

EXECUTIVE SUMMARY

In 2001, Congress directed the Council to conduct an analysis of several different approaches to rationalizing the BSAI crab fisheries (see Consolidated Appropriations Act of 2001 (Pub. L. No. 106-554)). In response, the Council adopted the following purpose and need statement to guide it through the process of considering rationalization alternatives for the fisheries:

Vessel owners, processors and coastal communities have all made investments in the crab fisheries, and capacity in these fisheries far exceeds available resources. The BSAI crab stocks have also been highly variable and have suffered significant declines. Although three of these stocks are presently under rebuilding plans, the continuing race for fish frustrates conservation efforts. Additionally, the ability of crab harvesters and processors to diversify into other fisheries is severely limited and the economic viability of the crab industry is in jeopardy. Harvesting and processing capacity has expanded to accommodate highly abbreviated seasons, and presently, significant portions of that capacity operate in an economically inefficient manner or are idle between seasons. Many of the concerns identified by the NPFMC at the beginning of the comprehensive rationalization process in 1992 still exist for the BSAI crab fisheries. Problems facing the fishery include:

- 1. Resource conservation, utilization and management problems;*
- 2. Bycatch and its' associated mortalities, and potential landing deadloss;*
- 3. Excess harvesting and processing capacity, as well as low economic returns;*
- 4. Lack of economic stability for harvesters, processors and coastal communities; and*
- 5. High levels of occupational loss of life and injury.*

The problem facing the Council, in the continuing process of comprehensive rationalization, is to develop a management program which slows the race for fish, reduces bycatch and its associated mortalities, provides for conservation to increase the efficacy of crab rebuilding strategies, addresses the social and economic concerns of communities, maintains healthy harvesting and processing sectors and promotes efficiency and safety in the harvesting sector. Any such system should seek to achieve equity between the harvesting and processing sectors, including healthy, stable and competitive markets.

In June of 2004, after deliberating at several meetings, the Council took final action adopting its preferred alternative for rationalizing the fisheries. As a part of that action, the Council requested this comprehensive review of the first five years of the program. The analysis examines five years of fishing under the program. The change to any share-based management system requires participants to modify their behavior. Some changes evolve over time, as participants adapt to the program. While some aspects of this transition (such as fleet consolidation) occurred immediately on implementation of the program, others, such as the joint fishing of allocations in cooperatives, have occurred more gradually. In considering the assessment of the program in this document, it should be noted that the fishery continues to evolve as participants learn to operate under the program and adapt to the changes it has brought on.

Description of the management

Prior to the rationalization program, the major Bering Sea and Aleutian Islands crab fisheries were managed under the License Limitation Program, a limited entry program under which licenses were allocated to harvesters based on historic participation. A guideline harvest level (GHL) for each fishery set target catch for the fishery. Managers monitored harvests by in-season reports and attempted to time the closure of a fishery with completion of the harvest of the GHL. Harvests exceeded the GHLs in some years, however, because in-season monitoring could not keep pace with harvests during the short seasons.

Over time, managers improved in their abilities to monitor catch in season, limiting the extent of these GHL overages. Since the seasons in most of the BSAI crab fisheries do not conflict, most participants were active in several of the fisheries, moving from one fishery to another. However, stock declines in the Bristol Bay red king crab and the Bering Sea *C. opilio* led to seasons lasting only a few days or weeks. Consequently, equipment was often idle for several months of the year.

The rationalization program allocates catch shares in the large crab fisheries in the Bering Sea and Aleutian Islands, specifically the following:

- Bristol Bay red king crab
- Bering Sea *C. opilio* (snow crab)
- Eastern Bering Sea *C. bairdi* (Tanner crab) – East of 166° W
- Western Bering Sea *C. bairdi* (Tanner crab) – West of 166° W
- Pribilof blue and red king crab
- St. Matthew Island blue king crab
- Western Aleutian Islands (Adak) golden king crab – West of 174° W
- Eastern Aleutian Islands (Dutch Harbor) golden king crab – East of 174° W
- Western Aleutian Islands (Adak) red king crab – West of 174° W

To address the concerns of various stakeholders in these fisheries, the Council developed a “voluntary three pie cooperative” program intended to protect the interests of the harvest sector, the processing sector and defined regions and communities. Each program fishery is managed with a total allowable catch (TAC), which sets a specific catch limit, instead of a GHL. Although the change to a TAC may be largely semantic, it signifies a change to more precise catch management.

Harvesting quota shares (QS), revocable privileges to harvest a specific percentage of the annual TAC, were allocated in each program fishery. Approximately 97 percent of the QS (referred to as “owner QS”) in each program fishery were initially allocated to license holders based on their catch histories, while the remaining 3 percent of the QS (referred to as “C shares” or “crew QS”) were initially allocated to captains based on their catch histories in the fishery. The annual allocations, which are expressed in pounds, are referred to as individual fishing quota (IFQ). QS are designated as either catcher vessel QS or catcher processor QS, depending on whether the vessel giving rise to the privilege processed the qualifying harvests on board. C share QS may be acquired by persons with recent participation on a vessel in the fishery and, under a recent amendment, will require that their holders demonstrate continued active participation in a program fishery (or for recipients of an initial allocation, continued active participation in State or Federal fisheries in or off Alaska).

Catcher vessel owner IFQ are issued in two classes, Class A IFQ and Class B IFQ. Class A IFQ are issued for 90 percent of the catcher vessel owner IFQ in a program fishery. Crab harvested using these IFQ must be delivered to a processor holding unused individual processing quota (IPQ). In addition, Class A IFQ are subject to regional share designations, whereby harvests are required to be delivered within an identified region. In most program fisheries, regionalized shares are either North or South, with North shares designated for delivery in areas on the Bering Sea north of 56° 20' north latitude and South shares designated for any other areas, including Kodiak and other areas on the Gulf of Alaska. In the Western Aleutian Islands (Adak) golden king crab fishery, the designation is based on an east/west line to accommodate a different distribution of activity in that fishery. Share designations are based on the historic location of the landings and processing that gave rise to the shares. The delivery restrictions of Class A IFQ are intended to add stability to the processing sector by protecting processor investment in program fisheries and to preserve the historic distribution of landings and processing between regions. To provide harvesters with additional market leverage for negotiating prices for landings of crab, Class B IFQ are issued for the remaining 10 percent of the catcher vessel owner QS in a program fishery and may be delivered to any processor (except a catcher processor) in any location.

QS and IFQ are transferrable under the program, subject to limits on the amount of shares a person may own or use. IFQ transfers after a delivery to cover overages are allowed. The program also allows harvesters to form harvest cooperatives. Cooperatives receive the annual IFQ allocated to their members. Formation of cooperatives is intended to facilitate production efficiency by aiding harvesters in coordinating share transfers and harvest activities and deliveries to processors, as catch is monitored at the cooperative level. Harvesters within a cooperative may transfer IFQ freely without notice to managers since those IFQ are directly allocated to the cooperative and are counted against the cooperative's allocation. IFQ transfers between cooperatives are administered through NOAA Fisheries. After the fifth year of the program, leasing of QS (or equivalently, the sale of owner IFQ - defined as the use of IFQ on a vessel in which the owner of the underlying QS holds less than a 10 percent ownership interest and on which the underlying QS holder is not present) is allowed only among harvest cooperatives.

To ensure that future share holders in the fishery have fishing background, to acquire shares in the fishery an individual is required to be a US citizen and to have at least 150 days of sea time in US commercial fisheries in a harvest capacity. An partnership or corporation is eligible to purchase shares only if it is at least 20 percent owned by a US citizen with at least 150 days of sea time in US commercial fisheries in a harvest capacity and is at least 75 percent U.S. owned, allowing it to document a vessel. Initial recipients of QS and CDQ groups are exempt from these eligibility criteria.

“Individual use caps” are imposed on the use and holdings of harvest shares in order to prevent excessive consolidation of shares under the program. Different caps apply to owner share holdings and C share holdings. In addition, the six groups participating in the Community Development Quota program – a program intended to benefit Bering Sea coastal communities - are subject to higher share caps. “Vessel use caps” limit the amount of owner IFQ that may be harvested by a single vessel. Vessel use caps do not apply to cooperatives, thereby providing an additional incentive for cooperative participation (see Table ES 1)

Table ES 1 Harvest share use caps as percent of the respective quota share pool.

Fishery	Owner share		C share use cap**	Vessel use cap*
	Individual use cap*	CDQ group use cap*		
Bristol Bay red king crab	1	5	2	2
Bering Sea <i>C. opilio</i>	1	5	2	2
Eastern Bering Sea <i>C. bairdi</i>	1	5	2	2
Western Bering Sea <i>C. bairdi</i>	1	5	2	2
Pribilof red and blue king crab	2	10	4	4
St. Matthew Island blue king crab	2	10	4	4
Eastern Aleutian Islands golden king crab	10	20	20	20
Western Aleutian Islands golden king crab	10	20	20	20
Western Aleutian Islands red king crab	10	20	20	20

* as a percentage of the owner share pool.

** as a percentage of the C share pool.

To protect processor investments in the fisheries, the program also created processing quota shares (PQS), which are allocated to processors based on processing histories. PQS are a revocable privilege to receive annual allocations of individual processing quota (IPQ), which authorize the acceptance of deliveries of a portion of the annual TAC from a program fishery. IPQ is issued for 90 percent of the catcher vessel owner IFQ pool, corresponding to the 90 percent allocation of owner IFQ issued as Class A IFQ. As with

owner QS and Class A IFQ, PQS and IPQ are designated for processing in a region. To protect independent vessel owners and processors that are not vertically integrated, processor harvest share holdings are also limited by a cap on vertical integration. To promote efficiency, processing shares are transferable, including leasing of PQS (or equivalently, the sale of IPQ) subject to a use cap that prohibits any person from holding or using in excess of 30 percent of the processing shares in a fishery. An exception allows consolidation of processing (but not share holdings) beyond the caps in fisheries and regions that pose particular economic challenges to processors. To provide a period of general stability for processors and communities to adjust to the program a two-year “cooling off period” was established during which processing shares could not be relocated from the community where the historical processing occurred that led to the allocation (the community of origin). In addition, a right of first refusal was granted to community groups and CDQ groups from communities with significant crab processing history on the sale of any processing shares for use outside of the community of origin. Exceptions to the right allow a company to consolidate operations among several commonly owned plants to achieve intra-company efficiencies and the temporary lease of shares outside of the community of origin.

Catcher processors participate in both the harvest and processing sectors and therefore have a unique position in the program. Catcher processors are allocated catcher processor QS and issued corresponding catcher processor IFQ. These shares carry both a harvest privilege and an accompanying onboard processing privilege. A person holding catcher processor shares may either harvest and process crab onboard under the allocation or choose not to process harvested crab, instead delivering their catch to any other processor.

An arbitration system serves several important purposes in the program, including dissemination of market information to facilitate negotiations, the coordination of matching Class A IFQ held by harvesters to IPQ held by processors, and a binding arbitration process to resolve terms of delivery. A “market analyst” and a “formula arbitrator,” jointly selected by the harvesting and processing sectors, develop a market report and price formula, which specifies an ex vessel price as a portion of the first wholesale price, to be used by participants to guide their delivery negotiations. Neither the market report nor the formula price are binding, but are intended to provide information concerning the market and the price that might be generated by a binding arbitration proceeding. Matching of Class A IFQ with IPQ is facilitated through a process of share commitments and dissemination of information concerning available shares. Once shares are matched, parties unable to negotiate terms of delivery (which may include the price) may use the arbitration system to resolve those terms.

To ensure predictability and fairness, the arbitration system sets forth standards to be followed by formula arbitrators and contract arbitrators. Although different standards apply to the formula arbitrator and the contract arbitrator, the differences between the standards are very limited and do not substantively change the general approach to be applied. The regulations provide that both the non-binding price formula and contract arbitrator’s decision must establish a price that preserves the historical division of revenues in the fishery while considering several listed factors (such as quality, product innovations, the interest of maintaining the financial health of the harvesting and processing sectors, and the timing and location of deliveries).

The program also made changes in the allocations under the CDQ program, broadening that program to include the Eastern Aleutian Islands (Dutch Harbor) golden king crab fishery and the Western Aleutian Islands (Adak) red king crab fishery and increasing the allocations in all crab fisheries covered by the CDQ program from 7.5 to 10 percent of the TAC. These changes in the CDQ allocations are intended to further facilitate fishing activity and economic development in rural Western Alaska communities. The CDQ allocations are managed independently from the program and are not subject to IPQ and regional landing requirements. The program also made an allocation of 10 percent of the Western Aleutian Islands

(Adak) golden king crab fishery to the community of Adak This allocation to Adak is thought to be appropriate because that community was excluded from the CDQ program because of its history as a military community.

The rationalization program includes a low interest loan program to assist eligible captains and crew in purchasing QS. The program implementation was delay for the first 5 years of the program, but funding of loans is expected to begin in the near future. “Sideboards” impose limits on the activity of crab vessels in other fisheries to protect participants in those fisheries from a possible influx of activity that could arise from vessels that exit the program fisheries or are able to time activities in the program fisheries to increase participation in other fisheries. An economic data collection program, to help the Council and NMFS assess the success of the program and develop future management actions was included in the program. The data collection is currently being modified to eliminate redundancies with other data collections and eliminate the collection of inaccurate data.

Harvest sector privileges

Prior to implementation of the rationalization program, NOAA Fisheries managed the Bering Sea and Aleutian Island crab fisheries under the License Limitation Program (LLP), whereby vessels assigned a transferrable LLP license could participate in those fisheries designated by the license. Licenses were initially allocated based on historic participation with species-area (fishery) endorsements (see Table ES 2). Licenses were issued by vessel type (catcher vessel or catcher processor) and specified a maximum vessel length (MLOA). Since licenses could carry multiple species-area endorsements, the total number of licenses was not additive.¹

Table ES 2 LLP licenses in the Bering Sea and Aleutian Islands crab fisheries (2005).

LLPs	Bristol Bay red king crab	Bering Sea <i>C. opilio</i> and <i>C. bairdi</i>	Pribilof red and blue king crab	St. Matthew Island blue king crab	Aleutian Island red king crab	Aleutian Island golden king crab	Catcher processor
Licenses endorsed for							
also endorsed for							
Bristol Bay red king crab	270	264	110	168	28	25	26
Bering Sea <i>C. opilio</i> and <i>C. bairdi</i>		273	109	169	30	27	27
Pribilof red and blue king crab			118	77	15	8	2
St. Matthew Island blue king crab				170	26	19	13
Aleutian Island red king crab					30	8	4
Aleutian Island golden king crab						28	9

Source: NMFS RAM Division.

A moratorium on entry, established in 1995, limited speculative entry into the fisheries while the LLP was being developed and approved. Nevertheless, the fisheries remained heavily overcapitalized. Further, the limited access management increased the incentive for all license holders to participate in the fisheries because a person could not receive a return without participating. Some participants allege that financial pressures of boat payments ensured their participation, as revenues from the fisheries were their primary source of income from their vessels. Participants also likely remained in the fisheries to reinforce their stake in any future history-based allocation. In the years leading up to implementation of the rationalization program, few licenses were transferred. First, entry to the crab fisheries was costly because it required the purchase of an LLP permit and a properly configured vessel from which to fish. Secondly, the continuing overcapitalization, together with the historically low GHs for the Bering Sea *C. opilio* fishery, in particular, made the crab fisheries economically unattractive for potential new entrants.

When the program was implemented, NOAA Fisheries made initial allocations of owner QS to persons holding LLP licenses. Since most licenses were held by corporations, aggregation of license holdings by owner name typically will not reflect actual common control of QS holdings. In addition, complex

¹ Exceptions to the LLP license requirement included vessels that do not exceed 32 feet LOA in the BSAI and certain vessels constructed for, and used exclusively in, CDQ fisheries.

corporate ownership patterns prevent a complete assessment of the level of concentration of ownership beyond relying on the named owner for this report. Consequently, levels of consolidation of owner shares exceed those represented in the following discussion.

Approximate 250 persons received allocations of owner QS in the largest fisheries – the Bristol Bay red king crab and the Bering Sea *C. opilio*, as well as in the Bering Sea *C. bairdi* fisheries. The largest allocations in these fisheries exceeded 2 percent of the QS pool. In the St. Matthew Island blue king crab and the Pribilof blue in red king crab fisheries, 136 persons and 112 persons received allocations of owner QS, respectively, with the largest allocations exceeding 4 percent and 3 percent of the respective QS pools. Initial allocations were made to 15 persons in each of the Aleutian Islands golden king crab fisheries, with the largest allocation in the Eastern fishery exceeding 20 percent of the pool and the largest allocation in the Western fishery exceeding 40 percent of the pool. In the Western Aleutian Island red king crab fishery, 30 persons received an initial allocation, with the largest allocation exceeding 40 percent of the pool. Catcher processor allocations were less than 10 percent of the pool in all fisheries, except the two Western Aleutian Island fisheries, in which catcher processors received approximately 40 or more of the QS allocated.

The initial crew QS allocations showed a pattern similar to initial allocations of owner QS allocations across the program. Since fewer persons qualified for initial allocations of C share QS, holdings were more concentrated than initial owner QS holdings. In most cases, the initial allocations of C share QS were more evenly distributed among initial recipients. In each of the three largest fisheries, fewer than 200 persons receive an initial allocation of C shares, with the largest allocations less than 2 percent of the respective C share QS pools. In the St. Matthew Island and Pribilof fisheries, 72 and 40 persons received initial allocations, respectively, with the largest allocations exceeding 3 percent and 4 percent of the respective pools. In the Eastern Aleutian Islands golden king crab fishery, 13 persons received initial allocations, with the largest allocation making up less than 13 percent of the C share QS pool. Initial allocations of C share QS in each of the two Western Aleutian Island fisheries were made to fewer than 10 people, with the largest allocations exceeding 40 percent of the respective pool.

In the first five years of the program, substantial portions of the harvesting QS pools were transferred. Transfers of shares in some fisheries sum to over 50 percent of the QS pool, while transfers in the two largest fisheries (the Bristol Bay red king crab and Bering Sea *C. opilio* fisheries) sum to in excess of 20 percent of the respective QS pools. As with other data concerning owner share holdings, transfer data can be misleading. In some cases, transfers are changes in the name of the holder. In other cases, the transfer might reflect a change in structure of the share holding entity (such as the addition of a new partner or a change in corporate ownership). Yet, a change in corporate or partnership ownership structure will not be recorded, if the named entity holding shares remains unchanged.

Share holdings distribution data in the Bristol Bay red king crab, Bering Sea *C. opilio*, and both Bering Sea *C. bairdi* fisheries suggest that owner quota share holdings have become slightly more concentrated since the initial allocation. In each of these fisheries, the maximum holding increased to a level that exceeds the individual cap applicable to most holders, as a result of CDQ groups, who are subject to separate higher share holdings caps, have increased their holdings in the fisheries. Although some QS holders have consolidated holdings in the fisheries, the number of owner quota share holders increased or has stayed near constant since the initial allocation in all of the fisheries.

The current distribution of C share quota share holdings shows larger changes from the initial allocation than that of owner shares. Persons have consolidated holdings, acquiring shares to the individual cap in the Bristol Bay red king crab, Bering Sea *C. opilio*, and both Bering Sea *C. bairdi* fisheries. Approximately 20 fewer persons and 40 fewer persons hold shares in each of these fisheries than held shares at the initial allocation, respectively. Although active participation requirements did not apply for

the first three years of the program and the exemption of cooperative members from the requirements continues to apply, some holders may have divested as they have lost their connection to the fisheries. C share holders might also be more likely to divest of their share holdings, since those holdings are a relatively small portion of the overall QS pool, limiting the annual income that might be derived from those shares. Holders of owner QS who no longer enter a vessel into the fishery may be more likely to maintain their share holdings, as the flow of income from those shares is likely to be substantially greater, since those shares make up a much larger share of the QS pool.

Limits on vertical integration included in the program are intended to prevent PQS holders from acquiring a substantial share of the QS pool. In addition, PQS should decrease the incentive for processors to acquire harvest shares, as PQS holdings ensure access to a portion of the landings in the fishery. These factors appear to have limited the degree of vertical integration in the fisheries. IFQ allocations under a rule that restricts the allocation of Class B IFQ to PQS holders suggest that slightly less than 20 percent of the Bristol Bay red king crab QS pool is held by PQS holders and their affiliates. A similar portion of the Bering Sea *C. bairdi* catcher vessel owner pool is subject to PQS affiliation, while slightly less of the Bering Sea *C. opilio* catcher vessel owner pool is subject to PQS affiliation. In the two Aleutian Island golden king crab fisheries almost no QS are held by persons with affiliations with PQS holders in that fishery (although a few of the QS holders have affiliations with holders of PQS in other fisheries).

The Harvest Sector

A precipitous decline in the fleets in all fisheries occurred on implementation of the program (see Table ES 3). In the Bristol Bay red king crab fishery, the fleet contracted to less than one-third its pre-rationalization size. In the Bering Sea *C. opilio* fishery, the contraction was of smaller magnitude because this fleet had contracted to some degree prior to implementation of the program, as GHs in the fishery were at historic lows in the years preceding the program. Despite the fleet consolidation, average vessel catches in the large fisheries currently parallel those of seasons prior to 2000, when either fewer vessels were participating in the crab fisheries or one or more of the major fisheries had a relatively high harvest (see Figure ES 1).

Table ES 3 Total catch and vessel participation in fisheries open preceding and subsequent to program implementation in 2005/6.

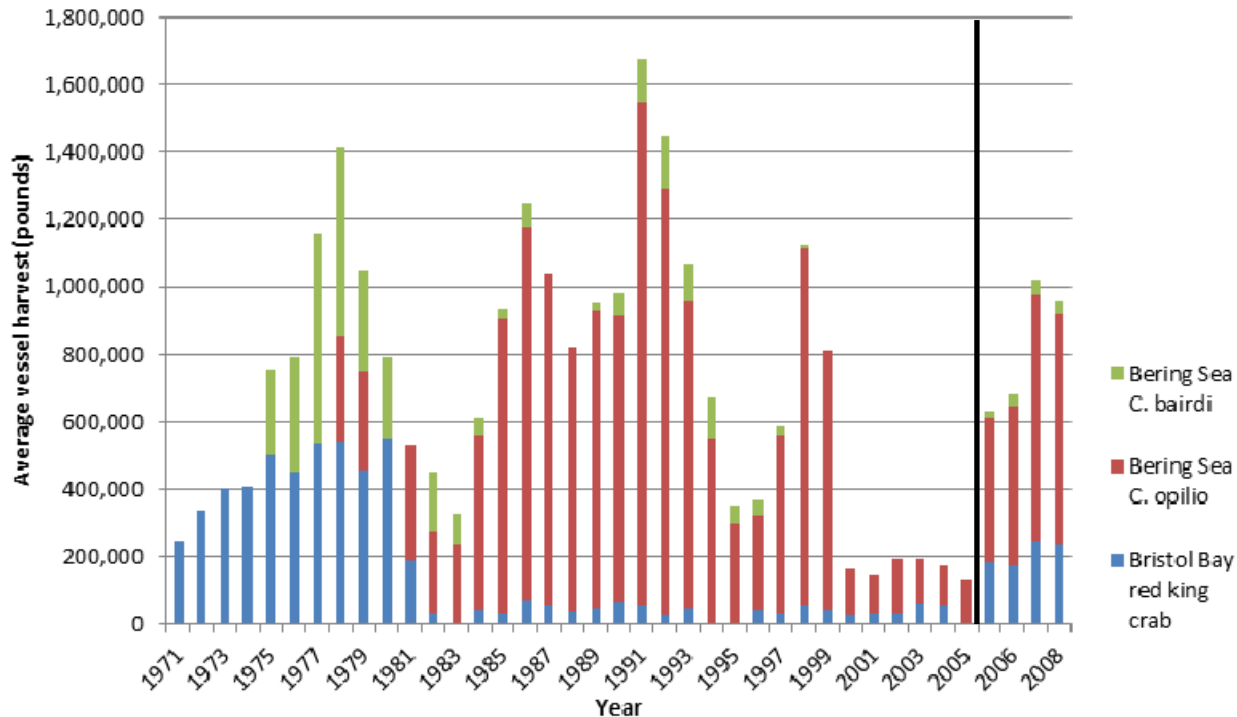
Fishery	Seasons	Average total catch	Average number of vessels participating
Bering Sea <i>C. opilio</i>	2001-2005	24,511,160	189
	2005/6 - 2009/10	43,710,333	74
Bristol Bay red king crab	2001-2004	11,144,469	243
	2005/6 - 2009/10	16,260,196	78
Eastern Aleutian Islands golden king crab	2001/2-2004/5	2,910,091	19
	2005/6 - 2009/10	2,721,660	5
Western Aleutian Islands golden king crab	2001/2-2004/5	2,643,870	7
	2005/6 - 2009/10	2,272,224	3

Sources: ADFG fishtickets prior to 2005 and NMFS RAM catch data (for 2005-2006 through 2009-2010)

Notes: Catch as a percent of IFQ allocations for 2005-2006 through 2009-2010 seasons.

Fleet consolidation in the program fisheries was the result of owners and operators making business decisions to idle boats in order to remove excess capacity from the fisheries. Leasing of quota, and the accompanying retirement or sidelining of excess capital, has taken place to the degree but more quickly than most predicted. A few factors likely contributed to the substantial consolidation that occurred in the first years of the program. Consolidation was stimulated by the cooperative structure under the program.

Cooperatives created the framework for and led to the development of harvesting associations. These strengthening relationships, in turn, created an environment ripe for consolidation of harvesting. In addition, it is likely that a portion of the fleet active prior to implementation of the program only remained in the fishery because of the impending rationalization program. Owners of these vessels quickly removed their vessels once the program was implemented.



Source: ADFG Annual Management Report 2008-2009.

Notes: Harvests for seasons overlapping two calendar years are attributed to one of the two years, to avoid double counting catches from a single fishery in the same year. Harvest per vessel is sum of average vessel's harvest in each fishery.

Figure ES 1 Approximate annual average vessel harvests in the Bristol Bay red king crab, Bering Sea *C. opilio*, and Bering Sea *C. bairdi* fisheries (1971 through 2008-2009).

In the first five years of the program, participants have harvested most of the issued IFQ. In each year in the two largest fisheries – the Bristol Bay red king crab and Bering Sea *C. opilio* fisheries – catches have exceeded 99 percent of the IFQ allocation. Lower portions of the IFQ were harvested in the *C. bairdi* fisheries, as well as the St. Matthew Island blue king crab fishery, as participants have reported that those fisheries have been particularly difficult to prosecute because of low catch rates. This complication seems to have been resolved in the Eastern *C. bairdi* fishery as most of the TAC was harvested in the 2009-2010 season. The St. Matthew Island fishery opens in October, one month later than its historical September opening. Some participants attribute low catch rates in the fishery to the later opening under current regulations. Crab are thought to migrate offshore and be more dispersed in October which may contribute to lower catches. Reduced fleet size due to consolidation may also have contributed to low total catch relative to the TAC during the 2009-2010 season. Harvest of the Western Aleutian Islands golden king crab fishery in some years has been reported to be economically challenging because of low market prices for golden king crab and limited processing capacity in the West region (where 50 percent of the catcher vessel owner IFQ is required to be landed). The 2009-2010 harvest of nearly the entire IFQ allocation suggest that a recent amendment creating an exemption to the regional landing requirement (by agreement of QS holders, PQS holders and the communities of Atka and Adak) will resolve the processing capacity issue in the fishery.

While most participants have managed to harvest close to their full allocations, a few IFQ holders have exceeded their IFQ allocations in the first five years of the program. Overages have averaged approximately 30,000 pounds per year aggregated across all fisheries (or less than 5,000 pounds per fishery each year). These overages average slightly more than 4 one-hundredths of a percent of the TAC. Cooperative membership likely plays a role in reducing the number of overages, since IFQ attributable to QS of several different holders are aggregated at the cooperative level. Cooperative held IFQ is fished as a pool by members with no overage until the entire cooperative allocation is fully harvested. The ability of harvesters to avoid overages is also aided by permissible discarding. Under the program, harvesters are permitted to discard crab without charge against IFQ. So, when a harvester estimates that available IFQ are fully used, any catch in remaining deployed gear may be discarded. Lastly, in the most recent season an amendment to the program has permitted harvesters to engage in post-delivery transfers to avoid overages.

Overall, fleet consolidation in the fisheries has tended to distribute catch to larger vessels. The fleet consolidation has led to all but 2 of approximately 15 vessels less than 85 feet in length dropping out of the fisheries. In addition, vessels less than 100 feet in length have disproportionately left the fleet. While vessels greater than 125 make up slightly less of the fleet than vessels greater than 100 feet and less than 125 feet, catches of the larger vessels have increased. This pattern has occurred consistently across all fisheries in the program. The resulting fleet is generally made up of larger vessels than the prerationalization fleet, while continuing to maintain diversity.

Short term transfers under leases and cooperative fishing arrangements are the primary means by which QS holders in the crab fisheries have achieved fleet consolidation under the rationalization program. Favorable lease rates have made quota leasing (inside and outside of cooperatives) particularly attractive under the rationalization program. High lease rates have likely contributed greatly to consolidation under the program. Lease rates fluctuate across seasons and are believed to vary across the fleet. Currently lease data are poor and do not support direct analysis of lease quantities or prices. Intra-cooperative transfers of IFQ are not administered or fully tracked by managers, limiting available information concerning these transfers. Anecdotal evidence suggest that lease rates in the Bristol Bay red king crab fishery have been as high as 70 percent of the ex vessel price, while Bering Sea *C. opilio* lease rates have exceeded 50 percent of the ex vessel price in some cases. In the Bering Sea *C. bairdi* fisheries lease rates are said to have fluctuated from approximately 20 percent to 35 percent of the ex vessel price. The lower rate in this fishery is likely a reflection of the fact that these fisheries have had relatively lower catch rates and low TACs. Lease rates in the Eastern Aleutian Islands golden king crab fishery are said to be approximately 50 percent of the ex vessel prices, while lease rates in the Western Aleutian Islands golden king crab fishery are said to be approximately 20 percent to 25 percent of the ex vessel price. The low lease rate in the Western Aleutian Islands fishery likely has resulted from the high operating costs and low ex vessel price in that remote fishery. In the one year of fishing in the St. Matthew Island blue king crab fishery, lease rates are said to have been approximately 30 percent to 35 percent of the ex vessel price.

Most QS holders have elected to join cooperatives, with almost all IFQ held by cooperatives since the third year of the program. The degree of consolidation of harvest activity is also shown by the relatively large share of the IFQ held by a relatively small number of cooperatives in the fisheries. By the 2007-2008 (the third year of the program), Bristol Bay red king crab and Bering Sea *C. opilio* fisheries, fewer than 20 cooperatives held in excess of 98 percent of the IFQ, with a single cooperative holding in excess of 20 percent of the IFQ in the Bristol Bay fishery. In the fifth year of the program, independent harvesters consolidated several cooperatives that had previously participated collectively in the arbitration system into a single cooperative. This cooperative held in almost three-quarters of the IFQ pool in the all fisheries except the Western Aleutian Island golden king crab fishery. The extent to which harvests of allocations are managed collectively varied within and across cooperatives, but has increased

substantially over time. Although most cooperatives have continued to allow individual members to arrange the harvest of their shares, management of harvests at the cooperative level has increased. This relinquishing of individual management of the harvest of shares not only contributes to consolidation of IFQ harvests, but also has allowed for better coordination, to reduce the disruption of unanticipated circumstances.

High operating costs in the first few years of the program also contributed to the high amount of leasing (and rapid consolidation of fishing). Fuel prices increased by more than 50 percent during the 2005-2006 season. Several participants also reported increases in insurance costs, in part, because many now purchase cargo insurance to cover the quota landings committed to IPQ holders and lease payments committed to other quota holders. In the face of exceptionally favorable quota lease rates and high operational costs many participants elected to lease their quota holdings. Although fuel costs have stabilized, they have remained high. In addition, consolidation within cooperatives continued as cooperative members become more comfortable with cooperative management of their quota. The result of these factors has been greater consolidation of IFQ harvests. During the 2007-2008 season, the number of vessels participating in the Bristol Bay red king crab fishery fell to 74 despite a TAC increase of 31 percent from the previous year. In the Bering Sea *C. opilio* fishery, an approximately 70 percent increase in the TAC in the third year stimulated the reentry of vessels. This increase, however, only returned the fleet to a size of 78 vessels, its size in the first year of the program. As a result, the average vessel harvest in the fishery increased by more than 50 percent, despite the increase in the number of vessels.

Comparing vessel activities before and after implementation of the program in the two largest fisheries brings to light further changes in the fleet dynamics. Under the rationalization program, both the median and largest vessel annual harvests in the Bristol Bay red king crab fishery have been more than double the levels (in pounds and as a percent of the total catch) of the years immediately preceding implementation of the program. The mean and median vessel harvest in the fishery grew consistently in the first three years of the program, before declining in the two most recent years. The largest harvests have fluctuated, both in pounds and as a percent of the total harvests. In the first year of the program, the largest vessel harvests in the Bering Sea *C. opilio* fishery greatly exceeded the largest harvests in years immediately preceding rationalization. Since the 2005-2006 season, average vessel harvests have increased considerably, largely from higher TACs beginning in the third year of the program.

Prior to the rationalization program, TACs were typically harvested and seasons closed in less than one month in all of the program fisheries, except the Western Aleutian Islands golden king crab fishery. In the Bristol Bay red king crab fishery, seasons lasted less than one week, while in both the Bering Sea *C. opilio* and the Eastern Aleutian Islands golden king crab fisheries seasons lasted for less than one month. Although the Western Aleutian Islands golden king crab fishery lasted several months, its seasons also shortened progressively leading up to implementation of the program.

The allocation of exclusive harvest shares allowed the seasons in the fisheries to be extended substantially. Currently season limits are imposed for biological reasons. With this new latitude to schedule harvest activity, participants have dispersed catch substantially with deliveries distributed over a period of several months. Deliveries remain most concentrated in the Bristol Bay red king crab fishery and the St. Matthew Island blue king crab fishery, as the seasons in those fisheries are only four months and four and one-half months, respectively, substantially shorter than the season in other fisheries, and markets tend to be strongest near the year's end leading up to the holidays.

The extension of fishing over a longer period and consolidation of fishing effort has substantially changed the number and volume of deliveries. The average number of deliveries per vessel has doubled in most

program fisheries.² In addition, the average amount of crab delivered has increased. Prior to the rationalization program, in most fisheries vessels made a single delivery after a fishery closing. Under the rationalization program, almost all vessels make multiple deliveries in a season, fishing closer to the vessel's capacity prior to making deliveries. In general, deliveries average near or more than 100,000 pounds in each fishery, with the exceptions of the Bering Sea *C. bairdi* and St. Matthew Island blue king crab fisheries, which have had relatively low catch rates.

Under the rationalization program, since allocations are exclusive, participants do not need to race to prevent others from preempting their catch. To improve returns from the fisheries, participants have an incentive to reduce costs. The most obvious means of reducing costs is fleet consolidation, which is demonstrated by the removal of vessels from the fisheries. Stacking quota on fewer vessels can save on costs not only of capital, but also on maintenance, insurance, crew, fuel, and other variable input costs. In addition, several participants in the fisheries have reported that the exclusive allocations have allowed them to reduce vessel speed to conserve fuel without risking loss of catch.

The pot usage and pot catches in the fisheries suggest vessels are using the flexibility provided by exclusive allocations and extended seasons, as well as more liberal regulations on pot sharing, to save on operating costs in the fisheries. In the first five years of the program, the number of registered pots per vessel remained constant or increased in all fisheries, while the total number of registered pots in each fishery declined or remained constant. Prior to implementation of the program, pot limits constrained pot usage in some fisheries. Those limits were relaxed under the rationalization program, allowing vessels to choose the number of pots to use to increase operational efficiency. Some vessels are reported to have increased their pot holdings through acquisitions of used pots, which are reported to be readily available in the market. In addition, pot sharing arrangements are reported to be common. In most fisheries, these practices have led to the pulling of each pot more times each season. Vessels are believed to have increased soak times through slowing the pace of fishing and allowing pots to fish during periods when deliveries are made. These increased soak times are believed to have contributed to the increased catch per unit effort observed in most fisheries in the first five years of the program. A different effect has arisen in the Aleutian Islands fisheries where increased soak times (and an accompanying increase in catch per unit effort) has reduced the number of pulls per pot.

The greatest effect on crew arising from the rationalization program was the loss of crew positions brought on by consolidation in the fisheries. Crew sizes are generally unchanged since implementation of the program, so vessel participation provides a direct estimate of the number of crew that have left the fisheries. Assuming six crew members per vessel, approximately 975 fewer crew (including captains) were employed in the Bristol Bay red king crab fishery on average in each of the first five years of the rationalization program, in comparison to the 2000 to 2004 season average; approximately 675 fewer crew were employed in the Bering Sea *C. opilio* fishery on average in each of the first five years of the program, when compared to the 2001 to 2005 season average.³

Although these job losses are substantial, one must also consider the terms of employment in the prerationalization fisheries in assessing the magnitude of the loss. Prior to implementation of the program, few crab deck jobs, fully supported a crewmember. Because of the low total catches and high number of

² In some instances, multiple deliveries are suggested by multiple fish tickets across multiple days in a single delivery.

³ Note that these estimates are based on an assumption of 6 persons per crew (including captain). Crab Economic Data Reports suggest that average crews are approximately 5 persons; however, these surveys may have some biases. For years prior to implementation of the program, the surveys requested average crew size. Subsequent to the implementation the survey requests the number of paid crew per fishery. Both suggest that average crews are slightly less than 6 persons.

vessels in the fisheries in years leading up to the rationalization program, most crew worked only a month or so in the crab fisheries. Crew typically worked other jobs (including crew jobs in other fisheries) throughout the remainder of the year. In addition, since pay was a share of the vessel's net revenues in the derby, pay was subject to risk. The relatively short tenure of crab crew jobs was attractive to many crew who were able to negotiate (or take) short periods away from other employment to fish crab. Notwithstanding their relatively short term, for many deck crew, their crab fishing jobs were reported to have provided important contributions to annual income. Particularly in the case of crew from remote communities with few job opportunities, replacing income from lost crab crew jobs is reported to be problematic.

Since crew compensation arrangements vary across the fleet, changes in crew share payments can be best assessed by examining the change in payment amounts and change the percentage of gross vessel revenues paid to crew before and after the implementation of the program. Available data suggest that mean and median crew payments as a percentage of gross vessel revenues declined by approximately one-third under the rationalization program (see Table ES 4 **Error! Reference source not found.**). Although this decline is substantial, on average, the increase in revenues from consolidation (i.e., increase in average vessel harvest) more than compensated for additional deductions, charges, and decrease share percentages. In general, this additional compensation came at the cost of greater crew efforts harvesting those additional pounds. Even in 2006, when Bering Sea *C. opilio* prices were particularly low, the average crew earned substantially greater compensation than in the years preceding rationalization, with the exception of 1998, when harvests from the Bering Sea *C. opilio* fishery were substantially greater than for any other year for which data are available. Although data for these vessels suggest total annual crew compensation on each vessel has increased, a progressive decline in the crew share percentages from approximately 24 percent of gross revenues in the first full calendar year of the program to slightly less than 21 percent in the fourth calendar year is also evident. The long run effect of this trend is uncertain.

Table ES 4 Harvest, captain pay, crew pay, and percentage of gross vessel revenues paid to crew by vessels participating in both the Bristol Bay red king crab and Bering Sea *C. opilio* fisheries (1998, 2001, 2004, 2006-2009).

Year	Number of vessels	Vessel revenues		Captain pay		Crew pay (excluding captain)		Percent of gross to crew (including captain)	
		Mean	Median	Mean	Median	Mean	Median	Mean	Median
1998	151	1,034,471	983,861	123,019	116,947	249,953	232,979	35.9	35.3
2001	143	435,583	369,474	50,310	43,426	97,279	87,042	34.1	34.3
2004	162	620,513	583,453	72,301	69,625	148,010	135,224	35.7	35.5
2006	56	1,367,208	1,244,964	98,025	96,090	195,317	185,298	24.0	24.2
2007	55	2,210,463	1,958,662	144,081	145,564	300,238	283,862	23.0	22.4
2008	61	2,729,428	2,646,745	179,973	176,911	385,464	365,392	22.6	22.4
2009	57	2,256,501	2,090,932	141,269	138,993	308,668	272,565	21.5	20.9

Source: Crab Economic Data Reporting.

Notes: 2005 omitted, as Bering Sea *C. opilio* fishery prosecuted as limited entry derby and Bristol Bay red king crab prosecuted as share-based fishery. Excludes any vessels on which crew were paid in excess of 75 percent of the vessel's gross revenues. Adjusted for inflation using CPI-U to 2009 dollars.

Most vessel owners assert that the decline in crew shares as a percentage of gross revenues is simply a reflect the change in vessel owner net revenues arising from the costly acquisition of shares to harvest. Many crew are said to have received full crew share on IFQ initially allocated to the vessel owner;

however, in some cases vessel owners are reported to deduct IFQ value from revenues prior to paying crew, even for shares received in the initial allocation. Changes in crew compensation relative to pounds harvested by a vessel reinforce the conclusion that quota costs are a major contributor to declines in the percentage of gross vessel revenues paid to crew.

An additional factor to consider in assessing crew compensation under the rationalization program is the change in daily compensation. If only fishing, transiting, and offloading days are considered, crew appear to have suffered a decline in daily compensation under the rationalization program; however, such an approach assumes that crew work no additional days in preparation for a season or at the end of a season. If each crewmember is assumed to work an additional 10 days on the vessel and gear, the conclusion is far less clear, with crew daily compensation in a similar range to prerationalization daily pay. This relative equivalence (or ambiguity) arises from several competing effects. Prior to the program, crews spent few days fishing, so days spent on vessel and gear work made up a greater share of their time. Since the program was implemented, vessels have stacked substantially greater catches on the remaining active vessels increasing the revenue base on the average vessel. These two factors, on average, counterbalance the effect of quota royalties (or the reduced share of gross revenues paid to crew) that has diminished crew pay.

The processing sector

Prior to implementation of the rationalization program, processor entry to the crab fisheries was not subject to limit. With the implementation of the rationalization program, participation in program fisheries by processors is limited by PQS and IPQ allocations yielded annually by those PQS. Initial allocations of processor quota shares were substantially more concentrated than harvester quota share allocations under the program because fewer processors than vessels were active in the fisheries during the qualifying period. As in the harvest sector, concentration of initial allocations of processing privileges varied across fisheries. The Aleutian Islands fisheries, which had the least participation during the qualifying period, were the most concentrated. The Bristol Bay red king crab, Bering Sea *C. opilio*, and Bering Sea *C. bairdi* fisheries, which had the most participants during the qualifying period, were the least concentrated. The regional distribution of shares differed with landing patterns that arose from the geographic distribution of fishing grounds and processing activities. In the Pribilof red and blue king crab fisheries, most historic processing occurred in the Pribilofs, resulting in over two-thirds of the processing allocations in those fisheries being designated for processing in the North region. Most processing in the St. Matthew Island blue king crab fishery occurred on floating processors near the fishing grounds in the North region. The Bering Sea *C. opilio* fishery allocations are split almost evenly between the North and South regions; while less than 5 percent of the Bristol Bay red king crab PQS is designated for North processing. All qualifying processing in the Eastern Aleutian Island golden king crab fishery occurred in the South region, resulting in all processing shares in that fishery (and in the Western Aleutian Islands red king crab fishery, which was based on the same history) being designated for processing in the South region. All processing allocations Western Aleutian Islands golden king crab fishery were split evenly with half required to be processed in the West region and half undesignated, which can be processed anywhere. Bering Sea *C. bairdi* processing shares are also undesignated.

During the first five years of the program, transfers of PQS total over 20 percent the PQS pool in 5 fisheries and over 50 percent of the pool in one fishery. As with harvester shares, the extent to which these transfers represent actual market transfers is uncertain, as some restructuring of processing interests occurred. In addition to the transfers of PQS, substantial leases of annual quota (IPQ transfers) occurred in the first five years of the program. In most fisheries, between 20 percent and 35 percent of the IPQ are transferred annually. As with PQS transfers, in some cases, these leases represent shifting of shares within a corporate structure that may not reflect a true lease; yet, true leasing of interests occurred. Despite the number of transfers, PQS holdings are currently only slightly more concentrated than at the time of the initial allocation.

In the years leading up to the rationalization program, 20 or fewer processors participated in the largest crab fisheries. The largest three processors in these fisheries processed less than 15 percent of the fisheries' landings in each year. Processing distributions by community show that Dutch Harbor shore plants attracted a majority of landings in the Bristol Bay red king crab fishery and slightly less than a majority in the Bering Sea *C. opilio*. The remainder of landings was divided primarily among Akutan and St. Paul and floaters in the Bering Sea and King Cove and Kodiak on the Gulf. In the two Aleutian Islands golden king crab fisheries, participation fluctuated between 2 and 7 processors during the years leading up to implementation of the program. Dutch Harbor and Adak supported virtually all of the processing in those fisheries.

Under the rationalization program, a large portion of the processing (and raw crab purchasing) is vested in the holders of processing shares. To achieve efficiencies in processing, holders of processor shares have used custom processing arrangements to process substantial portions of the landings in the fisheries. Under these arrangements, a share holder contracts for the processing of landings of crab, while retaining all interests and obligations associated with the landed and processed crab. Because of the prevalence of these arrangements, both plant activities and buyer activities must be considered. Since the rationalization program, the number of processing plants participating in the Bristol Bay red king crab fisheries and the Bering Sea *C. opilio* fisheries have declined to approximately 10. The average processing by the top 3 plants in both fisheries increased to approximately 20 percent of the fishery. Ten or fewer plants participated in processing in the Bering Sea *C. bairdi* fisheries in each year of the program, with processing slightly more concentrated than in the two largest fisheries. Five or fewer processors participated in the Eastern Aleutian Island golden king crab and Western Aleutian Island golden king crab fisheries in the first five years of the program, limiting the information that may be released concerning processing in those fisheries. Only two plants participated in the St. Matthew Island blue king crab fishery in the one year that fishery was open since implementation of the program. These last three fisheries have relatively small TACs which limit processing opportunities.

In the first two years of the program, a large portion of the IPQ pool was subject to the "cooling off" provision, which required processing to occur in the community of the processing history that led to the allocation of the underlying PQS. Consequently, few changes in the distribution of processing of Class A IFQ/IPQ landings occurred in the first two years of the program. Also, entities representing the community in which processing occurred historically are granted a right of first refusal on certain transfers of the PQS and IPQ for use outside the community. This right is relatively weak because intra-company transfers are exempt from the right and the right lapses, if the IPQ are used outside of the community for a period of years. Limited information is available concerning the lapse of rights of first refusal, as no obligation to report a lapse exists. To date, rights of first refusal on PQS are believed to have lapsed in only a few instances (see Table ES 5). Most notably, the right has lapsed with respect to the shares arising from historic processing in St. George. The St. George harbor and its entrance were damaged by a storm in 2004. In the first two years of the program, that damage was found to have prevented processing in St. George. As a consequence, under the terms specified by the rationalization program the rights of first refusal would have lapsed. However, representatives of Aleutian Pribilof Island Community Development Association, the holder of the right, reached agreements with holders of these PQS to protect the interests of St. George. In another case, PQS were acquired by that right holder. In addition, the holder of the rights on behalf of the City of Kodiak and Kodiak Island borough has also acquired PQS through a negotiated arrangement with original holder of those PQS. In at least one other case, a right holder has consented to an acquisition of PQS by another entity despite its right.

Table ES 5 Initial and current distribution of rights of first refusal by community.

Fishery	Region	Right of first refusal boundary	Percentage of initial PQS pool	Percentage of current PQS pool
Bristol Bay red king crab	North	None	0.0	0.0
		St. Paul	2.5	2.5
	South	Akutan	19.7	19.7
		False Pass	3.7	3.7
		King Cove	12.7	7.4
		Kodiak	3.8	0.2
		None	3.4	12.2
		Port Moller	3.5	3.5
Unalaska	50.7	50.7		
Bering Sea <i>C. opilio</i>	North	None	1.0	16.0
		St. George	9.7	0.0
		St. Paul	36.3	30.9
	South	Akutan	9.7	9.7
		King Cove	6.3	6.3
		Kodiak	0.1	0.0
		None	1.8	2.0
		Unalaska	35.0	35.0
Eastern Aleutian Island golden king crab	South	Akutan	1.0	1.0
		None	0.9	7.8
		Unalaska	98.1	91.2
Pribilof red and blue king crab	North	None	0.3	0.3
		St. George	2.5	0.0
		St. Paul	64.8	67.3
	South	Akutan	1.2	1.2
		King Cove	3.8	3.8
		Kodiak	2.9	2.9
		Unalaska	24.6	24.6
St. Matthew Island blue king crab	North	None	64.6	64.6
		St. Paul	13.8	13.8
	South	Akutan	2.7	2.7
		King Cove	1.3	1.3
		None	0.0	0.0
		Unalaska	17.6	17.6

Source: RAM PQS data, 2009-2010

Despite the end of the cooling off period and the ease with which the right of first refusal may be avoided, a large share of the processing of IPQ landings are believed to have continued to be made in the community benefiting from the right. Three factors likely contribute to this distribution of processing. First, in many cases, the shore-based processing capital used to develop the history leading the PQS allocation continues to be used for processing in by the initial recipient of the PQS allocation. The regionalization of PQS strictly limits the movement of processing across regional boundaries. In addition, to date, most processors have acknowledged a community interest in processing of landings using their IPQ, and report that they have continued to process those landings in the community of origin. Whether this acknowledgement of community interests will persist is not known.

Little information concerning the extent of processing in specific communities can be released because of the limited number of processors that participate in the crab fisheries. No clear trend is apparent in the landings of Class B IFQ and C share IFQ in the Bristol Bay red king crab fishery, as landings in Dutch Harbor and Akutan (communities associated with approximately 65 percent of the Class A IFA) have fluctuated between landings have between approximately 60 percent and approximately 85 percent of the annual landings of those shares in the first 5 years of the program. Those two communities, however,

have attracted between 65 percent and 90 percent of the annual Class B IFQ and C share IFQ landings in each of the first five years of the program (well in excess of the approximately 45 percent of the Class A IFQ associated with those communities on the initial allocation.

As with harvesters one of the primary changes in operations under the rationalization program is the distribution of landings among processors and throughout the season. Prior to the rationalization program in the two largest fisheries, deliveries were concentrated in very short periods – typically one week or less in the Bristol Bay red king crab fishery and fewer than 20 days in the Bering Sea *C. opilio* fishery. Under the rationalization program landings are distributed over a substantially longer time period. In the Bristol Bay red king crab fishery, most landings continue to be concentrated in a relatively short period in the fall; however, the processing season is several weeks long. In the North region of the Bering Sea *C. opilio* fishery, the days between a processor's first and last deliveries has fluctuated since implementation of the program. From the outset, processors operating in the North expressed a strong preference for concentrating deliveries in a short period of time, but several factors, including general lack of familiarity with use of cooperative fishing practices, ice in the vicinity of plants, and a fire at one plant have contributed to extending processing over a period of between two and three months. In the fifth year, harvesters made a coordinated effort to complete landings in the North region early in the season, resulting in processing being completed in one and one-half months. In the South region in the Bering Sea *C. opilio* fishery, landings were distributed across a noticeably longer period, when compared to prerationalization years. This distribution of landings over time is less costly to South region processors, which process landings from groundfish fisheries (i.e., pollock and cod) during the *C. opilio* season. In the Eastern Aleutian Islands golden king crab fishery in the first five years of the program, processors generally distributed their processing over a period of between two and three months. Since most of the processors in this fishery also participate in the groundfish fisheries, the distribution of landings across a greater period of time is of less importance. The average days between first and last delivery in the Western Aleutian Islands golden king crab fishery differs year to year since the rationalization program was implemented. To a large extent, this extended period has arisen from circumstances related to operations at the Adak plant, the only plant operating in the West region in four of the first five years of the program. Its operator held little IPQ, and often had protracted negotiations for custom processing and leasing arrangements. In the fifth year, the operator of the plant declared bankruptcy and was unable to process any landings from the fishery. NOAA Fisheries adopted an emergency rule (after receiving a recommendation from the Council) allowing an exemption from the West region landing requirement for all shares in the fishery. Subsequently, the Council adopted an amendment that would allow for an exemption on the agreement of QS holders, PQS holders, and the communities of Adak and Atka.

Clearly, the largest effect of the program on processing operations has arisen from the extended seasons in the fisheries. In some cases (particularly in the South region), processors have operated fewer crab lines and reduced peak operating crews. Use of fewer lines reduces both labor and capital costs associated with opening, configuring, and maintaining lines. Reductions in peak crews allow processors to save on transportation costs associated with bringing in crew for the short crab seasons. In some instances, savings on overtime labor may also be realized. In the North region, these savings are less available as plants in that area typically process only crab during the periods when the crab fisheries are open. In North plants, concentrating processing activity into a short period is needed to achieve efficiencies. With processing consolidated in fewer plants, the processing season is substantially longer, but operations are conducted in a manner similar to before implementation of the program.

Scheduling deliveries around available processing windows is critical to processor efficiencies. The importance and the success of processors in scheduling deliveries have varied across time, location, and fisheries. At times in the first year of the program, harvester/processor relationships were particularly strained by attempts of both sectors to dictate scheduling of deliveries. Although some conflicts have continued to arise, most delivery scheduling issues have been resolved to the satisfaction of both parties.

In the case of processors in the North region, scheduling of deliveries is critical to maintaining processing efficiencies under the program. Harvesters are generally sensitive to these circumstances and put some effort into cooperating with processors' operational schedules. In the 2009-2010 season, harvesters put substantial effort into coordinating landings in the North region soon after the New Year. Although this effort was primarily motivated by a desire to use the North region IFQ prior to ice conditions developing in vicinity of St. Paul, North region processors benefited from the consolidation of landings that reduced down times for processing crews. Processors in the South have more latitude to move labor among crab and groundfish species production. Despite this greater flexibility, delivery scheduling occasionally causes tension between the sectors.

The lengthening of seasons and greater distribution of landings across those seasons has reduced peak staff levels in plants in the South during the Bristol Bay red king crab and Bering Sea *C. opilio* processing seasons. Although these changes in delivery patterns, at times, mean less overtime for staff, in some instances, they may allow longer term employment, particularly for crews that work in both groundfish and crab fisheries. In addition, processors may be able to secure better trained or more suitable crews, as short term employment requirements decline. These changes can improve safety and performance in plants. In the North region of the Bering Sea *C. opilio* fishery, processing patterns have changed under the extended seasons, but processing labor works under terms and conditions similar to those prior to rationalization. Processors attempt to concentrate deliveries to achieve efficiencies. This scheduling means plants operate at set capacity for a period of time with employees working relatively long hours and earning substantial overtime pay. Although the seasons last a few months (as opposed to a few weeks) work is short term with all employees brought in exclusively for the crab season. In some cases, these employees are relatively long term employees of the processor who work in other plants. In others, they are short term employees hired exclusively for crab processing. In the other program fisheries, most processing is done by crews that work in both groundfish and crab fisheries, with crews shifting among different species production as demands arise. These crews tend to be longer term employees, working several months for the processor. The change to rationalization has had little effect on processing workers active in these fisheries, but to the extent that rationalization has allowed fisheries to be prosecuted that might otherwise have been closed (e.g., the two Bering Sea *C. bairdi* fisheries) processing workers have benefited from additional employment.

CDQ group and Adak community group participation in program fisheries

Community development quota (CDQ) groups and the community group representing Adak annually receive 10 percent of the TAC of each of the program fisheries prior to allocations being made under the program. Both before and after implementation of the rationalization program, CDQ groups made substantial investments in the program fisheries. Three CDQ groups hold PQS directly. CDQ groups and the Adak community group have acquired PQS interests recently and may also have indirect holdings of PQS. Share holdings of these groups vary by fishery, with the most substantial holding in the Western Aleutian Island golden king crab fishery, where a single group holds almost 30 percent of the PQS. Five of the six CDQ groups had direct holdings of QS during the 2009-2010 season and the sixth has indirect holdings through partnerships and joint ventures. Others are also known to have indirect holdings. Direct holdings alone show that CDQ groups have substantial interests in most program fisheries. The Adak community group has no direct QS holdings in the program fisheries. CDQ holdings are greatest in the Eastern Aleutian Islands golden king crab fisheries, in which CDQ interests are approximately 30 percent of the QS. CDQ groups also directly hold in excess of 10 percent of the QS in both of the major fisheries (the Bristol Bay red king crab and the Bering Sea *C. opilio* fishery).

CDQ groups may, and do, harvest their allocations using vessels of both operation types (catcher vessel and catcher processor). In addition, CDQ groups have integrated harvest of their allocations with program fishery allocations. In the Bristol Bay red king crab fishery, the portion of the annual CDQ harvests landed with harvests from the program fishery allocations has fluctuated between approximately 15

percent and almost 70 percent. In the Bering Sea *C. opilio* fishery, between 25 and 40 percent of the annual CDQ harvests are landed with harvests from the program fisheries. In the other program fisheries, much of the CDQ landings data cannot be revealed because of confidentiality limitations.

Ex vessel prices and terms of delivery

Ex vessel pricing structures have changed under the rationalization program. To assess how changes in pricing structure have affected negotiations and pricing, the section begins with a brief discussion of pre-rationalization delivery terms (including ex vessel pricing). After that discussion, this section describes delivery terms under the rationalization program, including those terms for Class A IFQ landings and Class B and C share IFQ landings.

In the years leading up to implementation of the rationalization program, harvesters in the Bristol Bay red king crab and Bering Sea *C. opilio* fisheries coordinated most price negotiations. The Alaska Marketing Association (AMA), a harvester organization, would solicit price offers from each processor until a price offer acceptable to its members was received. Since deliveries were unrestricted, once an acceptable offer was received from a processor all other processors usually matched that offer in order to maintain market share. Prices generally remained constant over the short seasons, with minor variations across processors to create incentives for deliveries. Historically, the Aleutian Island golden king crab fisheries had longer seasons and far fewer participants than the Bristol Bay red king crab and Bering Sea *C. opilio* fisheries. Traditionally, harvesters in these fisheries negotiated prices independently with some price variation throughout the season.

Several aspects of the structure of the program have affected delivery terms and pricing under the program. The different catcher vessel IFQ types (Class A IFQ v. Class B and C share IFQ) may bring different prices because of the different limitations on use of those shares and the effects of the arbitration program on Class A IFQ landing prices. The arbitration system serves several important purposes in the program, including dissemination of market information to facilitate negotiations, the coordination of matching Class A IFQ held by harvesters to IPQ held by processors, and a binding arbitration process to resolve terms of delivery. The arbitration process begins with the two sectors (harvesters and processors) jointly selecting a “market analyst,” who produces a market report, a “formula arbitrator,” who develops a price formula specifying an ex vessel price as a portion of the first wholesale price, and a pool of “contract arbitrators,” who preside over any binding arbitration proceedings. Neither the market report nor the formula price has any binding effect. Rather, they are intended to provide baseline information concerning the market and a signal of a reasonable price.

To ensure predictability and fairness, the arbitration system sets forth standards to be followed by formula arbitrators and contract arbitrators. As set out, the standards applicable to the two different arbitrators are both intended to “establish a price that preserves the historical division of revenues in the fishery” while considering several factors. The findings of both arbitrators should be based on the historical division of “first wholesale revenues between fishermen and processors in the aggregate based on arm’s length first wholesale prices and ex-vessel prices, taking into consideration the size of the harvest each year.” Within the context of this primary standard, the arbitrator is directed to take into account the listed factors (which include product developments, quality, delivery timing, operational efficiencies, and financial stability).

The price formula, in part through its effects on binding arbitration proceedings, has largely driven the pricing of Class A IFQ landings in the fishery. Since 90 percent of the annual owner IFQ allocation (or approximately 87 percent of the annual catcher vessel allocation of IFQ) is made up of Class A IFQ, the distribution of benefits between harvesters and processors under the rationalization program has in large part depended on the distribution of benefits from landings of Class A IFQ

Data distinguishing ex vessel prices by IFQ type, as well as anecdotal evidence, suggest that harvesters have been able to gain a premium on landings of Class B and C share IFQ catch over landings Class A IFQ catch. These premiums vary across participants and time, averaging between 5 cents and 10 cents per pound. Premiums are thought to fluctuate with market conditions, which vary within and across years. When crab product markets are particularly weak, processors are thought to be generally less willing to buy crab to add to existing inventories. In addition to anecdotal and collected price information, other sources of evidence suggest that harvesters have developed competition for Class B and C share IFQ landings. In many cases, harvesters have been able to make deliveries of crab harvested exclusively with Class B and C share IFQ. In addition, buyers of Class B and C share IFQ catches and the extent to which buyers purchase larger portions of the Class B and C share IFQ catches than Class A IFQ catches suggest that some processors are competing for landings of Class B and C share IFQ catch.

Production from the fisheries

One of the goals of the crab rationalization program is to increase the value of production from the fisheries. Some product development has occurred since the program began. A few processors and brokers have attempted to develop live and fresh crab markets in the U.S. and abroad. Processors, including catcher processors, have also produced more whole frozen crab, a small but possibly growing market. In addition, at least one processor has processed crab by breaking down sections into single legs prior to cooking to increase value and recovery. These market developments have generally focused on red king crab, the crab that is best suitable for development of new high-end markets. While these attempts to develop new markets are encouraging to some observers, overall the progress in market development has been slower than in most fisheries undergoing rationalization.

A few characteristics of the Bering Sea and Aleutian Islands crab fisheries have likely slowed product innovation. First, the requirement that all crab harvested in BSAI fisheries be processed live was in effect before the rationalization program began; consequently, the opportunities to make product quality improvements were less than those commonly observed in the transition to share-based management in other fisheries. Secondly, the distance to markets and less reliable air service in remote processing locations pose challenges to processors attempting to innovate with products with relatively short shelf lives, such as live crab and fresh crab. Thirdly, development of new product forms, such as more heavily processed products, may require significant outlay of capital or increases in labor, which may be more costly in remote Alaska communities where most of the crab from program fisheries is processed. Finally, the recent market price for shellfish sections has been so high that processors may have little incentive to produce anything else. The higher price received for value added products, such as meat, may not offset the yield loss of those products. In addition to fishery-specific factors that may hinder product developments, those developments may be constrained by certain aspects of the arbitration program.

Entry opportunities

Entry into the fisheries under the LLP occurred primarily in two ways. Some persons with access to considerable capital were able to enter through the purchase of an LLP license and vessel. The nature of the fisheries increased the risk associated with entry. In brief derby seasons of a few days or weeks, poor catch rates and vessel breakdowns could result in no or little revenues for the season. New entrants dependent on revenues from the fisheries for their vessel payments faced greater risks under this derby management as they competed with others for a share of the GHL.

An alternative method of entry was open to some captains and crew in the fisheries. The typical progression in the fisheries was for crewmembers to work their way up to become skippers. With most vessels employing approximately 5 deck crew, the opportunity for advancement to skipper was limited. Some long term captains who sought to enter the fisheries were able to convince the vessel owner/license holders they worked for to sell them an interest in the operation. Persons entering the fishery in this manner typically had strong long term relationships with their employers (i.e., the vessel owners) and

shared in the oversight of annual maintenance and upkeep of the vessel. This progression from skipper to vessel owner was available only to a few skippers, who had strong relationships with a vessel owner who was interested in sharing an interest in the vessel.

Since the crab fisheries were greatly overcapitalized on implementation of the rationalization program, any absence of entry to the fisheries to date should be fully expected. The restructuring of harvest privileges under the rationalization program has changed the nature of entry opportunities substantially. Entry can occur through the purchase of harvesting QS without ownership of an interest in a vessel or a supporting license. Annual IFQs can then be fished liberally through leasing arrangements. Since QS are divisible, gradual entry into the program fisheries is permitted. The cost of entry is determined by QS prices, which depend on TACs, crab markets and other factors.

The market for crab QS has tended to be less fluid than that for sablefish or halibut QS because crab QS holdings are more concentrated with a relatively smaller number of known participants in the market. Since much of the share concentration resulted from the initial allocation of QS, the thin market is largely a reflection of the historic distribution of interests in the fisheries. The more industrial nature of the fishery, with larger investments in vessels, has also contributed to concentration of interests. With this concentration, few transactions take place and most transactions for owner QS have tended to be large, requiring substantial access to capital. Until the most recent year, the annual average priced transaction for owner QS (based on available price information and the average transfer size) exceeded \$300,000 in the Bering Sea *C. opilio* fishery and the Bristol Bay red king crab fishery. While full scale entry requires ownership of a vessel in addition to quota acquisition, cooperative harvest of IFQ and leasing create an opportunity for a more gradual entry without a vessel. This method of entry has created greater entry opportunities than existed under LLP management. Alternatively, the separation of accessible harvest privileges from vessel ownership allows persons to enter by purchasing a vessel without QS. Through the leasing market such a person can access IFQ without substantial QS holdings; however, such an approach to entry to the fishery is relatively high risk and may have little return.

C share QS, which make up 3 percent of the total QS pool, have also opened new avenues for small scale entry by eligible crew. C share QS typically sell for less than owner QS, in part, because of the active participant requirements applicable to C shares. The relatively low caps on C share QS holdings and the small percentage of the total harvest share allocation made up of C shares limit the ability of persons to consolidate large C share QS holdings. As a result, C share transfers must be of relatively small amounts of QS, which are likely to be more affordable, particularly to crew, who may have less access to capital. Available transfer information from the first five years of the program suggests that the average transfer in each fishery is for approximately one-hundredth of the QS pool and is valued at less than \$50,000.

Unlike the harvest sector, entry to the processing sector was not limited under the LLP. As a result, processor participation fluctuated greatly in the years leading up to the implementation of the rationalization program. In the early 1990s, more than 50 processors operated in the Bristol Bay red king crab and Bering Sea *C. opilio* fisheries. Under lower GHIs in the late 1990s and early 2000s, processing participation dropped to fewer than 20 plants in those fisheries.

Both prior to and since implementation of the rationalization program, entry to the processing sector as only a crab processor was very challenging. Processors that also process groundfish are able to keep plants operating for a greater period of time, spreading capital costs across larger scale production. Consequently, entry to the processing sector is affected by a processor's potential to enter groundfish fisheries and secure a portion of that production. With groundfish processing fully capitalized, entry opportunities in the crab processing sector are also limited. In addition, to the extent that other management programs (such as the AFA Bering Sea pollock cooperative program, Bering Sea and Aleutian Island cod sector allocations, and the Amendment 80 cooperative program) directly or indirectly

limit the ability of processors to enter those fisheries, entry to the crab fisheries is more constrained, regardless of the limits on entry created by the crab management program. Share holdings data suggest that a few processors have entered the fisheries, since implementation of the program, in some cases with development of substantial holdings. In at least one case, the entrant has not processed landings directly, the lease of those shares has supported processing by an entering processing platform.

Management and enforcement

The system of share-based fishing established by the program includes several fishing privileges and obligations that must be overseen by NOAA Fisheries managers and enforcement agents. These requirements present extensive and unique challenges to NOAA Fisheries Restricted Access Management and Office of Law Enforcement. The several sets of accounts authorizing fishing and processing activities must be monitored. Using plant observers and electronic reporting, landings can be attributed to the appropriate accounts. Overall, managers and enforcement believe that fishing and processing activities are in compliance with the allocation of privileges for those activities as intended by the program.

Some aspects of the program have effectively created systems of self monitoring that have relieved monitoring and enforcement burdens. The arbitration system is administered through a series of contracts that are subject to civil enforcement by the participants in that system. The system of harvest cooperatives has also reduced monitoring burdens by consolidating annual IFQ allocations into fewer accounts, effectively shifting a portion of the oversight of those accounts to harvest sector share holders.

Under the Council motion adopting the program, NOAA Fisheries collects fees to pay for the costs of management (including enforcement) arising out of the program. These costs are the incremental costs that are incurred due to the implementation of the program. The fee is split equally between harvesters and processors, with processors responsible for collecting the fee and making payment to NOAA Fisheries. Catcher processors, who catch and process their catch, pay the full amount. Fees are limited to no more than 3 percent of the ex vessel value of the fishery in a crab fishing year. Although NOAA Fisheries cannot adjust the fee percentage at the end of a season, regulations require that any debit or credit to the fee collection account must be carried forward and applied toward the fee percentage calculations for future years. In some years, fee collection has exceeded costs, allowing, NOAA Fisheries to reduce the fee percentage below 3 percent and even and remove the fee in its entirety in one year.

Fishing vessel safety

Historically, the BSAI crab fisheries have been considered to be the most dangerous in Alaska, especially those crab fisheries that take place in the winter months where cold temperatures, high winds, poor weather, icing conditions and high seas have been contributing factors to crew and vessel losses. The combination of environmental conditions, onboard stowage of crab gear and launching and retrieving of the gear, and minimal safety regime create numerous safety hazards for this fleet. In addition to the safety issues inherent with operations, fleet economics and fishery resource management issues also created safety concerns. Throughout the 1990s, a major fisheries management problem with the Bering Sea crab fleet was that despite efforts to limit overcapacity through the LLP, the catching power within the fleet greatly exceeded the available amount of crab, resulting in an extremely competitive “race for fish” in what was already a high-risk operating environment. From August 1990 through March 1999, 73 people died in the BSAI crab fisheries as a result of capsizing, sinking, man overboard (MOB), and industrial accidents, such as being struck or crushed by crab pots. When taking into account changes in workforce size, variations in season length and number of vessels participating in the fishery, workers participating in BSAI crab fisheries were experiencing an astronomical fatality rate of 770 fatalities per 100,000 full time fishermen.

In 1999, the safety program developed for the BSAI crab fleet, known as the “At the Dock Stability and Safety Compliance Check” (SSCC) was established. Under the program, the USCG reviewed vessel

loading and stability issues with the master and checked for overloading. Vessels found to be without stability reports, overloaded, or having missing, outdated, or inoperable primary life saving equipment (i.e. immersion suits, liferafts, EPIRBs) would be issued captain of the port orders and not allowed to get underway until the safety discrepancy was corrected. From October 1999 through January 2005, SSCCs identified 1 or 2 crab vessels every season that were improperly loaded and required those vessels to reduce the number of pots on board. Additionally, compliance checks found a significant number of vessels with outdated or improperly installed primary life saving equipment. Since the establishment of the SSCC, a total of ten lives have been lost, representing a significant improvement over the 1990–1999 time period, where the fleet lost an average of eight fishermen annually. Other changes that occurred prior to rationalization that lessen risk and improve safety include the pre-staging of helicopters during the two major crab seasons and the ability to delay openings up to 48 hours to allow bad weather pass if the USCG's ability to conduct search and rescue missions are significantly impaired. In addition, starting in September 2005 (simultaneously with the rationalization program), vessels participating in the BSAI crab fisheries are now required to have a current and valid USCG safety decal before vessel registration is issued to participate in the fishery. However it is important to note that, a dockside exam does not focus on vessel seaworthiness but only on the required survival equipment on board the vessel. Vessel operators are also now required to call the USCG 24 hours prior to leaving port when carrying pot gear so that the USCG can confirm they have a decal and participated in the SSCC before they depart.

One of the primary arguments for the rationalization program was to improve safety of the fleet. Although fatalities of the BSAI crab fishery declined significantly since October 1999, prior to the implementation of the program, rationalization programs can improve operational safety through reducing risk. In the years leading up to the rationalization program, crews in the fisheries would actively fish crab for only a few days or weeks each year. Under the rationalization program, most crews are active in the crab fisheries for a period of months providing crew with more (and more regular) experience deploying and hauling gear. Maintaining a consistent crew better maintains vessel management, improves efficiency and safe operating procedures, crew become more familiar with the vessels operation, other crew, deck rotation. The extended seasons under the program also have allowed captains to slow fishing. Slowing down the pace allows for crew to get more (and more regular) rest than in the derby fishery. A less fatigued crew is less likely to have accidents. Anecdotally fishermen have said that they work fewer hours in a single day allowing for more time to sleep and they are not staying up 3 or 4 days straight.

Rationalization has led to a consolidation of the fishing fleet allowing for vessels that are more fully capable of operating in their chosen service of fishing in the Bering Sea in the winter. Prior to implementation, many vessels fished to maintain historic interests in the crab fisheries. The overall poor profitability of the highly capitalized fisheries with relatively low TACs may have economically forced some owners to postpone needed vessel maintenance. Fleet contraction resulted in the removal of many of these marginal vessels from the fleet. The consolidation of the fleet resulted in an increase in the average vessel size, as smaller vessels were disproportionately removed from the fisheries. Larger vessels lend themselves to a larger work platform and may be able to handle the weather conditions more easily and are more fully capable of operating in their chosen service.

The rationalization program has resulted in several improvements in efficiency that can allow for reduced risk in the fishery. For instance, individual allocations and spreading the season out allows more flexibility in choosing to stay in port if weather is predicted to be poor. Anecdotally fishermen say that they delay going out if the weather is bad. They are also more likely to suspend fishing on grounds during periods of bad weather. These secure fishing privileges, together with flexible transfer rules for cooperatives, are said by some participants to allow them to move vessels off the grounds when weather is turning bad. With the end to the race for fish, participants also put less emphasis on catching power, reducing the incentive to overload vessels. Stability and safety compliance checks (which were performed on over 70 percent of the fleet in the years 2007 through 2009) found vessels were carrying

fewer pots than their stability instructions allowed.

While the rationalization program has provided some opportunities for improved safety, some aspects of the fishery may continue to pose safety risks. Participants continue to desire to minimize days at sea to reduce operational costs. The work ethic of individuals who have been historically employed largely because of their ability to work fast for long periods of time persists. The effect of these factors on fishing practices may subside over time, but currently are still valued and exist within the fleet. In the first couple of years of the program, harvesters raised concerns that rigid delivery dates established by processors were resulting into a “race” to meet pre-established delivery schedules and in some cases were becoming a detriment to safety; however, over the last few years, efforts have been made by both harvesters and processors to address this issue. Regional landing requirements have also limited the flexibility of captains to take sea conditions into account when deciding where to deliver crab, particularly in the North region, where ice conditions are known to create a barrier to deliveries. This issue should be addressed through the development of a satisfactory provision for emergency relief from regionalization to alleviate risks associated with regional landing requirements.

The rationalization program has clearly demonstrated the ability to improve safety by making foundational changes which increase fishing time, reduce an emphasis on catching power, allow large, more efficient and safer vessels to remain in the fishery, and improve crew experience. These are areas that are typically difficult to control through Coast Guard safety regulations. In order to maintain the progress made in saving lives and reducing risk, hazards to the fleet must continue to be monitored and addressed. In addition, safety effects of the rationalization program should also continue to be monitored and addressed appropriately.

Biological management issues

Catch in excess of the harvest targets was difficult to prevent in the derby-style fisheries that predated the crab rationalization program. Even with good in-season assessment and catch reporting, catches can change rapidly. Since the implementation of the crab rationalization program, the total allowable catch (TAC) for these target fisheries has never been exceeded. Deadloss in the Bristol Bay red king crab and the Aleutian Islands golden king crab fisheries has decreased post-rationalization, compared to the seasons immediately preceding implementation of the program. In the Bering Sea *C. opilio* fishery, the rate of deadloss is comparable to that which occurred in the two most recent years before rationalization. In the first year of fishing after being closed for more than 10 years, deadloss in the St. Matthew Island blue king crab was slightly more than 2 percent of catch. Since deadloss is counted against IFQ allocations, this deadloss presents no biological risk.

High grading is the sorting through legal crab for the most valuable (typically the largest and cleanest) crab, and discard of the remaining legal crab to ensure that only the highest-priced portion of the catch is landed and counted against the IFQ. During the first year under rationalization in the Bristol Bay red king crab fishery, the number of legal male crabs captured during the fishery and subsequently discarded was dramatically higher than discard rates in previous years, and represented approximately 20 percent of legal male red king crab caught. ADF&G reacted to the 2005-2006 discard issue by downwardly adjusting the TAC determination for the 2006-2007 season, thus resulting in an economic penalty for the share holders in that season. In an effort to address the biological concerns harvesters, processors, and cooperative members agreed to improve retention of legal size crab to the level of the pre-rationalized fishery in the years 1999-2004, and to reduce bycatch of females and sublegal males. In addition, beginning in the 2006-2007 season, most harvesters and processors changed their pricing structure to reflect their support for a full retention policy, and moved to a single price that does not distinguish for shell condition, in order to remove the incentive to high grade. As discarding of legal males did not occur on a similar scale in 2006-2007, no further downward adjustment was made for the 2007-2008 season

(Vining and Zheng 2008). No adjustment has been made since. High grading and discard rates have not been an issue, other than the 2005-2006 Bristol Bay red king crab season.

Experimental studies have shown that longer soak times, in conjunction with the required pot escape mechanisms, are likely to increase the proportion of legal versus non-legal crabs caught in the fishery (Barnard and Pengilly 2006). Soak times in the Bristol Bay red king crab fishery and the Bering Sea *C. opilio* fisheries have lengthened since the program was implemented. Catch per unit effort have increased to some extent, but catches of sublegal and female catch under the rationalization program remain within the range of bycatch levels from previous years.

Mortality is also caused by ghost fishing of lost crab pots. Mortality of crab caused by ghost fishing is difficult to estimate with precision given existing information, but studies have shown that unbaited crab pots continue to catch crabs, and pots are subject to rebaiting due to capture of other fish and crab, until biodegradable mesh gives way. The impact of ghost fishing on crab stocks remains unknown. Pre-rationalization, it has been estimated that 10 percent to 20 percent of crab pots were lost each year, although lack of observer coverage precluded accurate recording. In the first five years of the program, estimates indicate that lost pots represent less than 5 percent of registered pots in the Bristol Bay red king crab, St. Matthew Island blue king crab, Aleutian Island golden king crab, and Bering Sea *C. opilio* fisheries. Pot losses have ranged from 6 percent and 14 percent of registered pots in the *C. bairdi* fishery. One factor that may affect the rate of lost gear in these latter fisheries is the longer fishing season. Longer soak times mean that the time between setting and retrieving the gear is extended, and combined with the three to four month season, increase the risk of a change in the weather and unforeseen encroachment of sea ice preventing the vessel from successfully retrieving its gear.