The Bering Sea/Aleutian Island Crab Rationalization Program: Addressing Community Effects with Processor Quota

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Abstract
The Bering Sea/Aleutian Islands crab fishery has been made famous by Discovery Channel's Deadliest Catch program, which shows viewers how harvesters brave the ice and storms of the Bering Sea to catch king, snow and tanner crabs. Although always well managed biologically, in 2005, the fishery implemented an ITQ program in order to reduce overcapitalization and reduce the competitive fishing that created dangerous conditions. In the first year of the program, the number of vessels participating decreased by two thirds. Many exiting vessel owners have continued to benefit from the fishery by leasing their quota allocations to vessels that are still fishing, but their hired crews have been displaced. A distinctive feature of the BSAI crab program is that, in addition to harvest quota, processors were allocated processing quota. This means a pound of landed crab must be offset by harvest quota, and by processing quota. This feature is designed to maintain the geographic distribution of landings, and in particular sustain historic processing participation in island communities in the Bering Sea that are near the fishing grounds, and which had a considerable advantage during the derby. This case study will draw on several recent NOAA studies, including the recently completed ten-year review of the effects of the catch share program.

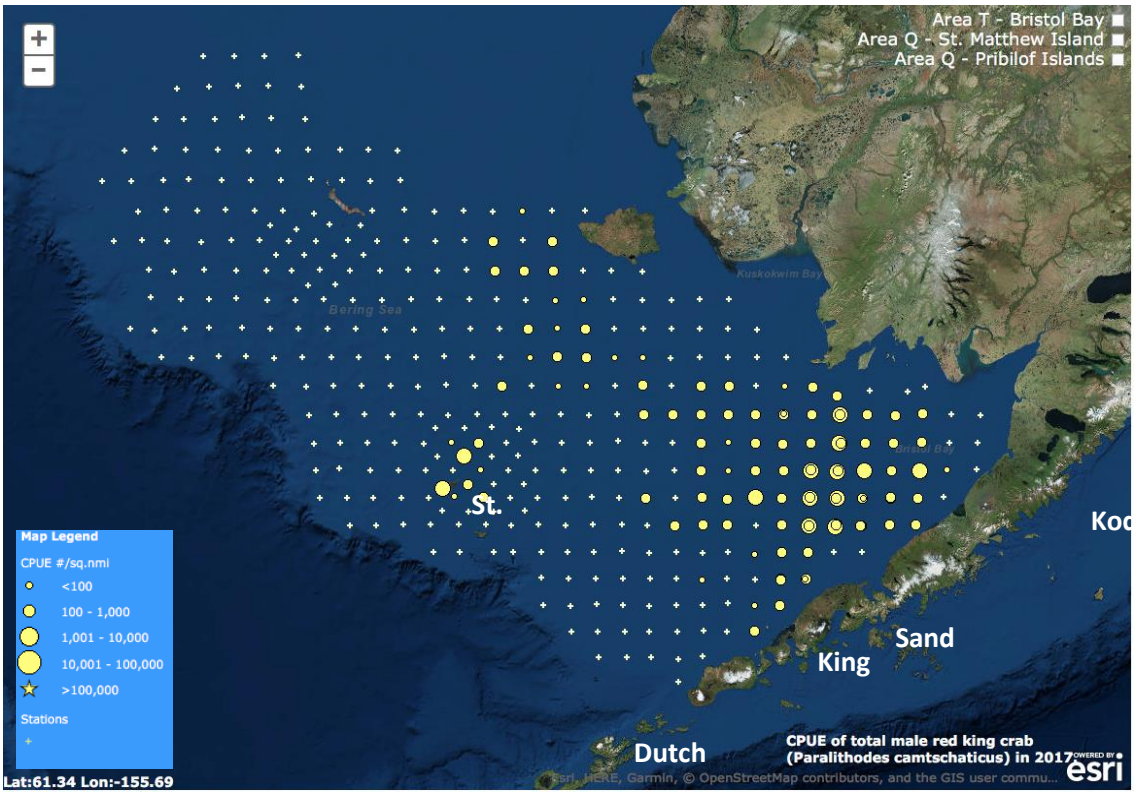
1. INTRODUCTION

1.1 Description of the fishery

The Bering Sea/Aleutian Island crab fishery pursues several valuable stocks in the Bering Sea, west of Alaska and north of the Aleutian Islands. An overwhelming majority of the landings are Bristol Bay red king crab (*Paralithodes camtschaticus)* and snow crab (*Chionoecetes opilio and Chionoecetes bairdi*). There are smaller fisheries, open in some years, on golden king crabs, and two populations of blue king crabs; this analysis focuses on the red king and snow crabs, since they constitute enough of the catch as to determine fleet-level outcomes.

Figure 1 shows the trawl survey abundance of the male red king and *opilio* crabs targeted by the fishery; effort location is considered confidential, but tracks abundance for king crab and is on the southern region of *opilio* abundance, due to polar ice during the fishing season. The king crab season opens 15 October, and harvesters typically then return home for the holidays before beginning the snow crab season, which is most intensive January through April. King crab are harvested at depths of 90 to 300 feet, while snow crab are harvested at depths of 240 to 320 feet.

BSAI crab stocks are considered to be sustainable, with stocks at or near MSY (NPFMC 2017b). In 2017, the Eastern Bering Sea snow crab stock was estimated to be at 0.71 B_{MSY}, and the Bristol Bay red king crab population at 0.85 B_{MSY}. Most other assessed populations were above B_{MSY}, except Pribilof Island blue king crabs, which is designated as "overfished", reflecting low stock levels arising from ecosystem shifts in its range; it has not been fished since the 1980s and is not returning to its previous level.



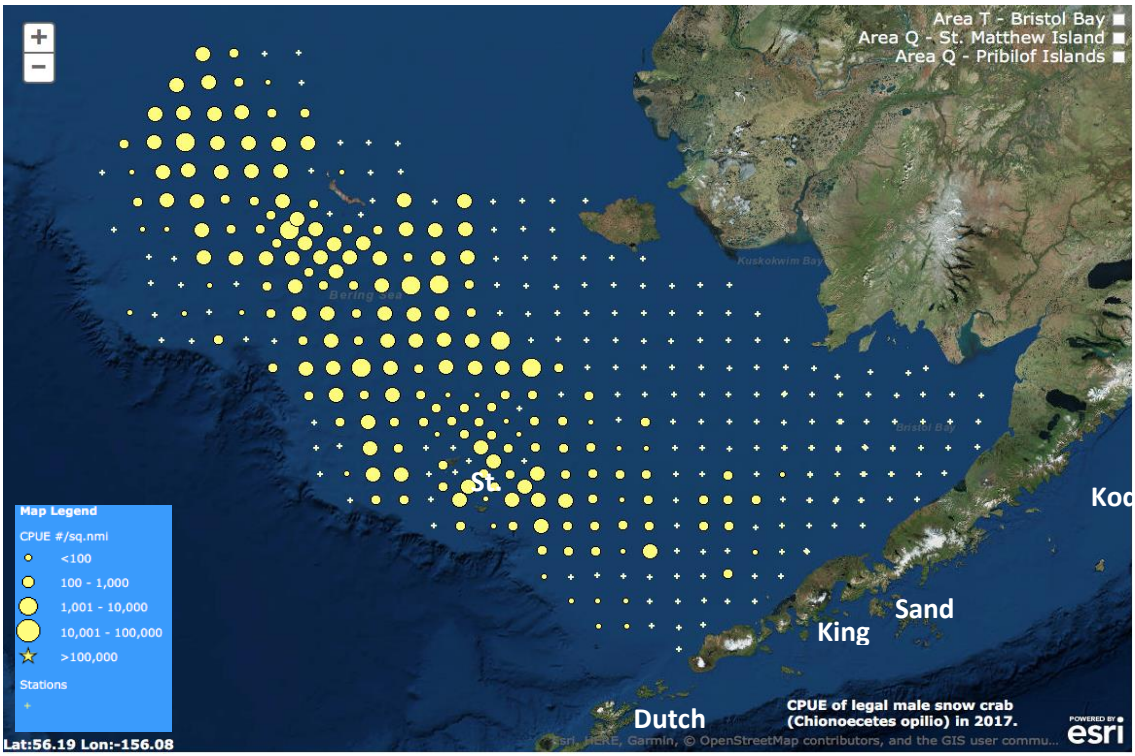


Figure 1. 2017 trawl survey abundance and key processing ports in the BSAI crab fishery.
Source: https://www.afsc.noaa.gov/maps/crabmap/crabmap.html

The fleet averages around 90 active vessels, with roughly 25 percent from Alaska, in equal measure from Kodiak and all other ports (Figure 2). Seventy percent of the vessels are from Washington state, predominantly home ported in Seattle, over 1 700 miles away. Majority foreign ownership is prohibited in this fishery.

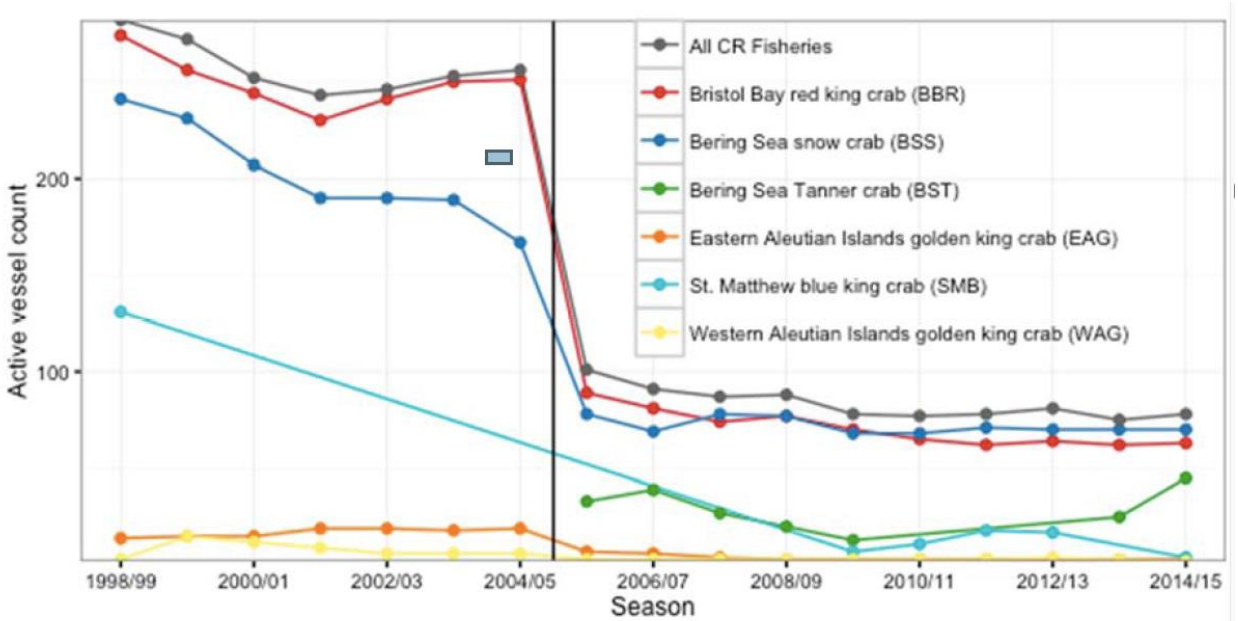


Figure 2. Active vessels each season, before and after the transition to ITQs.
Source: NPFMC 2017a Figure 5-1.

While some vessels have the capacity to process onboard, most of the catch is landed and processed shoreside. Major processing communities include Dutch Harbor/Unalaska, St. Paul, King Cove and Kodiak. These are all small to very small communities whose primary industry is fishing, and in the case of St. Paul and Dutch Harbor, primarily fish processing. Dutch Harbor is the primary port for the industrial groundfish fleets which account for most of the volume of Alaska's fisheries, and St. Paul's primary industry is crab processing (NPFMC 2017a Table 1-a). St. Paul's location in the middle of the Bering Sea, and close to the crab grounds, was an important competitive advantage during the pre-ITQ derby, a factor that will be discussed later.

Figure 3 shows a standard configuration for a BSAI crab vessel. Most vessels in the fishery are between 100 and 150 feet in length, with a median size of 197 gross tons (NPFMC 2017a Table 5-6). Their engines range from 500 to 2 000 horsepower, with a median of 940, reflecting the importance of being able to maneuver in very rough seas as well as a legacy of a race-to-fish, which required fast vessels. Vessels have recirculating seawater tanks in which the caught crab are stored live. The fishery uses steel pots with mesh sides of approximately 7'x7'x3', baited with a combination of cod, small pelagics and squid, deployed as shown in Figure 4. Vessels typically operate with a deck crew of 4, plus a captain who may be the vessel owner or may be hired. Vessels, gear and quota share are typically owned by individual families, although the legal structure of the family business varies (see NPFMC 2017a Table 4-5 for quota ownership information, which roughly mirrors harvest capital ownership).

Figure 3. 125-foot BSAI crab vessel Northwestern.
Source: http://fvnorthwestern.com/northwestern/#jp-carousel-2302

Photo courtesy of Garrett Evridge (pictured, left).

Figure 4. Pulling a crab pot in calm seas.
Source: AFSC 2016.

Fishing trips are typically five to ten days, giving harvesters a chance to set gear, find crab populations, catch and load crab, and deliver to their processor before dead loss mounts; dead loss is a concern when crab have been on board for five to seven days. Vessels have delivery appointments at processors that often dictate when fishing ends and transit to the processor begins.

Given the isolated nature of the resource, and sideboard and gear configuration arrangements that prevent others from catching crab, there are minimal conflicts with other groups. Of course, there are differing ideas about how to evolve the fishery that work through the Council process, but the fishery has not been subject to any disasters during the period of the IFQ program.

1.2 Economic contribution and social implications of the fishing activity

Caught crabs (Figure 4) are immediately sorted onboard to remove females and undersized males, which are returned to sea; current discard mortality estimates are between one third and one half. Legal size males are retained and delivered live to processors; processors do not accept dead crab, though dead loss is counted against a vessel's IFQ. Crabs are quickly cooked, then frozen and portioned. Snow crabs are sold globally as clusters (clusters of five legs from each side of the animal) and king crab are sold as individual legs. The catch is then shipped frozen. Between 2010 and 2014, 57 percent of the snow crab volume was sold within the US, with China representing 24 percent of sales, primarily for reprocessing and export to Japan and other Asian markets (AFSC 2016 p. 115). Forty-four percent of king crab was consumed in the United States, while Japan is the largest export market, accounting for 34 percent of the total (AFSC 2016 p. 126).

The high-value products that come out of the BSAI crab fishery make up the majority of income for nearly everyone who participates in the fishery. The seasons of the individual crab fisheries are spaced out, so most LLP holders participate in multiple crab fisheries to make up a year-round business. Many vessels will tender for salmon processors in Bristol Bay or southeast Alaska during the summer when no significant crab fisheries are open, and some will also use their pots to catch pacific cod. However, BSAI crab nevertheless drives the economic outcomes of their businesses.

For the crew, including hired captains, hired engineers and deck crew, the BSAI crab fisheries provide the opportunity to make a comfortable year's salary in a few months of very hard, dangerous work. The crew are paid on a shared system, where the vessel subtracts certain costs such as food and divides the remainder of the revenue among the boat, captain, and individual crew members.

For processors, crab fisheries range from a critical component of a multi-fishery processing strategy to the lifeblood of the community. Kodiak, for example, was home port for much of the Alaska-based fleet prior to the ITQ program. Processors there, who focused mainly on summer fisheries like groundfish and salmon, would buy the fleet's last load as they came home at the closure of the season. Kodiak was home to a number of smaller or less well-maintained boats, and its fleet consolidated disproportionately. However, processors have remained in business to handle groundfish and salmon during the summer. In contrast, St. Paul Island developed a significant specialist crab processing plant during the derby, and it is the island's major employer. Although it is very expensive to operate in the middle of the Bering Sea, their proximity to the resource gave them an advantage in a derby, where full vessels could offload without taking the additional time to steam to Dutch Harbor; by saving steam time, vessels could get back to competing for a larger share of the TAC sooner. However, with quotas, vessels do not need to compete with one another for a share of the catch, so the steam time does not lead to foregone catch. Due to higher operating costs, the plant in St. Paul could not compete with other plants on the price for crab or other products, and thus faced the threat of going out of business under a standard ITQ system.

To address concerns by St. Paul and communities with other small processing plants close to the fishing grounds, the Council developed the concept of IPQ, which was assigned to processors based on their history, and transactions were geographically restricted. The BSAI fishery region, and subregions within it that dictate the movement of IPQ are legally defined, and operations within them are licensed and taxed as commercial businesses. Additionally, there is a tax on fish landings in the state of Alaska, and in some communities. Some cooperatives voluntarily tax their own landings in order to fund operating expenses.

2. MANAGEMENT OF THE FISHERY AND RIGHTS-BASED APPROACH

The management of harvest quota share provides for allocations to two separate groups: the fishing fleet and Community Development Quota (CDQ) groups (https://alaskafisheries.noaa.gov/fisheries/ cdq). CDQ groups are seven regional corporations representing coastal communities in western Alaska, most of which have predominantly indigenous residents. They receive quota allocations in several fisheries, some of which, like halibut, coastal communities have significant participation histories, and others of which, like crab, pollock and groundfish, the communities have not had the harvesting capital or technology to participate historically.

2.1 Management of the fishery

BSAI crab populations are managed jointly by the Alaska Department of Fish and Game (ADF&G), and the North Pacific Fishery Management Council (NPFMC). They are regarded as very well managed, with the most important stocks being the Bristol Bay red king crab and the Eastern Bering Sea *opilio* and *bairdi*, both marketed as "snow crab". The NPFMC establishes TACs, size and sex restrictions and other conservation measures as part of the Fishery Management Plan Framework, while ADF&G establishes reporting requirements, state bycatch limits, and aspects of gear (see NPFMC 2011).

Federal regulatory authority is provided by the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The MSA establishes eight regional councils around the United States; the NPFMC regulates fisheries in the portions of the Bering Sea and Gulf of Alaska within the US EEZ. The NPFMC process is considered co-management, as the Council is a politically appointed body of representatives primarily of the North Pacific fishing industry, often leaders within individual fishing industry groups. It is further advised by two appointed bodies, an industry Advisory Panel (AP) which consists of representatives of major industry groups, and a Scientific and Statistical Committee (SSC) comprised of academic and agency scientists. Meetings of these groups follow US public meeting and rulemaking regulations, with extensive notice and opportunities to provide public comment before and during each public meeting. Measures are proposed by the process, given an analysis by Council or National Marine Fishery Service staff, provided for public review and testimony, peer review by at least the AP and SSC, before being presented for approval by the Council. Opportunities for public input, and especially input by industry organizations, are many.

Each year, the NPFMC uses this process to establish a total allowable catch (TAC) for each population. In US law, a TAC is a hard cap on fishing landings, and which, when met, shuts down fishing with gear capable of catching the species. For the reasonably well targeted crab fisheries, this means the fishery stops when the TAC is met.

The TAC for the key populations are based on annual stock assessments, which are developed by a lead assessor and refined through critique by an NMFS Plan Team of stock assessment scientists (NPFMC 2017b). This means that not only are new data introduced every year, but the form and structure of the stock model is refined and evolved. The recommended stock assessment model is then presented to the SSC, which uses the results of the recommended and alternative models to select an Allowable Biological Catch (ABC). The models on which crab ABCs are set have improved dramatically in the last decade, and

now include estimates of reference points and quantified uncertainty, which qualifies as Tier 3 within the Council's five-tier system of classifying stock assessments. Based on the assessment, a harvest control rule is applied, and uncertainty-scaled buffers added, to establish a fishing mortality that will not exceed maximum sustainable yield and an ABC. The Council then sets a TAC, which may not exceed the ABC under US law.

While the effective mortality and effort controls are through the TAC and quantity of quota issued, there are a number of supplemental regulations. Vessels must hold a limited entry license permit (LLP) to be eligible to fish. Gear is restricted by pot size, and escapement vents must be placed within the pot netting, with size varying by the fishery. The fishery only retains legal size (varies by species) mature males, so undersize males and all females are returned to the ocean. The fishing season is selected to minimize discard mortality, with no fishing allowed during the molt or soft shell stages. Within these restrictions, however, harvesters can fish as much gear as they can transport and take as much crab as they can catch. There are no regulations on vessel size or power. The need to have several-hour offloads at a processor around which a cooperative is organized institutes a *de facto* port schedule.

Depending on the nature of conflicts that arise, different resolution mechanisms are available. For conflicts about fishery policy, the Council process effectively allows parties to bring their positions into a public process that evaluates potential changes. Torts among participants are resolved in US courts, though smaller scale disputes may be resolved interpersonally, or through the cooperatives. Overall, clearly defined property rights ensure there are relatively few unresolved conflicts.

Activity in the fishery is monitored through a range of mechanisms. The US Coast Guard is responsible for certifying vessels as safe to operate, and they also ensure compliance with safety regulations at sea, with boardings from vessels and monitoring from helicopters. Vessels are required to use VMS and keep logbooks of when and where they fish and how much they catch, though at-sea verification is for form rather than correct counts. The fishery has onboard observers, dockside observers, and fishery independent trawl surveys. Landings are entered by processors in the eLandings system to ensure accurate catch accounting. Violations of these regulations can bring about heavy fines, criminal charges, and social sanctions.

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

The BSAI king crab fisheries were first developed in the 1950s, primarily by foreign interests. Following the establishment of EEZs, US interests took over the open-access king crab fisheries and developed the snow crab fisheries, with catches in the former peaking around 1980 and the latter in the early 1990s. A moratorium on new entrants was enacted in 1995, with limited entry licenses (LLPs) issued to vessels that developed the various crab fisheries in 2000. Importantly, these vessels were primarily based in Seattle, Washington, more than 1 700 miles away. Coastal Alaska communities lacked the capital and did not historically participate in this offshore fishery in notoriously rough waters; they rather developed participation history in the processing sector. Under the limited entry system, mortality was managed as an Olympic derby: at an appointed time, fishing would open for a population. Vessels would race to the fishing ground in an attempt to catch as much crab as possible before the fishery closed. ADF&G would track catches each day until it gauged that the guideline harvest level (GHL) was being approached, and then announce the fishery closure.

This derby had several effects on fishing strategies. First, the fishery was badly overcapitalized: vessels were used that could carry many pots in one trip, and store large amounts of crab, so available fishing time was not wasted moving gear or product back and forth to port. This led to excessive costs and low levels of profitability that caused some vessels to be under-maintained. Third, even with larger capital, it

was common for vessels for overload themselves with crab or gear, which compromised safety because overloaded vessels were more likely to capsize, especially during the winter *opilio* season when ice storms could coat loaded gear in thick sheets of ice. Fourth, because vessels lost the opportunity to fish if they delayed their fishing because of poor weather, vessels fished in very bad weather and very dangerous sea conditions.

These fishing behaviors had three key adverse consequences, which were the focus of the Council's purpose and need statement for the ITQ program. First, racing to fish, overloaded and in bad weather, meant fishing was extremely dangerous, and this relatively small fishery lost an average of more than one life per year (NPFMC 2017a Appendix C, Fig. 7), making it one of the most dangerous jobs in the United States, and inspiring the title of a popular reality TV show, *Deadliest Catch*. Thus, the primary reason many supported the movement to ITQs was to eliminate the derby and improve safety in the fishery. Second, because harvesters were loading boats heavily, there was measurable dead loss in the fishery. Thus, the Council wished to improve yield and catch the accuracy of catch accounting. Finally, the stock of excessive, poorly maintained capital meant the Council wished to restore profitability by reducing excess harvesting capital. Thus, the elimination of many vessels from the fleet was a stated objective of the ITQ program.

The derby induced by the limited entry management also dictated the structure of the processing industry. In-season surges of crab landings meant enormous processing capacity was needed. Further, since landing meant time away from the fishing derby for the vessels, processing capacity close to the fishing grounds was valuable. Thus, large processing plants with highly seasonable employment were built in a number of isolated communities in the Bering Sea. Most notable among these is the plant on St. Paul Island, in the Pribilofs. The plants often provide the most significant source of employment in some communities, and in the case of St. Paul Island, they do not process for other fisheries.

2.3 Rights-based approach: allocation and characteristics

The user rights system in the BSAI crab fishery has two main components, a transferable individual fishing quota (IFQ) system for harvesters and a unique parallel set of individual processing quota (IPQ) to process caught crab. Both quotas are defined as a permanent right to a percentage (or share) of the annual TAC. This share is referred to as a quota share (QS), which each year beget an entitlement to a number of pounds based on the current year's TAC. These annual rights are termed quota pounds (QP), and selling them corresponds to a single year lease of quota. These are mediated by an extensively used cooperative system, in which harvesters may join cooperatives centered around processors to facilitate trading of quota to ensure small quota pound residuals on each vessel are efficiently caught at the end of the season.

Under the current system, once a TAC is established, 90 percent is allocated to holders of harvest quota shares, and ten percent to the Community Development Quota (CDQ) or Adak Community Allocation (or Western Aleutian golden king crab). Of the harvest QS, roughly 97 percent was allocated to LLP license holders based on their vessels' historic participation in the fishery, and the remaining three percent to hired captains (referred to as "C shares" or "crew QS") based on their individual participation. Of the harvest QS, approximately 90 percent must be landed at a processor holding IPQ, which is the right to process a share of the TAC allocated to individual processors at the outset of the program. For LLP holders who do not process themselves, or without an ownership link to a processor (an overwhelming majority of the fleet), the allocation is divided into 90 percent A shares and ten percent B shares. The motivation behind the B shares is to allow flexibility for the harvester (e.g., for small trips at the end of the season, or for offloading in the event of mechanical difficulty), to ensure harvesters have some leverage in price negotiations by threatening to take their B shares to other processors (NPFMC 2017a p. 10), and potentially to allow for entry of new processors (NPFMC 2017a p. 13).

The effect of this A/B split on markets has not been determined. Despite a vigorous ex ante argument about the appropriate division to prevent processors monopsony (e.g., Matulich et al. 1996; see also Wilen's (2010) response to extending these lessons to another fishery) there has not been an analysis of whether this ensures competitive pricing, as the market that would set prices for ex-vessel crab has completely collapsed. Mathematically, taking the market for wholesale crab as given, it is possible to solve for prices in the markets for landed crab and therefore the value of harvest quota. However, introducing processing quota means that there is no unique solution for the price of IFQ and IPQ, only the sum of the two (Matulich and Sever 1999). Market participants have been unable to resolve this competitively, and a binding arbitrator has set ex-vessel crab prices to preserve the historic division of rents between harvesters and processors every year of the IFQ program (NPFMC 2017a p. 20).

Quota pounds to cover a catch may be acquired after landing. Leasing is allowed only for members of a cooperative, a provision which was delayed for five years to allow the formation of relationships necessary to support networks for leasing (NPFMC 2017a p.10). Therefore, the owner of the quota does not need to be on board a vessel while it is being fished.

To prevent pure speculation in quota, quota holders must be a US citizen and have at least 150 days of sea time as a harvester in some US fishery. Corporations or partnerships that are at least 75 percent US-owned, and at least 20 percent owned by a US citizen meeting the 150 day criteria, may also own quota (NPFMC 2017a p. 11). To prevent excessive concentration, there are vessel use caps that limit the owned plus lease quota harvest of vessels, typically one percent in the largest fisheries.
(see https://alaskafisheries.noaa.gov/sites/default/files/reports/1415ifqquotacaps.pdf)).

Complementary to the harvest quota system, the "rationalization" program established a parallel quota instrument held by those wishing to process crab landed with A IFQ shares. PQS shares were allocated to incumbent processors in proportion to their processing activity during pre-rationalization qualifying years. To restrict vertical integration, no PQS holder may hold over 5 percent of the QS of any fishery. No processor can hold more than 30 percent of the PQS in any fishery, except the northern region snow crab fishery, where the cap is 60 percent. Importantly, custom processing arrangements where crab is processed to its (harvesting owner's) specification without taking ownership of the crab, are exempt from these processing caps.

Community protection, for communities involved primarily through processing, is provided through "regionalization" of processor shares, which by implication require A shares to be landed in specific communities. While the transfer of PQS and IPQ is allowed, it is not generally allowed across regions. Further, communities retain a "right of first refusal", which allow key community groups to match offers to sell IPQ out of the community (NPFMC 2014).

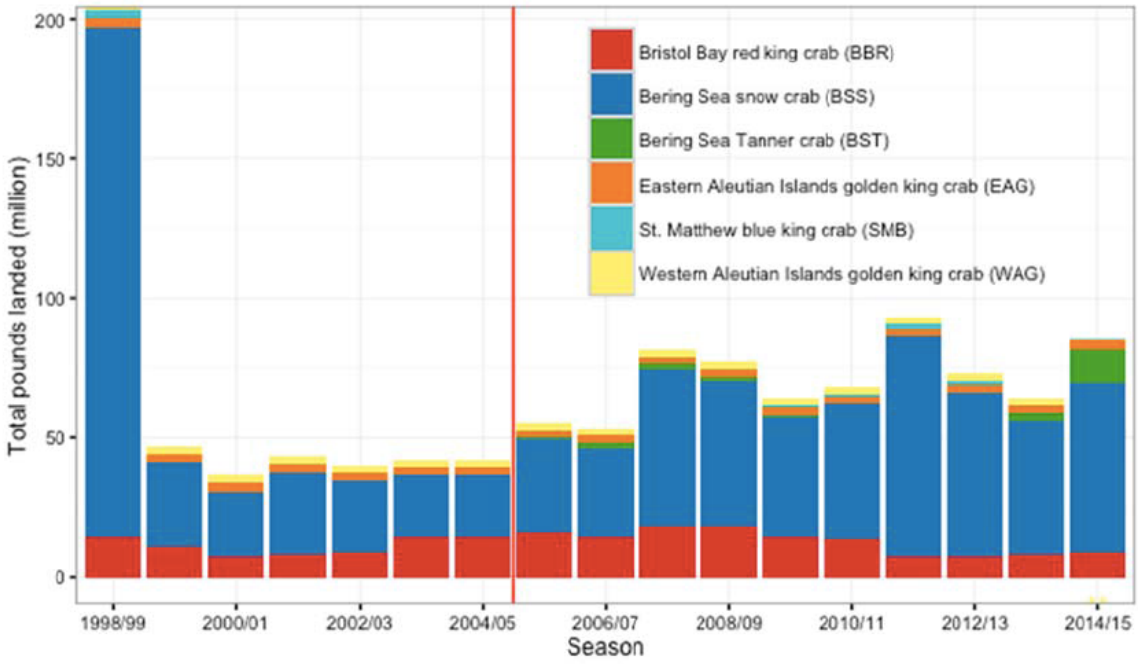
3. CONTRIBUTION OF THE RIGHTS-BASED APPROACH TO ACHIEVING SUSTAINABILITY

As the rationalization program simultaneously implemented harvest ITQs and IPQs, effects of both were observed. The ten-year review (NPFMC, 2017a) presents a comprehensive review of these effects, but this report emphasizes the unique effects of the IPQ, and hence presents only the major effects of the ITQ program.

3.1 Sustainable use of the resources

The BSAI crab fisheries were well managed prior to the IFQ program, so the rights program itself has not changed the structure or health of the stock or the characteristics of the retained catch. However, there is some evidence that the quality of data, and therefore, the models which can be built based upon them, have improved. The ten-year review of the IFQ program identified several improvements in sustainable

resource use, although the resources were used relatively well prior to the program on a global scale. In a derby fishery, hitting a GHL can be difficult, and though overages were generally small, the GHL was exceeded in two of the five years immediately prior to the IFQ program in the BBR fishery, and in four of the five years in the BSS. Neither fishery has ever exceeded the TAC since IFQs. This improvement is supported by increases in the quality of catch accounting, including required onboard logbooks and reports by processors into the eLandings catch accounting database. In the IFQ period, the quality of the crab stock assessments has increased, so the major stocks have credible estimates of their reference points. However, it is difficult to ascribe this change exclusively to the IFQ program, as many fisheries in the North Pacific have undergone similar improvements in stock assessment methodology.



Source: NMFS AKRO RAM Division IFQ accounting database

Figure 5. Annual catch in the BSAI crab fisheries.
Source: NPFMC 2017a Figure 5-2.

In addition to supporting improvements in data collection, since the ITQ program, the industry has also worked through the Bering Sea Fisheries Research Foundation, which uses industry contributions to fund research supporting the fishery. This has included survey net selectivity experiments, growth studies, and discard mortality research. An additional group, the Aleutian King Crab Research Foundation was formed to conduct similar studies for the smaller Aleutian king crab stocks.

3.2 Economic viability of the fishery

The most dramatic effect of the ITQ program was an immediate decrease in the number of vessels participating: the fleet dropped by about two-thirds, from 250 to 80-90 (Figure 6). The vessels that exited the fishery were from Alaska and Washington, and other geographies in about equal proportion. Other than the smallest vessels, less than 80 feet, vessels of all sizes exited in equal proportion.

Figure ES-5 Number of unique BSAI crab vessels with earned ex vessel revenue, by state, 1998 through 2015

Note: Figure based on data from Table 1-13b.
Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT

Figure 6. Time series of number of participating vessels, by vessel owner's home state.
Source: NPFMC 2017a Figure ES-5.

The technology, length and distance covered on fishing trips were largely unchanged. In order to catch the same amount of crab with fewer vessels, the season lengthened. With fewer boats on which to work, the structure of the labour market for crew changed. The job changed to be a longer-term appointment, and much safer: the fishery shifted from an average of one death per year to having no deaths in the first ten years of the IFQ program (though one vessel was lost in 2017). While the number of positions dropped by slightly more than half, pay to each crew member increased by roughly 2.5 (Table 1).

Table 1. Crew employment and earnings.

Table 5-21 Crew employment and earnings, aggregated over all CR Program fisheries - 1998, 2001, and 2004 through 2014 calendar year fisheries

Fishery	Year	Number of vessels	Total crew positions	Mean crew size	Mean vessel harvest (pounds)	Mean days at sea	Captain pay ($)		Mean crew pay (excluding captain)	Crewmember pay ($)	
							Mean	Median		Mean	Median
All CR Fisheries	1998	212	1266	6.0	1,017,733	96	117,276	115,785	249,780	40,249	39,744
	2001	211	1251	5.9	199,825	52	61,540	40,973	123,271	19,936	14,625
	2004	235	1395	5.9	192,605	32	73,609	66,613	154,847	25,541	22,138
	2005	169	1007	6.0	320,039	37	78,770	55,911	152,893	25,903	20,264
	2006	101	640	6.3	628,448	68	86,828	75,006	174,865	28,204	26,858
	2007	86	572	6.7	758,928	68	134,958	129,146	283,763	45,274	42,429
	2008	94	632	6.7	1,069,194	90	175,376	175,115	383,915	59,896	56,582
	2009	88	588	6.7	947,489	82	130,190	128,226	284,227	44,260	42,796
	2010	77	493	6.4	999,199	96	162,080	154,244	349,985	55,129	50,619
	2011	76	500	6.6	1,040,932	86	218,737	218,875	485,532	74,306	70,103
	2012	83	564	6.8	1,467,050	93	227,378	223,413	494,148	73,933	71,940
	2013	81	542	6.7	1,248,407	78	196,037	199,614	428,422	65,232	62,077
	2014	76	513	6.8	1,259,443	93	202,485	184,286	443,124	66,892	63,681

Source: NMFS AFSC BSAI Crab Economic Data Report (EDR) database, 2005 and later crew positions information from eLandings
Notes: Excludes vessels that did not report any payment to the captain for labor, and vessels for which the gross percentage share paid to crew was greater than 75 percent, based on EDR data. Data for 1998-2004 excludes vessels without qualifying history for CR Program initial allocation. In results aggregated over all CR fisheries, data for the year 2005 includes the 2005 Bering Seas snow crab fishery, which occurred prior to CR Program implementation. Gross share percentage for catcher/processor crew payment uses estimated ex-vessel value of catch based on average price of CV sector landings.

Source: NPFMC 2017a Table 5-21.

The slowing of the race to fish has lengthened the processing season. This has reduced the maximum staffing level and quantity of overtime pay. However, it has also lengthened the term of employment and provided for steadier work.

In combination, the ITQ program has achieved its goals of reducing overcapitalization and increasing safety by eliminating competition for catch through quota allocations. This has reduced the number of vessels, and numbers of crew jobs, but increased professionalization of the crew as the seasons are now longer and employment more stable; pay to the crew in aggregate has not changed. However, the community of Kodiak, home to a disproportionate number of exiting vessels with locally based crew, has experienced adverse effects from the transition to an ITQ system.

3.3 Social equality

While the concentration of quota at the vessel level has not been a concern, and no reallocation is being considered, the primary issue with the IFQ program has been that of intergenerational turnover, and the related issue of quota leasing. Many crew members feel that there is an inadequate opportunity for them to buy into the fishery as owners, and build a holding of quota necessary to develop their own vessels. There are two components to this argument. First, the quota share that is sold is often transacted through tight small interpersonal networks, which makes it difficult for someone not heavily connected with those networks to know that quotas are for sale. For example, quotas will often be transacted within families, or with long-term crew members on the same boat, or fishing partners on different boats. Second, the price of quotas is perceived to be high, making it difficult for many crews to buy blocks of quotas that become available.

Absent an owner-on-board provision, many entities that received initial allocations do not choose to sell their quota share after they retired or stopped fishing. Rather, they choose to lease the quota—selling quota pounds—to active vessels. Since the marginal cost of catching additional crab is low once on the grounds and an abundant area has been identified, the lease rates for quota are very high. Figure 7 shows they are approaching 65 percent of ex-vessel value for red king crab and 50 percent for snow crab.

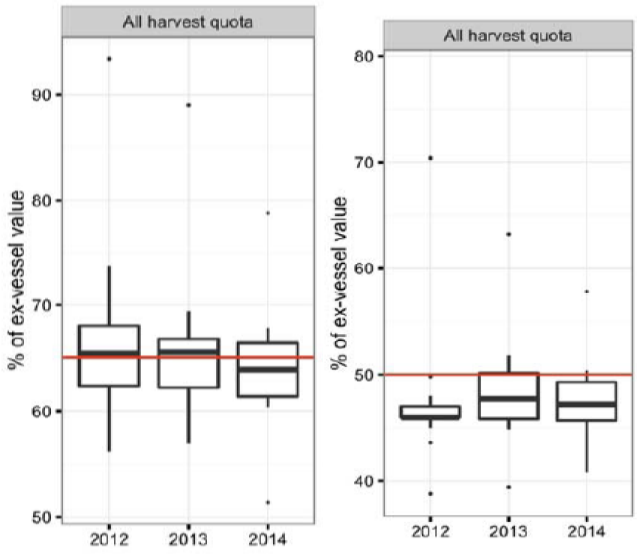


Figure 7. Share of ex-vessel value paid as lease rate for quota share in the red king crab (left) and snow crab (right) fisheries.

Source: NPFMC 2017a Figures 5-5 and 5-7.

Figure 8 shows the effect of these lease rates on perceptions of accessibility of additional quota for different parties, especially crew. Because current quota holders can lease their quota at high rates, they would only be willing to sell for the present discounted value of these high annual values: quota prices are high. Thus, most parties feel that these prices are a deterrent to purchasing quota shares and initiating or expanding their ownership investment in the fishery.

- Frequency count of coded responses related to participants' perceptions of the barriers to purchasing quota shares

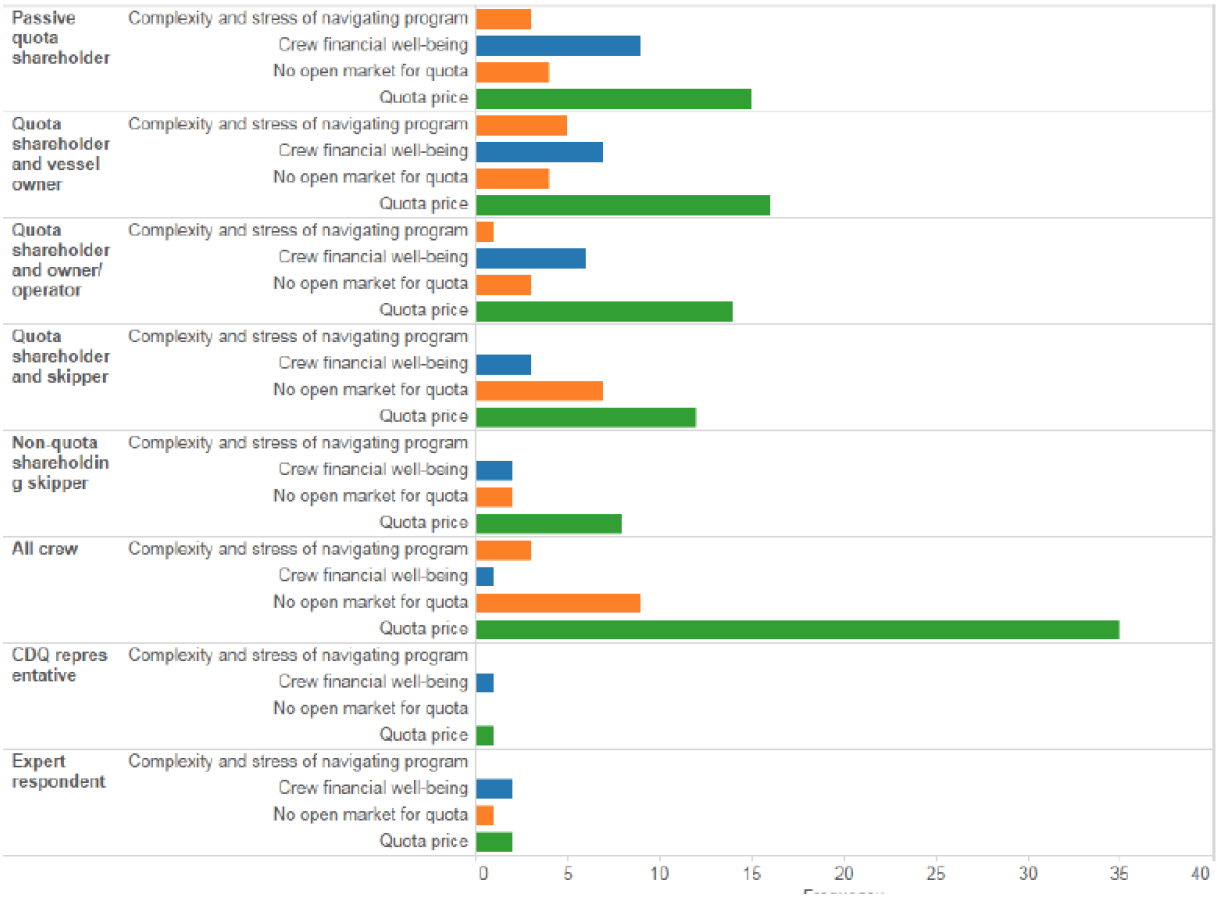


Figure 8. Participants' perceptions of the barriers to purchasing quota shares.
Source: Himes-Cornell (2015) Figure 6.

4. MAIN CHALLENGES AND WAY FORWARD

4.1 Challenges for the fishery

The IFQ rationalization program has largely achieved its goals of reducing excess capacity, improving safety, and continuing engagement of historically active processing communities. While vessels under 80 feet all left the fishery, all vessels in this fishery would have been considered large scale.

4.2 Improving fishery sustainability in the future

Biological threats to this fishery are not from overfishing, but rather from ocean acidification and broader ecological shifts in subpolar seas driven by climate change. The current catch, processing and distribution system is effective at efficiently capturing the TAC and delivering it to high-value markets in its highest value product form. From this perspective, the economic viability of the fishery is strong, and it is likely to remain successful as long as biological productivity is feasible.

The primary challenges going forward will be distributional, chiefly between those who currently hold quota and those who wish to make a career out of the fishery in the future. However, it is difficult to identify an appropriate level of accessibility to quota for the crew. The quota is an asset that is valued like other assets, as the present discounted value of the stream of annual profits it provides. Data is not available on how long current owners served as crew in the fishery, or what proportion of historical crew has the financing and skill to advance into capital ownership. Those referencing the cost of entry during the open-access development phase of the fishery, when entry cost only included the value of a boat, should associate that with an unprofitable fishery: one where paying for maintenance was difficult, and safety was compromised. Crab quota shares are now valuable because the fishery is profitable, and people are willing to pay a lot for them. Thus, making the fishery more accessible by reducing the price of quota is tantamount to making it less profitable.

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