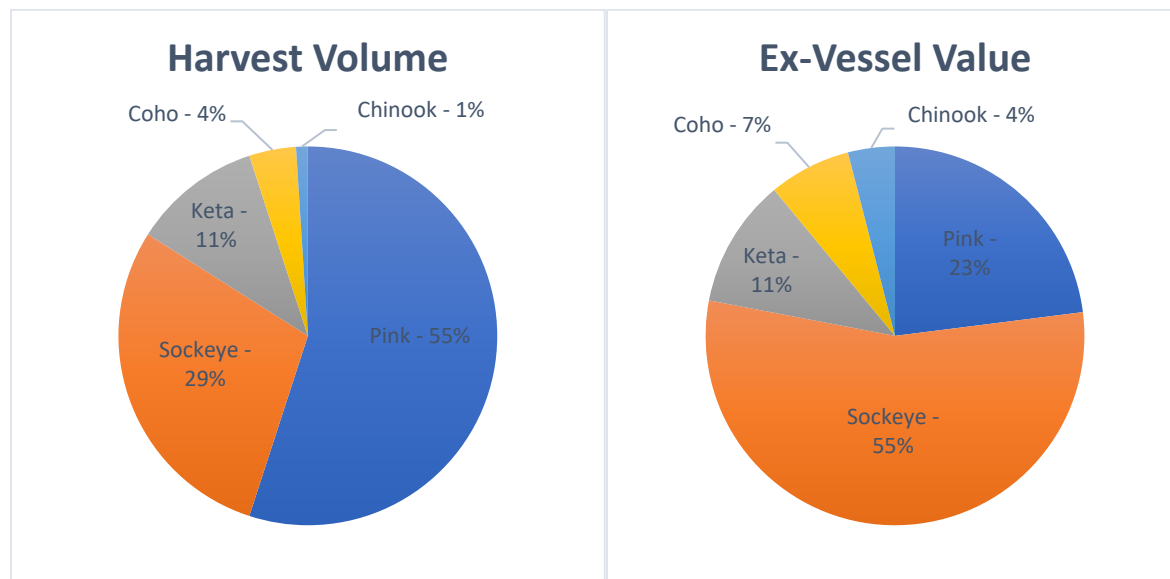


Figure 3. Harvest Volume and Ex-Vessel Value by Salmon Species, 2014-2015.

1.2.1.2 First wholesale sales volume and value by product type

Frozen head and gut (H&G) and canned product forms account for the vast majority of Alaska salmon production, but other key product forms provide a significant share of production (i.e. first wholesale) value. Over the last two years, frozen H&G and canned product accounted for 81 percent of production volume and 61 percent of first wholesale value while all other product forms (roe, fillets, fresh H&G) combined accounted for 19 percent of production and 39 percent of first wholesale value.

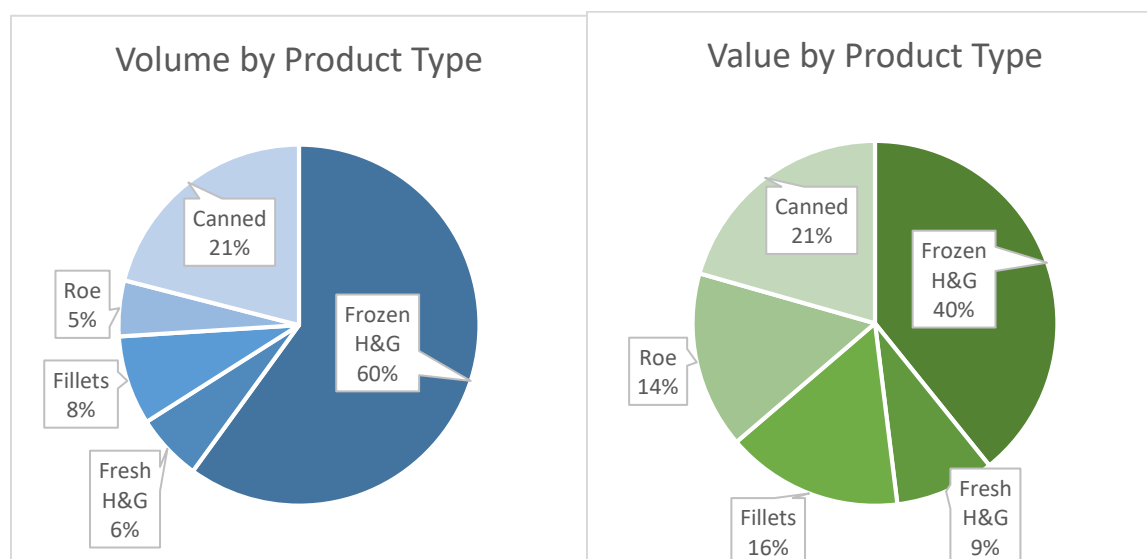


Figure 4. First Wholesale Sales Volume and Value of Key Salmon Products, 2014-2015.

1.2.1.3 Alaska Salmon Market Composition

It is estimated that the U.S. is the largest market for Alaska salmon products, but export markets as a whole account for approximately three-quarters of first wholesale sales. China is the largest export destination, but the vast majority of product exported to China undergoes additional processing and is re-exported (primarily to Europe, the U.S., and Japan). South Korea and Thailand also import significant volumes of intermediate products for further processing or storage. In terms of final consumption, the U.S., Europe, and Japan are Alaska's biggest salmon markets. Canada and South Korea are also major markets.

Table 2. Estimated Market Share of Total First Wholesale Sales Value, 2014-2015 Average.

Market ⁵	Pct. of First Wholesale Sales Value	Key Products
United States (Est.)	27%	Fillets/H&G (fresh & frozen), canned pink salmon
China	18%	Frozen H&G pink/keta
Europe	15%	Frozen H&G sockeye and canned salmon
Canada	14%	Canned salmon, fillets/H&G (fresh & frozen)
Japan	11%	Roe and frozen H&G sockeye
South Korea	4%	Frozen H&G sockeye
Others	10%	Canned salmon, frozen H&G pink/sockeye

Sources: ADOR (Alaska Salmon Price Report), ASMI Alaska Seafood Export Database, and McDowell Group estimate.

1.2.2 Employment, income and reliance on the fishery

1.2.2.1 Kodiak's reliance on the Fishing

Total population of the Kodiak archipelago, including the six villages of Port Lions, Ouzinkie, Larsen Bay, Karluk, Old Harbor and Akhiok, is nearly 14 000 with approximately 11 000 of those residents living in and around the city of Kodiak. Transportation in Kodiak is limited to floatplanes and watercraft, with the exception of a short road system around the city of Kodiak.

The seafood industry, including fish harvesting and processing, is the single most important economic activity in Kodiak. The fishing industry drives the area's economy and employed an estimated 5 900 FTE workers, accounting for approximately 40 percent of the region's employment in 2015/16. Kodiak waters produce several commercial species leading to more consistent production throughout the year, as a result, Kodiak's seafood processors employ the highest percentage of local residents (48 percent) of any major production region in Alaska.

In 2015, Kodiak was the second largest commercial fishing port in the U.S. by volume landed, and third in terms of ex-vessel value, with landings worth USD 262 million. Other key Kodiak area ports include Larsen Bay, Alitak Bay, Old Harbor, and Chignik.

⁵ Note: Some countries, such as China, South Korea, and Canada re-export substantial quantities of Alaska salmon products. These data should not be regarded as market share of final consumption, but rather an estimate of market share in terms of first wholesale sales.

1.2.2.2 Employment

According to the report, “Alaska’s Fishermen: Harvests, earnings, and their other jobs”, published by the Alaska Department of Labor Workforce and Development (ADLWD), about 32 200 people were directly employed by the seafood industry in 2011, including about 9 900 permit holders who made at least one landing that year and more than 22 000 crew members: salmon harvesting represented more than half of the total jobs. During the salmon fishing season, up to 5 000 people are employed in Kodiak’s commercial salmon fishery, including harvesting, processing, and management jobs.

The State of Alaska has issued 188 licenses or limited entry permits in the Kodiak salmon set gillnet fishery. A typical set gillnet operation directly employs 2-3 individuals, including the permit holder. However, this figure doesn’t fully capture participation in the set gillnet fishery. Because it is land-based, fishing with immediate and extended family members is especially common in the Kodiak set gillnet fishery. Often, the labour of the 2-3 member crew is supplemented by other individuals in a fish camp.

For example, many women play a central role in the day-to-day operations of a fish camp, both supporting fishing operations from shore, and working in the boat, though not necessarily as paid crew. Statistics on gender balance in the Kodiak set gillnet fishery are not available, but according to the 2011 report from the ADLWD, women accounted for approximately 14 percent of commercial fishers in the State – both skippers and crew – and about one-third of processing workers.

1.2.2.3 Income

The averaged 2015/2016 harvest of Kodiak salmon had an ex-vessel value of USD 34 million and first wholesale value of USD 301 million. In 2015/2016 ex-vessel landings worth USD 4.6 million were generated by the 146 set gillnet permits fished, on average.

In the five-year period, 2013-2017, average gross earnings per set gillnet permit in Kodiak was USD 50,246. This number does not account for costs associated with operating a set gillnet site, including crew shares, license fees and taxes, transportation to/from the site, fuel, provisions, and so forth. To put this in context, in 2016, the U.S Bureau of the Census reported the annual real median personal income at USD 31 099, and the real median household income at USD 59 039. In other words, the average set gillnet permit, after expenses, generates income on par with the national average annual personal income.

Fish harvesting in Alaska is seasonal, and fish harvesters in Alaska often hold more than one job. According to the 2011 report from the ADLWD, almost 9 000 active permit holders and crew had payroll jobs⁶ in 2011 — that is, they worked for an employer when they weren’t fishing. Over 29 percent of the more than 9 900 permit holders and 27 percent of 22 200 crew members held second jobs in Alaska where they drew a wage. A number of other fishermen may have also been self-employed when they weren’t fishing. Further, the information necessary to track permit holders and crew into the workforce is not always available (for example, second-job information for fishermen who worked in other states, for the federal government, or who participated in other commercial fisheries).

⁶ Most payroll jobs in Alaska — those where employers pay a wage or salary — are covered under state unemployment insurance laws. Employers are required to report job numbers and wages to the Department of Labor and Workforce Development, which uses those numbers to count jobs and record wages. Counting fish harvesters is more difficult because most commercial fishermen are considered self-employed and do not pay into the unemployment insurance system, and crew generally work for a share of the profit rather than a set wage. Without these unemployment insurance records, the department uses a variety of other sources to estimate employment.

Operating a set gillnet site in Kodiak is a full-time job, but set gillnet fishing only occupies between eight and 16 months of a given year. Set gillnetting is seldom the permit holder's only source of income. According to the 2011 ADLWD Report, set gillnet permit holders were especially likely to have other jobs. More than 50 percent of all set gillnet permit holders also had a known wage and salary job. Statewide they earned nearly USD 41 million of the USD 84.5 million in payroll earnings of all harvesters in 2011.

Table 3. Estimated Total Gross Earnings (Nominal) for the Kodiak Salmon Set Gillnet Fishery, with Average Gross Earnings (Nominal) by Permit, 2013-2017.

Year	Residency	Total Permits Issued/Renewed	Total Permits Fished	Total Pounds	Average Pounds	Total Gross Earnings	Average Gross Earnings
2017	Resident	129	98	10,525,746	107,406	\$6,940,681	\$70,823
	Nonresident	59	45	3,115,384	69,231	\$2,154,669	\$47,882
	Year Totals	188	143	13,641,130	95,393	\$9,095,350	\$63,604
2016	Resident	131	91	4,082,897	44,867	\$3,300,503	\$36,269
	Nonresident	57	46	1,460,071	31,741	\$1,165,955	\$25,347
	Year Totals	188	137	5,542,968	40,460	\$4,466,459	\$32,602
2015	Resident	132	105	8,217,282	78,260	\$3,640,978	\$34,676
	Nonresident	56	49	2,249,640	45,911	\$1,111,819	\$22,690
	Year Totals	188	154	10,466,922	67,967	\$4,752,798	\$30,862
2014	Resident	131	104	5,341,435	51,360	\$6,872,007	\$66,077
	Nonresident	57	42	1,542,455	36,725	\$2,087,912	\$49,712
	Year Totals	188	146	6,883,890	47,150	\$8,959,918	\$61,369
2013	Resident	133	105	6,646,341	63,298	\$7,390,116	\$70,382
	Nonresident	55	47	1,762,092	37,491	\$2,155,085	\$45,853
	Year Totals	188	152	8,408,433	55,319	\$9,545,201	\$62,797

Source: CFEC.

Table 4. Alaska Permit Holder's Other Jobs Wage and Salary Earnings 2011.

Alaska Permit Holder's Other Jobs Wage and Salary Earnings 2011				
By Species, Gear, and Region	With WS Earnings	No WS Earnings	Percentage with WS Earnings	Average Earnings
Statewide Salmon	2,237	4,540	29.3%	\$29,306
Statewide Set Net	1,410	1,379	50.6%	\$28,982
Kodiak (all fisheries)	110	543	16.8%	\$28,822
Source: AK Department of Labor and Workforce Development				

No published data on non-fishing employment for the Kodiak set gillnet fishery was available. Though based on this authors experience, non-fishing employment in the set gillnet fishery is consistent with the

2011 Report published by ADLWD. According to the report, jobs in the construction trades were the most common for both permit holders and crew when they weren't fishing, together, over 13 percent of permit holders and crew worked construction jobs when not fishing. Nearly seven percent of fishers worked in material moving occupations, such as marine cargo handling, the job category with the second-highest number of participants. Food processing, mostly in fish processing plants, was the third-highest category, which is logical given the proximity of fish processing plants to fishing grounds, especially for small communities where the seafood industry is a major part of the economy, and other opportunities are limited. Another significant category of non-fishing employment was education, as the seasonality of teaching jobs allows educators to take advantage of their free summers to earn money fishing.

Permit holders earned more on average than the crew in their other, non-fishing-related jobs. This is not surprising as crew members were much younger on average than permit holders, with an average age of 21. In 2011 permit holders had an average age of 47. Permit holders earned on average around USD 29 000 each in non-fishing wages. In contrast, crew members earned USD 18 650 working payroll jobs, on average.

2. MANAGEMENT OF THE FISHERY AND RIGHTS-BASED APPROACH

2.1 Management of the fishery

2.1.1 Alaska Salmon Management Overview

Pacific Salmon are anadromous; they return to the stream of their birth after spending a fixed lifespan in the ocean. The annual "run" takes place during several weeks each summer. Some salmon populations swim only a few hundred yards upstream; others travel as far as 2 000 miles up the Yukon River at speeds of 50 miles a day against the current. Each fish returns to the unique stream in which it was born, and many streams harbor multiple discreet populations. There are approximately 10 000 different spawning populations that must be considered. Stream-jumping by salmon populations only occurs in geologic time, however, it was not until well into the 20th century that biologists understood that each run is genetically unique and that successful long-term conservation of the aggregate salmon resource requires adequate "escapement" of spawning populations in each and every stream (Cooley, 1963)⁷.

Alaska's salmon fisheries are not managed by harvest quota. Today the dominant feature of Alaska's salmon harvest policy is "fixed escapement," or ensuring that sufficient numbers of adult spawning salmon escape capture in the fishery and are allowed to spawn in the rivers, thus maintaining the long-term health of the stocks. For the most part, salmon are caught when they return to spawn and die in their rivers of origin. Fishery managers must ensure that a sufficient number of fish escape up the river while avoiding potential economic harm to fishers by allowing excess escapement. In what can sometimes be a very short period, the fleet has an opportunity to catch all remaining fish not needed to meet escapement goals.

Salmon managers open and close fisheries on a daily basis to ensure that adequate spawning escapements are achieved. When run failures occur, managers close fisheries to provide for predetermined escapement needs and therefore ensure long-term sustainable yields. When run strength is strong, managers liberalize harvest regulations to utilize surpluses. Alaska's focused emphasis on in-season management by local biologists with delegated regulatory authority to ensure sustained yields is a key ingredient to successful salmon management.

⁷ Salmon Biology - <http://www.alaskool.org/projects/traditionallife/fishtrap/fishtrap.htm>

Another key aspect of Alaska's successful model for sustainable fisheries management is the separation of powers among government agencies that set policy (Alaska Board of Fisheries or BOF) and those that implement and enforce allocations and harvest limits (Alaska Department of Fish and Game or ADF&G). Alaska changed from federal management of its fisheries to state management in 1959 when it became a state, the ADF&G and BOF were formed the same year. While the ADF&G was formed with a strong conservation mandate to manage salmon fisheries for sustained yield, the BOF, on the other hand, was given the responsibility for allocating fishery resources among users. Another agency, the Commercial Fisheries Entry Commission (CFEC), was formed in 1973 to implement Alaska's limited entry law, it issues and regulates fishing permits for state fisheries.

2.1.2 Kodiak Area Salmon Management

The Kodiak area commercial salmon fisheries are managed by local area ADF&G biologists following 10 area management plans and a harvest strategy that emphasizes the following three criteria:

- 1) Promote maximum sustained yield for future KMA salmon returns by ensuring salmon escapements of sufficient magnitude and distribution.
- 2) Provide for orderly fisheries while maximizing harvest opportunities on the highest quality salmon.
- 3) Adhere to the biological and allocative requirements of all management plans adopted by the Alaska Board of Fisheries (BOF) for the KMA salmon fishery.

In the KMA salmon may only be taken from 1 June through 31 October during fishing periods established by the ADF&G. There are ten salmon management plans for Kodiak, developed by the BOF that direct ADF&G management activities for specific areas and during explicit time periods. These plans are used for both conservation and allocative purposes. Allocation considers both issues relating to salmon harvests within the Kodiak area among the three authorized gear types and issues relating to salmon harvests between Kodiak and adjacent management areas⁸, including Cook Inlet, Alaska Peninsula, and Chignik.

Management of Kodiak area salmon fisheries is complex. Salmon spawning activity has been documented in about 800 streams within the Kodiak area. An estimated 440 streams support significant salmon production. Of those streams, four support Chinook salmon spawning populations, 39 support sockeye salmon spawning populations, 174 support coho salmon spawning populations, all support pink salmon spawning populations, and about 150 support chum salmon spawning populations.

When decisions must be made, annual run sizes are often uncertain; salmon stock composition is often unknown and must be assumed. Many in season management decisions for the Kodiak area commercial salmon fisheries are based upon estimated salmon run abundance and timing indicators. In season catch data, catch per effort data, test fish data, catch composition data, and escapement information from a variety of sources is used to assess stock strength in season. These various data and predictions, along with BOF management plans, are used by ADF&G to regulate fishing areas and times to achieve escapement targets and allocative criteria set by the Board of Fisheries. In season adjustment in areas open to fishing and fishing time are dictated by escapement goals. Escapements of several important stocks of salmon are monitored continuously with weirs, while aerial and ground-based surveys index escapement abundance of other stocks of salmon in the Kodiak area.

⁸ Salmon tagging studies have demonstrated the presence of nonlocal stocks of salmon in the commercial salmon harvests of the Kodiak area. Nonlocal stocks of salmon present in Kodiak area commercial salmon fisheries include sockeye salmon migrating to streams in Cook Inlet, Chignik, and the southern portion of the Alaska Peninsula and Chinook salmon from Oregon through Cook Inlet.

Within the KMA, there are seven districts, which are further broken down into sections and statistical areas. All fishermen must indicate catch by species and place of capture (statistical area) at the first point of sale or landing. All salmon buyers, including processing facilities and fish transport vessels (aka tenders), must be licensed and are required to report all landings data to ADF&G immediately. The data is compiled and evaluated daily by ADF&G.

In season run timing models are used to predict escapement levels using historic run passage information. Salmon run timing within the KMA follows a general chronology by species. Commercial fisheries management is based on the run timing of four targeted salmon species: sockeye - *Oncorhynchus nerka*, coho - *O. kisutch*, pink - *O. gorbuscha*, and chum - *O. keta*.

Management of major sockeye salmon runs are based on escapement and utilize daily escapement information from salmon counting weirs on several of the larger streams. Due to inadequate funding for aerial surveys, escapement data for many small streams are obtained much later in the season. Because of this lag in timing, ADF&G will employ a more conservative management approach, which includes increased closed water areas and reduced fishing time. These management actions occur for systems that have the potential to be overharvested or have shown signs of overharvest in previous years.

The length of the initial fishing periods for pink salmon are determined preseason based on the magnitude of the wild stock pink salmon forecast. Adjustments in weekly fishing time and areas open to fishing will occur as the actual run strength becomes apparent through assessment of harvest and escapement estimates.

Initially, chum and coho salmon are incidentally harvested in fisheries directed at sockeye or pink salmon. Terminal or near-terminal fisheries targeting chum or coho salmon are managed based on an assessment of actual run strength and current harvest information. Commercial fisheries are not currently directed toward Chinook salmon *O. tshawytscha*. Incidental harvests of Chinook salmon occur during directed sockeye and pink salmon fisheries.

2.2 Brief history of the former rights-based approaches used in the fishery

Since pre-historic times the annual return of pacific salmon has been a mainstay in the lives of Alaska Native peoples. Immense river systems, including the Yukon and Kuskokwim, allowed salmon to play an integral role in the lives of Alaska Native peoples living as far as 1 500 miles from the ocean.

In the 1800s, prior to the first contact with Eurasians, coastal Alaska Native peoples had well-developed property rights to particular salmon streams. The rights were vested with the nuclear family or clan, not the individual. In times of scarcity, a clan could fish in a neighbouring clan's stream by paying a royalty on the catch.

The arrival of first Russian, and then American settlers, and the advent of commercial salmon fishing upset these long-established traditions. In 1878, the first salmon canneries were built in Alaska, presaging a dramatic decline in the salmon resource. The number of canneries grew rapidly between 1878 and 1920. During this time there was also a drastic proliferation of purse seine and gillnet fishing vessels. This growth occurred in the absence of any effective governmental regulation and, had it not been for the sharp drop in demand due to the Great Recession after the First World War, might have completely destroyed the fishery.

Salmon packing companies were issued Federal permits to harvest fish, in some instances at the exclusion of all other users, granting large operators exclusive access to key salmon runs. Many canneries in Alaska

employed fish traps, which were remarkably efficient. Often built to fence off entire streams, the fish traps built by early canneries allowed for virtually no salmon escapement. Another stated benefit of fish traps at the time was their low labour requirements. The high catch efficiency and low labour requirements of fish traps were viewed as a fault by local fishermen and labourers, to say nothing of the Alaska Native peoples, who were increasingly marginalized and excluded from the resource. To make matters worse, it was standard practice of cannery owners to import Chinese labour to work in the canneries.

To build canneries and fish traps the industry had to concentrate capital, labour, and materials in remote locations for the intense but short fishing period, it was risky business. In 1944, 396 of the 434 fish traps were owned by “outsiders”, meaning business people who did not live in Alaska, but profited from the salmon resources of the State. Just a handful of large companies controlled over half of the annual production between 1919 and 1959. It appeared to some that all of the benefits and revenue stemming from Alaska’s salmon resource were leaving the State, and that local fishers were being left out of the deal. The fish trap was a central issue in debates concerning rent capture between residents and nonresidents, owners and labourers, and Federal vs State control of resources. Banning fish traps ultimately became a rallying cry for Alaska statehood.

In 1959, with the adoption of the Alaska State Constitution, fish traps were banned by referendum, “As a matter of immediate public necessity, to relieve economic distress among individual fishermen and those dependent upon them for a livelihood, to conserve the rapidly dwindling supply of salmon in Alaska, to ensure fair competition among those engaged in commercial fishing, and to make manifest the will of the people of Alaska, the use of fish traps for the taking of salmon for commercial purposes is hereby prohibited in all the coastal waters of the State.”

A long-run decline in the salmon catch began after the peak year of 1939. It was temporarily arrested after Alaska became a state and instituted new conservation measures, including the banning of fish traps and setting escapement targets. During this time the salmon fishery was open access, where any individual could participate by purchasing a fishing permit for a nominal annual fee. In 1975, nearly 100 years after the first salmon canneries were built in Alaska, the State issued limited entry permits for salmon fisheries, leading to a recovery in the health and abundance of salmon stocks throughout the State.

2.3 Rights-based approach: allocation and characteristics

Today, the privilege to fish commercially in Alaska requires a permit issued by the State Commercial Fisheries Entry Commission (CFEC), which is an agency administratively attached to the Alaska Department of Fish & Game (ADF&G). CFEC permits are specific to species, gear type, and administrative area.

Prior to 1959, Alaska was a territory of the United States. When Alaska became the 49th State in 1959, its fishery resources converted from Federal to State management. Voter referendum and a constitutional amendment in 1972, in response to biological and economic failures in State salmon fisheries in the preceding decades, paved the way for the Alaska limited entry system.

Earlier attempts to limit entry into state fisheries were thwarted by a provision in the State constitution, which states, “no exclusive right or special privilege of fishery shall be created or authorized in the natural waters of the State” (Alaska Constitution VIII: 15). The State constitution was amended to expressly allow for the limitation of fishery access, “for the purposes of resource conservation, to prevent economic distress among fishermen and those dependent upon them for a livelihood.”

Following the constitutional amendment, in 1973 the Alaska State Legislature enacted the Limited Entry Act, establishing the Commercial Fisheries Entry Commission (CFEC) and giving it the authority to administer the program. The objective of the CFEC is to “limit entry into commercial fisheries and provide annual licensing and permitting of fisheries to facilitate the management and development of fishery resources for the maximum benefit of those dependent upon them and the economy of the state.”

Some key features of the limited entry program are: to restrict the issuance of permits to natural persons; prohibit permit leasing; prevent the use of permits as collateral for loans; and allow for free transferability. Limited entry permits cannot be held by nonpersons, such as corporations, communities, or other entities, and permit holders must be citizens or permanent residents of the U.S. and actively participate in the harvest of fish delivered under their permit. The Limited Entry Act prohibits permits from being pledged, leased, mortgaged, encumbered or transferred with any retained right of repossession, and the permit itself cannot be used as collateral for a loan⁹. Leasing permits are not allowed, except for medical emergencies. Limited entry permits are transferable on the open market, meaning they may be sold or gifted to another person.

The Limited Entry Act also defines entry permits as a use-privilege that can be modified by the legislature without compensation. Federal regulations, not specific to commercial fisheries, have a significant impact on the administration of the State Limited Entry Program. The Federal Interstate Commerce Clause prohibits State governments from discriminating against residents of other U.S. states, which has the effect of keeping Alaska’s State-managed fisheries open to all U.S. citizens.

Alaska’s limited entry program was implemented in 1975 when 19 salmon fisheries¹⁰ were limited. Among them were the salmon set gillnet fisheries in Kodiak, Prince William Sound, Cook Inlet, Alaska Peninsula, and Bristol Bay.

Permits were issued to individuals who demonstrated both a history of fishing and economic dependence on the fishery. During the phase, when an individual’s permit qualifications were determined, they were issued as an interim-use permit (IUP). More than 2 300 IUPs were issued to individuals in the five-set gillnet fisheries. Eventually, individuals who met the minimum qualifications were issued permanent CFEC limited entry permits. Additional limited entry fisheries were established in the following years. Today there are 65 commercial fisheries managed by area and species under Alaska’s limited entry program, of which 27 are salmon fisheries.

3. CONTRIBUTION OF THE RIGHTS-BASED APPROACH TO ACHIEVING SUSTAINABILITY

3.1 Sustainable use of the resources

Alaska has succeeded in sustainable yield management of its salmon fisheries since the enclosure of the salmon fishery under a limited entry permit system. In reference to salmon populations, the limited entry permit system has been vastly successful in increasing populations; catch has rebounded to record levels. In the Kodiak area, sustainable harvest levels of salmon have increased over the past 40 years.

Alaska’s salmon catch had grown steadily with the rapid expansion of the cannery capacity, beginning in 1878 through 1920. However, without adequate controls, this led to overfishing and a long-run decline in stock abundance and catch after the peak year of 1939. By 1953 stocks were so depleted that President

⁹ Two exceptions to this rule are loans financed by the State of Alaska, Division of Economic Development (CED) or by the Alaska Commercial Fishing and Agriculture Bank (CFAB). These two agencies are authorized under Alaska Statute to take a limited entry permit as security for a loan they extend.

¹⁰ Permit fisheries are defined by CFEC as a specific gear type for a fishery resource within a defined administrative area.

Eisenhower declared a federal disaster in Alaska. In 1959, statewide harvests totaled only about 25 million salmon, which is less than 20 percent of the current sustained production.

The decline was temporarily arrested after Alaska became a state and instituted new conservation measures including escapement targets, however, the inexorable entry of additional participants (prior to 1975, all fisheries in Alaska were managed as open access, where any individual could obtain a fishing permit for a nominal annual fee) and technological improvements to fishing gear caused further decline to record low levels in 1972. In the same year, the people of Alaska voted to amend the State Constitution to allow for a restriction on entry to Alaska's fisheries for certain purposes: conservation, prevention of economic distress, and promotion of aquaculture.

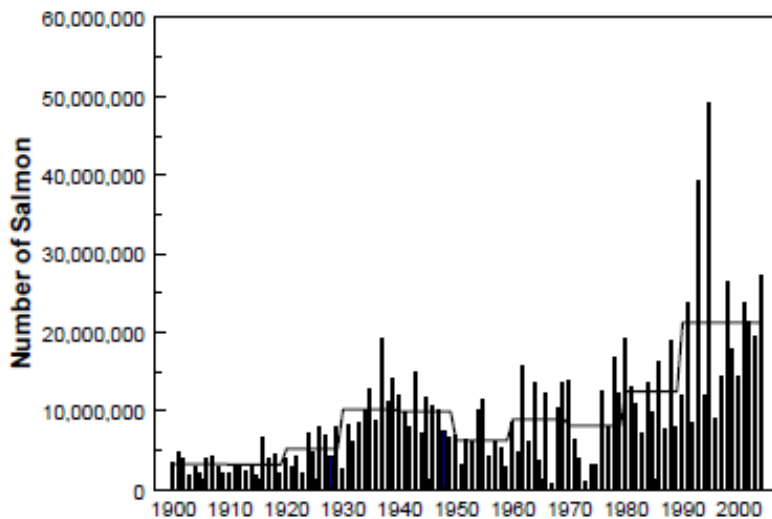


Figure 5. Commercial salmon harvests (all species) in Kodiak from 1900-2004 (bars provide annual catches and lines provide decade averages).

Source: The Commercial Salmon Fishery in AK. Clark, McGregor, Mecum, Krasnowski, and Carroll.

3.2 Economic viability of the fishery

Alaska's license limitation program was designed for the salmon fisheries, in other words, a fleet of individual owner-operators participating in a fishery managed for escapement and not by quota. The limited entry permit system has been beneficial to the economic viability of Alaska's salmon fisheries in several ways.

Net economic benefits have accrued to permit holders that would not have existed under an open-access regime. Limited entry permits are a property right of the holder and may be sold, bought and are heritable. A tradable entry permit gives its holder a permanent stake in the fishery, which provides an incentive to conserve the resource, to obey conservation laws, and to promote investment to rebuild salmon stocks as needed.

Alaska's license limitation program contributed to limiting fishing capacity because it is coupled with other limitations on an effort such as vessel size and gear restrictions. Taken together, Alaska's license limitation and other management tools allow managers to calculate with some assurance the power of the fishing fleets they are tasked to manage. Implementation of the Limited Entry Act also protected Alaska's fisheries from an influx of new fishermen from West Coast fisheries where fishing opportunities have been severely reduced by court decisions and stock conditions.

This combination of factors – a limited pool of fishers, with a vested interest in the fishery – created a scenario where managers were able to consistently achieve escapement targets, which over time resulted in increasing and sustained salmon harvests. Due to the magnitude of the Alaska salmon fishery, state biologists collect extensive information and statistics for management decisions. The objective of biologists, managers, and policymakers is to ensure healthy stocks and productive fisheries for harvesters and the businesses that rely on their catches. It is a virtuous circle.

In 2015, ADF&G's Division of Commercial Fisheries operational budget for Kodiak salmon totaled approximately USD 730 000, which was used to pay the salaries of management staff, for stream surveys, five weir projects, and sampling for the commercial fishery. The investment, paid in part by the industry through taxes, helps to ensure the continuation of a commercial fishery whose annual inflation-adjusted ex-vessel value since 1985 has averaged USD 47 million, and that supports more than 400 small businesses and thousands of jobs in the region.

3.3 Social equality

Alaska's limited entry program has always been controversial. The initial allocation process, which has not been fully presented here, is complex, expensive, and requires years to complete. While the program has survived all major legal challenges, courts have modified the program. Although the percentage of permits held by Alaskan residents has remained stable, in some areas, the number of permits held by local, rural Alaska residents has declined. Additionally, the high cost of permits in some fisheries, including salmon fisheries, has made the initial entry into some fisheries difficult.

Despite the controversy, Alaska's license limitation system has won general acceptance and has twice been supported by the voters. As stated, the electorate passed a constitutional amendment forming the basis for limited entry in 1972. Subsequently, in 1976, the voters defeated a referendum to abolish limited entry in Alaska by a margin of almost two to one.

The relatively free transferability of entry permits is not without challenges. The Alaska Legislature intended an entry permit to give its holder a permanent stake in the fishery in the hope of providing an incentive to conserve the resource. The Legislature also intended free transferability to ease hardship to an individual disabled from the fishery and to fishing families intending to maintain their access to a fishery. Finally, for the sake of simplicity and economy, the Legislature intended to leave redistribution of entry permits largely to the marketplace and to avoid involving the state in the re-issuance of entry permits.

Depending on the perceived value of a fishery, the current costs of entry permits range from several thousand to several hundred thousand dollars. The current market value of a Kodiak salmon set gillnet permit is USD 77 500. A high market value is a mixed blessing. On the one hand, it may reflect the perceived economic health of the fishery. On the other hand, the high price may present an obstacle to a local individual seeking to enter the fishery as a captain for the first time. And for those individuals who borrow funds to purchase an entry permit, servicing that debt may create an incentive to fish harder, increasing demands on the resource.

Additionally, it has been argued that transferability, or rather the high permit values resultant from transferability rules and market forces, disadvantages some Alaskans. In some rural areas of the state, more permits have been transferred from the area than have been transferred to the area. This net rural drain of entry permits in areas where economic alternatives to commercial fishing are limited is a serious concern.

While the Limited Entry Act is neutral with respect to residency, overall transferability has tended to serve residents of the State of Alaska. Through 2005, a total of 16 264 limited entry permits were issued in 65 fisheries. Over 80 percent of permits issued were initially issued to Alaska residents. As of year-end 2005, there were 14 536¹¹ remaining entry permits, 77 percent of which were held by Alaska residents. While total permit holdings by nonresidents have risen since initial issuance, the reason is mainly due to migration (Alaskan permit holders moving out of state), and not permit sales from Alaskans to non-Alaskans.

The most significant decline in permit holdings among Alaska resident types is from rural Alaskan permit holders living in an area local to their fishery (ARLs). Migrations of permit holders within and outside Alaska have led to a net decline in permit holdings by rural and urban Alaskans local to their fishery. Permit holdings of ARLs have also declined due to net transfer activity. Total permit holdings by ARLs have declined by 605 permits due to net transfer activity, 728 as the net result of migration, and 600 due to cancellation. However, of all permits held by Alaskans, Alaska rural residents hold more than 50 percent.

License limitation permits for the Kodiak salmon set gillnet fishery (S04K permits) were issued starting in 1975. Today there are 188 S04K permits. Of this total, Alaska Locals received 65.4 percent (123/188) of the permits, Nonlocal Alaskans received 7.4 percent (14/188) and Nonresidents received 27.1 percent (51/188) of the permits. Every permit issued was a transferable permit.

The number of permits held by each resident type can change for three reasons: permits can be transferred to other resident types (transfer); permit holders can move from one location to another (migration); or permits can be cancelled (such as when a permit holder does not pay the renewal fee for two consecutive years). This table indicates the extent to which these factors have contributed to net changes in permit holdings in this fishery. Migrations have had the largest impact on the changes.

Table 5. Initial Issuance and Year-end 2015 Totals of Kodiak Salmon Set Gillnet Permits.

Initial Issuance and Year-end 2015 Totals of Kodiak Salmon Set Gillnet Permits, With Net Changes Due to Permit Transfers, Migrations, and Cancellations, by Resident Type										
PERMIT	Initial Issue		Transfers		Migrations		Cancelled		2015 Year-end	
	Total	Percentage	Change	Percent change from Initial	Change	Percent change from initial	Change	Percent change from initial	Total	Percentage
local	123	65.4%	37	30.1%	-53	-43.1%	0	0.0%	107	56.9%
nonlocal	14	7.4%	0	0.0%	11	78.6%	0	0.0%	25	13.3%
nonresident	51	27.1%	-37	-72.5%	42	82.4%	0	0.0%	56	29.8%
Total	188	100.0%	0	0.0%	0	0.0%	0	0.0%	188	100.0%

Source: CFEC

While transferability of entry permits remains controversial, alternatives to transferability also present problems. If entry permits were to revert to the state to be reissued among applicants according to a ranking system, the process would be very expensive and time-consuming. If permits were reissued periodically through a lottery, fishers would be denied the opportunity to plan for their business. If permits were awarded periodically by competitive bid, the individual dependency on fishing protected by the current grandfathering system would be ignored, and individuals with better access to capital would

¹¹ Between initial issuance and the end of 2005, 1 728 had been eliminated, primarily due to cancellation of non-transferable permits (non-transferable salmon hand troll permits accounted for over 1 000).

benefit. Additionally, limiting the time during which an individual could hold an entry permit would eliminate the long-term stakes in a fishery believed by the legislature to be necessary to promote conservation. Finally, eliminating transferability would remove the incentive for the holder to maintain or enhance the value of the permit through the conservation of the resource.

4. MAIN CHALLENGES AND WAY FORWARD

4.1 Challenges for the fishery

Alaska's salmon fisheries are essential to sustaining the social, cultural and economic vitality of communities around the State. Numerous challenges confront the industry, including the rising cost of access rights (permits), which threatens local fisheries access and participation, contributing to the 'graying of the fleet' and the rural-to-urban migration of fishing rights, and global competition in the marketplace including from farmed salmon, among others, contributing to an overall loss in value of the fishery. Other factors, largely beyond the control of stakeholders and policymakers, such as climate change, threaten the long-term health of salmon stocks and sustainability of Alaska's salmon fisheries.

4.1.1 Greying of the fleet

4.1.2 Farmed Salmon

4.1.3 Climate Change

4.2 Improving fishery sustainability in the future

Alaska has a range of programs and policy provisions designed to support Alaskan access to commercial fisheries.

Explore supplemental forms of access to commercial fishing that are not market-based to facilitate new entry and provide diversification opportunities.

Establish youth permits or student licenses and mentorship or apprenticeship programs to provide young people with exposure to and experience in fishing and a pathway to ownership.

REFERENCES

Alaska Historical Society. 2015. *Alaska Fisheries: A Guide to History Resources*. [Online] Available at: <https://alaskahistoricalsociety.org/about-ahs/alaska-historic-canneries-initiative/alaska-fisheries-a-guide-to-history-resources/>

McDowell Group. 2017. The Economic Value of Alaska's Seafood Industry.

Schroeder, Robyn. n.d. 'Fish Traps in Alaska: Before and After Statehood' [Powerpoint slides]. Available at: <https://www.slideshare.net/guest639f11/fish-traps-in-alaska-final>