CHANGES IN THE VALUE OF THE SOUTHEAST ALASKA SALMON PURSE SEINE LIMITED ENTRY PERMITS FOLLOWING TWO PERMIT BUYBACK PROGRAMS

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Abstract

The Southeast Alaska salmon purse seine fishery (S01A) is an Alaska state waters limited entry fishery. When initially limited by the Commercial Fisheries Entry Commission in 1975, 419 permanent permits were issued. As salmon prices dropped in the late 1990s, current and expected future revenues also dropped leading to a decline in the market value of permit. This led permitees to look at different ways to improve their economic position. Reduction of permit numbers through the buyback and permanent retirement of some permits emerged as a preferred option for the S01A fishery; it was motivated as the best means to improve economic conditions in the fishery. After a very long road of regulatory changes at the state and federal level, 35 permits were bought and retired in 2008 using funds provided under a federal grant. A second buyback in 2012, based on a federally backed fishery reduction loan led to the retirement of 65 additional permits. Basic economic principles suggest that resulting decrease in supply of limited entry permits would lead to an increase in the market value of remaining permits. An important policy question is: whether the increased value to permitees is sufficient to offset the cost to taxpayers of financing the buyback. However, conducting that cost-benefit assessment is made difficult because of unrelated but concomitant changes in exvessel prices and catch volumes. During the same time that permits were being removed through the buyback, the exvessel value of salmon increased as did the volume of Southeast Alaska salmon harvests, per-vessel average exvessel gross earnings, and the market value of S01A permits. Econometric analyses based on Alaska Commercial Fisheries Entry Commission (CFEC) time series data on S01A permit values, estimated gross earnings, and salmon prices indicate that the buybacks led to statistically significant increases in the asset value of S01A LEPs. In light of the program's stated goals, the buyback was a qualified success in increasing the asset value of S01A permits and removing latent fishing capacity from returning to the fishery as exvessel prices increased. The buyback did not change the fundamental conditions that precondition the Alaska salmon LEP program to systematic vulnerabilities inherent in a management system that does not counter the pernicious race for fish motivations of participants.

Table of Contents

Appendices

List of Tables

List of Figures

1.0 Introduction

The Southeast Alaska salmon purse seine fishery (S01A) was put under Limited Entry Permit (LEP) management by the Alaska Commercial Fisheries Entry Commission (CFEC) in 1975 with an initial issuance of 419 permanent LEPs. When salmon exvessel prices and revenues collapsed in the late 1990s (Williams et al., 2009), permit values also crashed (Herrmann et al., 2004) and salmon LEP holders throughout Alaska began exploring regulatory changes and alternative patterns of industrial organization to recoup economic value. Fishing cooperatives were explored in the Chignik, Alaska LEP salmon fishery from 2002 to 2005. Although the Chignik cooperative was a successful innovation, it was opposed by a vocal minority of permitees and was disallowed under a 2006 ruling by the Alaska Supreme Court, which found the cooperative structure violated Alaska Statutes (Knapp, 2008). Permit-stacking and dual permits were implemented in the Bristol Bay, Alaska LEP salmon fisheries in 2004 (AS 16.05.251).[1] LEP holders in the S01A fishery were attracted to the idea of a permit buyback as a means to increase economic returns to individual permitees to remedy economic stress brought on by low exvessel prices. Their reasoning was that a reduction in the number of permits fished, ceteris paribus, would lead to an increase in the average catch for the remaining permitees. Implementing the initial buyback program required changes to the state's Limited Entry Act (AS 16.43) as well as Congressional appropriations and federal regulations. The initial buyback, in 2008, retired 35 permits and was funded with a federal grant. A second buyback, in 2012, retired an additional 65 permits and was financed through a federally backed fishery reduction loan in 2012. This paper will explain the larger context of limited entry in Alaska, document the specific history of buyback in the S01A fishery, and evaluate the buyback program in light of its stated goals. Analyses are based on Alaska Commercial Fisheries Entry Commission (CFEC) time series data on permit value, exvessel prices, and estimated gross earnings.

Limited Entry Permit (LEP) Fishery Management Tool

Limited entry permits (LEP) are a widely used tool to restrict the number of participants in commercial fisheries to help avoid grounds congestion, improve management precision, and contribute to economic wellbeing (Crutchfield, 1979; Wilen, 1988). LEP programs range in their design, shape, management, scale, and motivations. Fisheries managers were often the key advocates for limitation to maintain management control in the face of increasing harvest capacity (Wilen, 1988). Notably, fishery managers were the crucial advocates in many of the early implementations of

[1] Permit stacking is one individual who holds and fishes two LEPs. Dual permit operations are two individuals, each who hold one LEP, who fish together on one vessel, and thus are allowed to increase the amount of gear on the vessel (Shriver et al., 2014, p. 219).

LEP programs in Alaska, Washington, and Australia (Wilen, 1988). Once hailed as an elegant economic solution to the rivalrous and nonexclusive open access fishery often referred to as the "tragedy of the commons" (Hardin, 1968); evidence of the efficacy of LEPs varies according to unique objectives and circumstances of their design and implementation in particular fisheries. There is general agreement that they are not, by themselves, effective at preventing continued increases in fishing power or at preventing the dissipation of economic rent (Fraser, 1979; Wilen, 1988; Smith, 2004; Homans and Wilen, 2005). Despite limitation, fishers still face incentives that perpetuate rent dissipation (Wilen, 1988; Criddle, 2012). That is, whenever fishers can increase their fishing power, they gain a fleeting advantage over their competitors in the LEP fishery and temporarily receive a larger slice of the pie. Once the rest of the fleet adopts the new technology, any temporary gain to the individual is lost but average costs for all LEP operations have increased. What is rational from the individual's perspective is irrational when viewed from a management or fishery perspective (Criddle, 2012; Criddle and Shimizu, 2014). Fraser (1979) reviewed the salmon LEP program implemented in British Columbia and found that much of the economic benefit was dissipated as the fishing fleet was consolidated from small vessels to large vessels and fishing power actually increased post-limitation.

Townsend (1990) reviewed thirty entry restriction programs worldwide and found several congruencies. First, the economic success of a program is correlated with the level of restrictiveness (Townsend, 1990). Second, successful management is inversely related to the complexity of the fishery (Townsend, 1990). Third, the political and social support of the LEP program is critical for success. Millerd (2007) showed how early attempts at limiting entry in the British Columbia salmon fishery at the turn of the 20th century failed; although economically efficient, equity concerns, among other factors, led to a reversion to open access. Fourth, there is evidence that the rent generation power of LEPs is engendered through the reduction in short-run externalities, i.e., a limit to increases in participation as exvessel prices rise, rather than solving long-run externalities (Townsend, 1990). Fifth, the initial power of an LEP program is indicative of its long-term strength (Townsend, 1990). That is, although politically appealing, gradual implementation of limitation programs will either erode benefits or stagnate as ineffective as vested interests become entrenched with the status quo. Sixth, when generated, LEP rent is often politically divisive (Townsend, 1990). In general, there is a consensus that LEP programs are one tool, in the fishery manger's "tool box" to help control effort, but in of themselves, they do not ensure economic rationalization (Wilen, 1988; Townsend, 1990; Smith, 2004).

Alaska Commercial Salmon Fishery

Commercial fishing for salmon in Alaska began in the 1800's although subsistence harvest of salmon predates modern times (Newell, 1994; Clark et al., 2006; ADF&G, 2009). The Alaska Native salmon subsistence management system was an effective use of territorial use rights where clans or house groups excluded one another from access to salmon resources at specific locations (Rogers, 1979). The aboriginal management system was usurped in the late 1800's by commercial harvesting and processing of salmon using canning technology and more efficient harvesting tools including fish traps and higher quality fiber netting (Criddle and Shimizu, 2014). Criddle and Shimizu (2014) note that this usurpation altered the nature of risk in the harvest strategy from a risk averse subsistence harvest where overharvest could mean the difference between life and death, to an aggressive harvest strategy meant to maximize profits. The salmon canneries, under ineffective federal management, utilized efficient salmon traps and monopsony control to displace Alaska Natives. Their decision to maximize short run profits led to overharvest of salmon stocks and to eventual decreased salmon returns, and engendered resentment that motivated calls for Alaska statehood (Rogers, 1979; Criddle and Shimizu, 2014). Exacerbating stress to an overtaxed fishery and fuel to simmering political discontent, beginning in 1955, Japanese fishing vessels were allowed to intercept Alaskan salmon on the high seas, a political favor meant to help Japan's post-war recovery and strengthen its allegiance in the cold war against Russia (ADF&G, 2009). It is perhaps unsurprising that when, in that same year the Alaskan Constitution was written, it included unique provisions that stipulate that the state's natural endowment of resources would be reserved for the common use of the people, managed using the sustained yield principle, and that there will be no exclusive right of fishery.[2]

Alaska became the 49th state in 1959. Immediately after statehood, the federal government transferred management of Alaska's fisheries to the Alaska Department of Fish & Game (ADF&G) and the Alaska Legislature banned fish traps (ADF&G, 2009). To satisfy the sustained yield principle enshrined in the Constitution, ADF&G's Division of Commercial Fisheries manages the salmon fisheries by setting target levels of escapements for each distinct stock. Area Management Biologists (AMBs) meet escapement goals by using emergency orders (EO) to open and close salmon fisheries and to allocate harvest opportunity between different user groups (subsistence, personal use, commercial, and sport). ADF&G does not recover funds to cover the cost of management from the

[2] Wherever occurring in their natural state, fish, wildlife, and waters are reserved to the people for common use (Alaska Constitution Article VIII, Section 3). Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial uses. (Alaska Constitution Article VIII, Section 4). No exclusive right or special privilege of fishery shall be created or authorized in the natural waters of the State (Alaska Constitution Article VIII, Section 15).

fisheries that the state manages; this leaves the department vulnerable to changes in state budget as the costs of management continue to increase.

Alaska's LEP Program

Despite state control of the fishery resource, Alaska's salmon returns continued to decline through the 1960s, a decline that managers attributed, in part, to continued increases in participation that made it difficult to monitor catch and escapement (ADF&G, 2009). To allay the effect of increased participation on dwindling returns, the Alaska Legislature proposed limited entry in 1962 and 1968. Both attempts were challenged in court and deemed to violate both the Alaska State Constitution and the U.S. Constitution because both attempts effectively discriminated against nonresidents (Bozanich v. Reetz 1969; Reetz v. Bozanich, 1970). Thus, based on the outcome of court decisions, limited entry was not legal without an amendment to Article VIII, section 15 of the state's Constitution. In 1972, the State Constitution was amended and in 1973, the Alaska State Legislature passed the Alaska Limited Entry Act (AS 16.43), establishing authority to limit entry in 19 of Alaska's salmon fisheries where each fishery was defined by a combination of area, species, and gear (Shriver et al., 2014).

The Limited Entry Act established a new state agency, the CFEC (AS 16.43.030) with the authority to "regulate entry into the commercial fisheries for all fishery resources in the state" (AS 16.43.080 (1)).[3] The Act provides a process for limiting fisheries with the documented purpose:

> …to promote the conservation and sustained yield management of Alaska's fishery resource and the economic health and stability of commercial fishing in Alaska by regulating and controlling entry of participants and vessels into the commercial fisheries in the public interest and without unjust discrimination" (AS 16.43.010(a)).

Notably absent in the Act was any reference to economic efficiency (Rogers, 1979). Adasiak (1979) posits that an implicit goal in the Act's "economic health and stability" language was, "the goal of a professionalized, diversified fleet" and this goal was discussed during the creation of the law. Adasiak (1979) also notes that the Act does not control increases in effort at the individual level, but rather it is the regulatory authority of the Alaska Board of Fisheries and management authority of the Alaska Department of Fish & Game where effort is controlled. Fundamentally, the LEP program of Alaska does not mitigate the incentives for individual fishermen to stay one step ahead of their competitors and regulatory controls by investing in marginally more powerful gear to gain a temporary financial advantage (Criddle, 2012; Criddle and Shimizu, 2014).

[3] Note that not all fisheries within Alaska state waters are limited.

The Act provides the framework for limiting entry and issuing LEPs[4] to individuals. Issuing LEPs to individuals rather than vessels was a specific aspect of the program design meant to increase the bargaining power of fishermen in relation to processors (Adasiak, 1979). At the time of limitation, the perception was that the processing sector still maintained control over fishermen through financing arrangements and market availability (Adasiak, 1979). To allocate the initial endowment of LEPs the Act mandates that the CFEC rank applicants using a priority classification system that is based upon the applicant's degree of economic dependence, past participation, and the relative hardship they would suffer if denied a permit (AS 16.43.250). Using these standards, the CFEC ranks applicants. Applicants who the CFEC ranks at or below the minor economic hardship threshold receive permits that are permanent but non-transferable. Non-transferable permits are cancelled when the permit holder dies or does not pay their annual fee for two consecutive years (A.S. 16.43.150 (d)). Applicants who the CFEC ranks above the minor economic hardship threshold receive permits that are freely transferable. Transferable permits allow the permit holder to sell their permit on the open market, gift their permit, or bequest their permit to whomever they will (Shriver et al., 2014). The adjudication of permit applications can take several years.[5] LEPs must be renewed every year, regardless of whether or not the permit holder 'fishes' the permit (AS 16.43.150 (c)).

The complex points system was a means to allocate permits in an equitable manner, to not only the top harvesters, but also the marginal harvesters; rural fishermen in "subsistence-oriented communities" where commercial harvests provide a vital income source despite comparatively low harvests (Adasiak, 1979). Despite these design efforts, the Alaska LEP program has been criticized for poor understating of the socioeconomic and cultural context of local fishing communities in the initial LEP design and the permit drain after initial allocation from local fishing community residents to urban and nonresident fishermen with greater access to capital (Koslow, 1981; Knapp, 2011). Criddle and Shimizu (2014) offer, "The link between LEP program design, unfettered transfer of LEPs, and the erosion *of* (sic) regional economies is an unresolved public policy concern."

Alaska Hatchery Production

Alaska's salmon fisheries are augmented by substantial hatchery-reared salmon production and release, notably in Prince William Sound and Southeast Alaska. Hatchery-reared salmon are reared to smolts in hatcheries and then released to grow in Alaskan waters and become part of the commercial common property fishery (Vercessi, 2013). The hatchery-reared juveniles grow up in the wild and are

[4] The Alaska Legislature clearly defined an entry permit (LEP) as a "use privilege that may be modified or revoked by the legislature without compensation" in the Limited Entry Act (AS 16.43.150 (e)).
[5] The CFEC issues interim entry permits to applicants while their application is in the adjudications process. Interim entry permits are not permanent or transferable.

not distinguished from wild Alaskan salmon in exvessel purchases or marketing. In 2012, approximately 31% of the statewide commercial harvest was comprised of hatchery-reared salmon (Vercessi, 2013). ADF&G estimates hatchery contributions by recovery of coded-wire-tag and thermal otolith marking from hatchery-reared salmon (Gray et al., 2014). Figure 1 shows the annual percentage of hatchery-reared salmon as part of the commercial common property fishery (ADF&G, 2014). Figure 2 provides Alaska commercial salmon harvest, in millions of fish, by source for the years 1900 – 2013 (ADF&G, 2014).

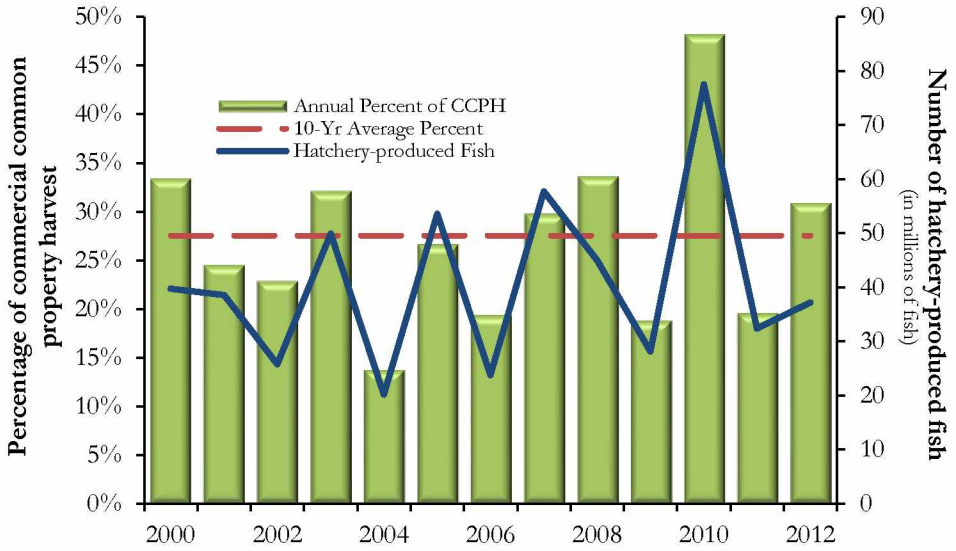

Figure 1. Percentage of hatchery produced salmon harvested in Alaska commercial common property fisheries (CCPH), 2000 -2012 (ADF&G, 2014).

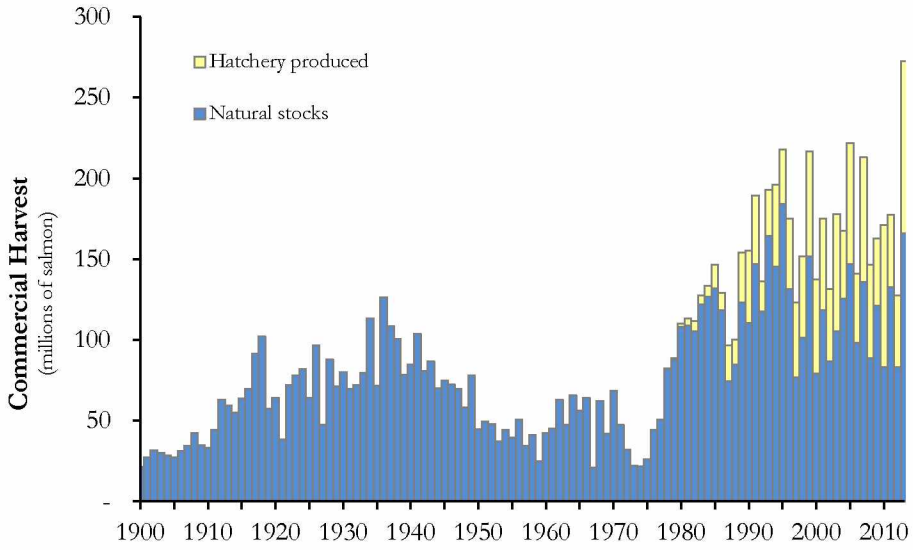

Figure 2. Alaska commercial salmon harvests by source, 1900 -2013 (ADF&G, 2014).

Alaska's salmon hatchery production began in 1971 as a division within ADF&G and expanded in 1974 with passage of a private nonprofit hatchery program (AS 16.10.400). The private nonprofit hatcheries are funded through a 3% exvessel salmon enhancement tax and "cost recovery" fisheries where hatcheries (or their agents) harvest fish in "terminal harvest areas" and sell the catch (AS 16.10.455). Adasiak (1979) posits that without the LEP program the private nonprofit hatchery program would not have passed and fishermen would not have supported programs that required an assessment to fund.

Hatchery production in Alaska is not without controversy, Hilborn and Eggers (2000) have asserted the hatchery production often replaces wild stock returns, specifically in the high hatchery production area of Prince William Sound. A cost-benefit analysis of the Alaska hatchery enhancements found that during the late 1980s and early 1990s, the cost of running the hatcheries exceeded the pecuniary benefits of the additional salmon production (Boyce et al., 1993). Ruggerone et al. (2010) have expressed concern that the increases in salmon hatchery production across the North Pacific affect density dependent processes of growth during the ocean production phase, where wild and hatchery-reared salmon compete for resources.

Alaska Salmon Market

Shortly following implementation of the LEP program in Alaska, the Fishery Conservation Management Act of 1976 established the 200 nautical mile exclusive economic zone and the regional fisheries management councils (P.L. 94-265). The creation of the exclusive economic zone and

enlarged federal management was beneficial to Alaska salmon as the federal government banned foreign fishing vessels from harvesting salmon within America's exclusive economic zone and federal managers placed limits on salmon bycatch in the groundfish fisheries (Criddle and Shimizu, 2014). Along with LEP implementation, control of the territorial sea and exclusion of foreign vessels, hatchery production, decreasing salmon returns in other parts of the world, and active management, statewide salmon returns and harvests increased as did exvessel values. These capitalized rents were evident by the increasing asset value of salmon LEPs into the 1980s. A shock to the Alaskan salmon fishery came in the early 1990s as increased production of farmed Atlantic salmon (*Salmon salar*) from Norway, Canada, the UK, and Chile caused the price of Alaskan salmon to drop along with salmon LEP values (Herrmann et al., 1993; Herrmann, 1994; Barnett et al., 2003; Williams et al., 2009; Criddle, 2012). Alaska's salmon fishery, which is oriented towards external markets, suffered a severe shock when suddenly it had to compete with farmed salmon (Criddle, 2012; Criddle and Shimizu, 2014). Farmed salmon has the advantage of providing fresh year-round, expectable product deliveries to worldwide markets in contrast to the dynamic and seasonal nature of wild salmon harvests (Criddle and Shimizu, 2014).

Pacific salmon is an important component of the larger Alaska seafood industry. In 2013, the McDowell group estimated that the seafood industry in Alaska is the largest employment sector following government employment. Harvests of Pacific salmon in Alaska account for 95% of all salmon harvest in the U.S. but only about 23% of the current U.S. domestic supply of salmon (McDowell Group, 2013). Most of the U.S. domestic supply of salmon now comes from imports of farmed Atlantic salmon (McDowell Group, 2013). To counter the increased farmed salmon production that began in the 1990s, wild Alaska salmon has been increasingly marketed as a separate and superior 'natural' product that differentiates Alaska salmon from farmed Atlantic salmon. Salmon exvessel prices have increased as marketing has differentiated wild Alaska salmon as coming from the pristine wild Alaska environment. This is part of the larger transition worldwide of marine products from commodities to differentiated goods (Criddle & Shimizu, 2014).

While Alaskan fisheries management is considered successful from the biological perspective, from an economic perspective, it has been described as, "an abject economic failure" (Criddle, 2012). Criddle and Shimizu (2014) posit that the economic crash of the salmon fisheries in the early 2000s was preconditioned by unresolved "fundamental vulnerabilities" in Alaska's salmon fisheries that include, "inexorable dynamics of the race-for-fish" that is not controlled through LEP management and salmon aquaculture production that is innovative, driven to adopt cost reducing technological innovations and has a direct impact on the price of wild salmon.

Buyback as a Fishery Management Tool

Often, after an LEP program has been implemented and fishing capacity has continued to expand along margins not controlled by the LEP, there are calls for retirement/buyback of some of the issued LEPs. These calls are motivated by the desire of existing LEP-holders to improve their economic returns (GAO, 2000; Weninger and McConnell, 2000; Clark et al., 2005). A buyback serves to contract the numbers participating in rent dissipation (Wilen, 1988). Buybacks can target vessels, gear, and/or licenses. Buybacks can serve as a vehicle to limitation and/or help rebuild stocks in over-fished fisheries, but only if managers can limit post-buyback increases in fishing power (Groves and Squires, 2007). Addressing over-capacity issues is not the sole motivation for buyback; Squires (2010) compiled the motivations for buyback that include:

> …(i)directly increasing economic efficiency; (ii) modernizing fleets and adjusting their structure and composition; (iii) facilitating the transition from fisheries with overexploited stock and overcapacity to private or common rights-based conservation and management; (iv) providing alternatives when rights-based management is infeasible; (v) providing disaster or crisis relief; (vi) addressing compensation and distributional issues; (vii) conserving common resources underlying fishery; and (viii) conserving biodiversity and ecological public goods (Squires, 2010, p. 368).

The verdict on whether buybacks are an appropriate vehicle to address the above motivations is still up for debate. In 2000, the U.S. Government Accounting Office (GAO) reviewed buybacks in the New England groundfish, Bering Sea pollock, and Washington State salmon fisheries. Overall, the GAO found that re-entry of vessels and fishermen mitigated much of the temporary gains in the reduction in fishing capacity (GAO, 2000). Clark et al. (2005) present a vessel buyback subsidy model and conclude that even if post-buyback capacity "seepage" can be overcame, the buyback "subsidies" can have a negative impact on economic efficiency.

Alaska's LEP statue includes a buyback provision that was part of the 'secondary' limitation process that aimed at reducing the number of permits in any one LEP fishery to an "optimum number".[6] The CFEC determines the optimum number of LEPs that balances the economic health of the fishery; allows for an efficient harvest; and avoids economic hardship to LEP holders (AS 16.43.290). If the CFEC's determined optimum number of LEPs is less than the current number of LEPs, the Limited Entry Act's provisions authorize the CFEC to conduct a voluntary buyback of permits until the optimum number is reached, financed by an LEP exvessel tax (AS 16.43.310). Optimum number determinations are time intensive and have only been completed in three LEP fisheries and only one

[6] As originally written, the Limited Entry Act's buyback provision was determined to violate the Alaska constitutional prohibition against dedicated funds. As part of the larger S01A buyback legislative changes, the Alaska Legislature amended the buyback provisions in 2002 with House Bill 286.

salmon LEP fishery.[7] No buyback has been completed utilizing the Limited Entry Act's buyback provision. Although this second stage of limitation was anticipated to proceed immediately after initial limitation, the institutional focus of the CFEC moved away from consolidation to adjudicating initial LEP applications (Schelle et al., 2004). In 1988, the Alaska Supreme Court issued a decision that would highlight a singular drawback to buyback in Alaska LEP fisheries. *Johns v. State* articulated the balance that CFEC must strike between the tensions of constitutional clauses in the limited entry amendment in *Article VIII section 15, No Exclusive Right of Fishery* and *Article VII Section 3 Common Use.* The Court stated:

> [T]here is a tension between the limited entry clause of the state constitution and the clauses of the constitution which guarantee open fisheries. We suggested that to be constitutional, a limited entry system should impinge as little as possible on the open fishery clauses consistent with the constitutional purposes of limited entry, namely, prevention of distress to fishermen and resource conservation. Ostrosky. 667 P.2d at 1191. The optimum number provision of the Limited Entry Act is the mechanism by which limited entry is meant to be restricted to its constitutional purposes. Without this mechanism, limited entry has the potential to be a system which has the effect of creating an exclusive fishery to ensure the wealth of the permit holders and permits values, while exceeding the constitutional purposes of limited entry.

The Johns decision had two major impacts on LEP management in Alaska. First, it articulated that the optimum number was the mechanism that made LEP management constitutional. The optimum number would allow a means for the CFEC to issue more LEPs if a fishery was deemed "too exclusive". Exclusivity of an LEP fishery is constitutional only if the level of exclusivity is for resource conservation or to prevent economic distress. Second, the decision heuristically pointed out the paradoxical drawback to buyback in a LEP fishery using the Limited Entry Act's buyback provision. Namely that if post-buyback LEP fishery was deemed too exclusive, the CFEC would be constitutionally bound to issue more LEPs, even as the state was taxing fishermen to pay for the cost of the buyback.

2.0 LEP Program Description and Buyback Outcomes

Statement of Problem

The 2008 buyback using federal grant money bought and retired 35 LEPs. The 2012 buyback financed by the federal reduction loan permanently retired an additional 64 LEPs. This amounted to

[7] The three LEP fisheries where optimum number determinations have been made are the Southeast Alaska roe herring purse seine fishery (20 AAC 05.1140); the Bristol Bay salmon drift gillnet fishery (20 AAC 05.1147); and the Northern Southeast Inside sablefish longline fishery (20 AAC 05.1145).

a 23.6% reduction in LEPs[8]. Figure 3 illustrates a conceptual long-run demand function for S01A LEP permits. The market for S01A LEPs is in part determined by the fixed supply of LEPs. It is expected that the permanent removal of LEPs from the market, ceteris paribus, would raise the selling price from an initial equilibrium price A to equilibrium price B after the 2008 buyback and to equilibrium price C after the 2012 buyback and a demand shift that reflects increases in exvessel gross revenues due to increased exvessel prices. This paper seeks to disentangle the effects of the reduced supply of LEPs (due to the buybacks) from changes in the demand for LEP (due to increased exvessel price). Specifically, this paper seeks to determine if the 2008 and 2012 buybacks had a statistically significant effect on the real prices of S01A LEPs. In addition, this paper will evaluate the buybacks in light of their stated goals.

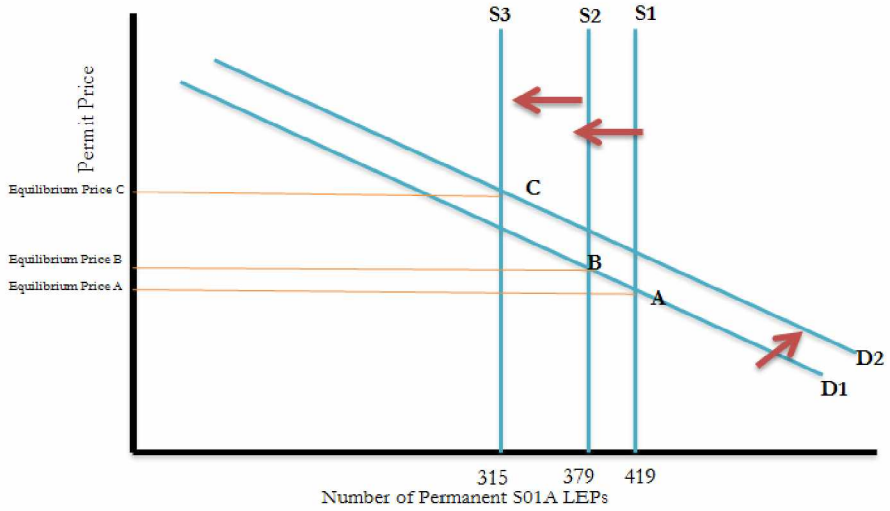

Figure 3. Conceptual representation of changes in the equilibrium price of S01A LEPs in response to increased (D1 to D2) long-run demand and reductions in the supply of permits from S1 to S2 and S3 in occasioned by two buybacks.

Limited Entry in Alaska's Salmon Purse Seine Fishery

The Southeast Alaska (S01A) salmon purse seine fishery was one of the 19 original LEP fisheries (Shriver et al., 2014). Purse seine vessels encircle schools or shoals of their target fish with a curtain of netting that is pursed at the bottom to entrap their target within a bowl of netting that can be drawn aboard (Figure 4). The CFEC designated the Southeast salmon purse seine fishery as a salmon fishery that had reached levels of participation that required limitation of entry in 1974 (20 AAC

[8] The reduction in LEPs is 24.8% when we include the four LEPs that were cancelled for non-payment of fees and one that was cancelled administratively.

05.310). In total, the CFEC issued 419 permanent transferable LEPs (see Table 1). The CFEC also issued non-permanent interim entry permits to applicants who did not appear to have sufficient participation history; interim permits lasted until the applications were adjudicated. It was not until 2003 that the final S01A application was adjudicated and a final decision made. Appendix 1 provides a time-series of the number of interim entry and permanent permits renewed and fished each year (1975 – 2013). Similar to many other LEP programs, the limitation of the Southeast salmon purse seine fishery did not achieve any major fleet reduction from its open-access state; rather it is thought to have prevented further increases in the number of participating vessels (Schelle and Muse, 1984). Limitation did not limit further increases in marginal effort or transfers from less effective to more effective fishermen.

Figure 4. An Alaska seine boat. Credit: Photo Courtesy Alaska Seafood.

Table 1. Initial issuance, total net changes, and year-end 2013 permanent limited entry permits (LEPs) in the southeast salmon purse seine fishery by resident type. The migration change represents residents who moved out of state, but continued fishing in the fishery. The transfer change represents a resident who transferred their permit (either through gift, sale, or inheritance) to a nonresident (CFEC, 2014).

					Cancelled Buyback					
	Total Initially Issued	**Percent Issued**	**Transfer Change**	**Migration Change**	**2008**	**2012**	**Total Canceled**	**Total Change**	**Total 2013 Year End**	**Total Year End Percent**
Resident	214	51.1%	4	-17	-9	-21	-33	-46	168	53.3%
Nonresident	205	48.9%	-4	17	-26	-43	-71	-58	147	46.7%
Total	419	100%	0	0	-35	-64	-104	-104	315	100%

Table 1 provides an overview of initial LEP allocation and changes in LEP holdings by resident type (either Alaska-resident or nonresident) in the S01A fishery for the years 1975 – 2013 (CFEC, 2014). Between 1975 and 2013, the CFEC issued 419 permanent S01A LEPs. Of this total, Alaskans received 51% (214/419) of the S01A LEPs and nonresidents received 48.9% (205/419). Of the 19 original salmon LEP fisheries, the S01A fishery has the highest proportion of nonresident LEPs issued. In comparison, in the Bristol Bay salmon drift gillnet LEP fishery, 39.7% of the initial allocation of LEPs went to nonresidents (Shriver et al., 2014). By the end of 2013, the total number of S01A LEPs was reduced to 315 permits due to permit cancellations (including permits eliminated by the buybacks). Of the 315 permanent S01A LEPs, Alaskans held 53.3% (168/315) at year-end 2013.

The Economics of the Southeast Alaska Salmon Purse Seine Fishery

Species Composition

The S01A fishery harvests five species of North Pacific salmon: Chinook Salmon *O. tshawytscha*, Sockeye Salmon *O. nerka*, Coho Salmon *O. kisutch*, Pink Salmon, and Chum Salmon. Two of these species, Pink Salmon and Chum Salmon, account for over 95% of the volume and about 84% of the gross earnings of the fishery (Table 2). According to the Alaska Department of Fish & Game managers, the S01A fishery has harvested about 77% of the total commercial Southeast Alaska salmon harvest in numbers of fish over the period of 1960 – 2013 (Gray et al., 2014).

Table 2. Percent of total value and volume of southeast salmon purse seine fishery by species, 1975 – 2013 (CFEC, 2014)

Species	Percent of Total Value	Percent of Total Volume
Chinook Salmon	1%	<1%
Sockeye Salmon	11%	3%
Coho Salmon	4%	2%
Pink Salmon	62%	76%
Chum Salmon	22%	19%

The majority of the harvested pounds in the fishery consist of Pink and Chum Salmon. Figure 5 presents a break out of harvest poundage by salmon species. It is clear that Pink and Chum Salmon harvest volume dominate in the S01A fishery. Pink Salmon mature and complete their life-cycle within a two-year period (ADF&G, 2014). This two-year life cycle has created odd and even year populations that are genetically unique (ADF&G, 2014). The distinct odd and even year populations

of Pink Salmon translate into harvest compositions that can vary significantly from year to year (see Figure 5).

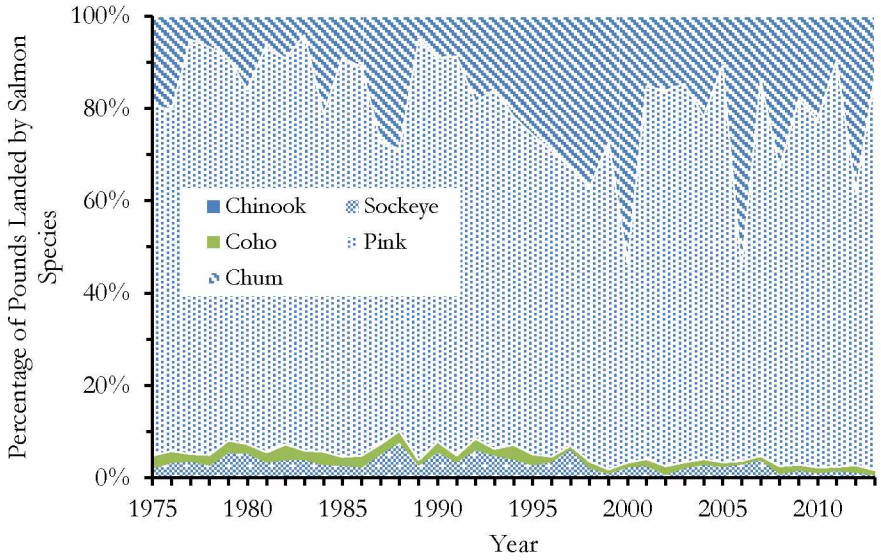

Figure 5. Percentage of harvest poundage by species, 1975 – 2013 (CFEC, 2014).

Pink Salmon Prices, Chum Salmon Prices, Harvest, and Total Gross Earnings

Pink and Chum Salmon play an important role in gross earnings for the S01A fishery. Figure 6 presents the total real estimated gross earnings and estimated average real exvessel price per pound for Pink and Chum Salmon in the S01A fishery (CFEC, 2014). Earnings were adjusted using the Consumer Price Index (CPI) with 2013 as the base (United States Department of Labor, Bureau of Labor Statistics, 2014). The real price of Pink Salmon in the S01A fishery fell from a high of $1.62 in 1988 to a low of $0.12 a pound in 2002. The real price of Chum Salmon peaked at $2.71 in 1978; fell to $0.76 per pound in 1986, reached $2.05 per pound in 1988, and bottomed out at below $0.50 per pound from 1996 through 2007. While real gross earnings in the S01A fishery is a function of catches and prices of all five species of salmon, earnings are most closely correlated with pink salmon real earnings (r = 0.94323) (Table 3).

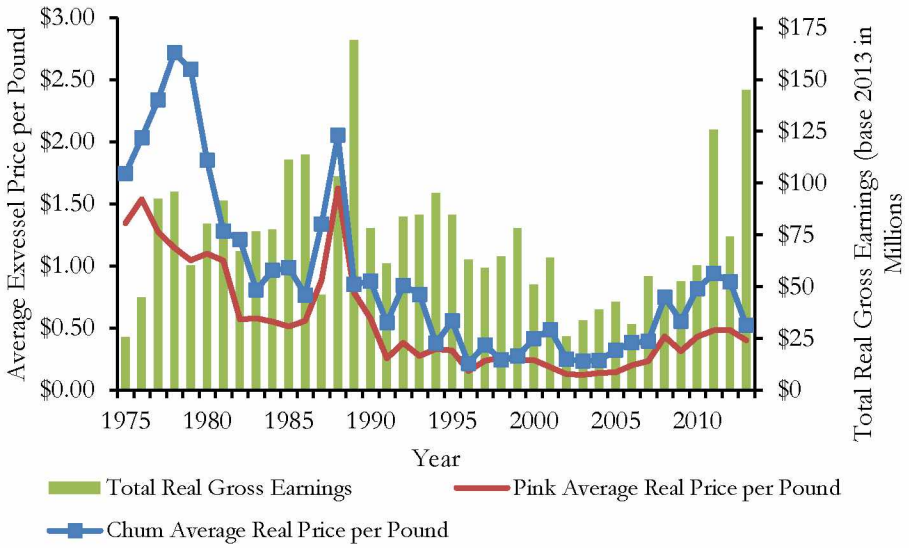

Figure 6. Annual mean real exvessel price per pound (2013 base) for Pink Salmon, Chum Salmon, and total real gross earnings in the Southeast Alaska (S01A) salmon purse seine fishery, 1975 – 2013 (CFEC, 2014).

Table 3. Pearson correlation coefficients (r) table for real gross earnings

Variable	r	Prob $\|\rho\| \neq 0$	OBS
Chum Salmon pounds	-0.152	0.356	39
Chum Salmon real gross earnings	0.185	0.260	39
Chum Salmon real exvessel price/lb.	0.180	0.273	39
Pink Salmon pounds	0.363	0.023	39
Pink Salmon real gross earnings	0.943	<.001	39
Pink Salmon real exvessel price/lb.	0.217	0.184	39

Figure 6 shows the movement in real mean exvessel price per pound for Pink and Chum Salmon as well as real total gross earnings during the time of LEP management. Figure 7 presents the total harvest and real earnings in the S01A fishery during the time of LEP management.

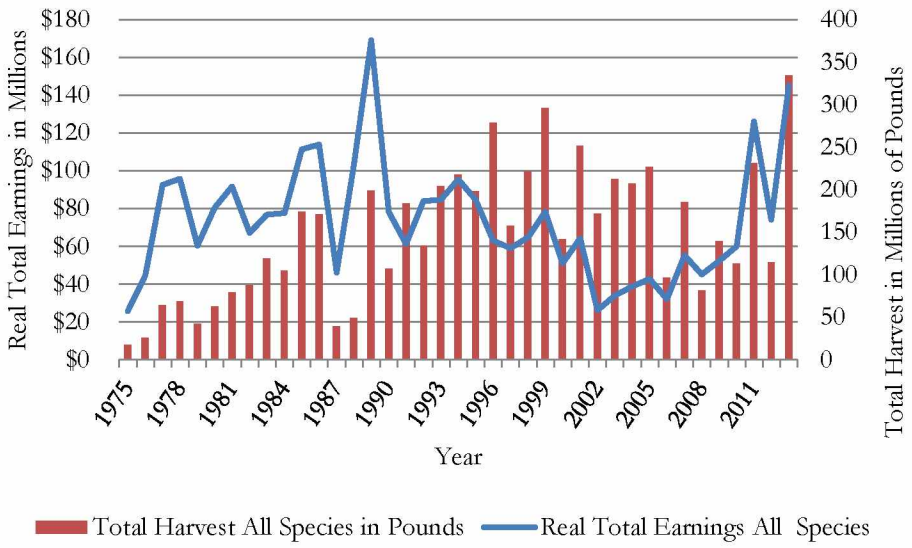

Figure 7. Total harvest and real gross earnings in the Southeast Alaska (S01A) salmon purse seine fishery, 1975 – 2013 (CFEC, 2014).

Change in Product Form

Pink Salmon represents the vast majority of the S01A fishery harvest. Over time, Southeast Alaska processors have shifted production from low value canned Pink Salmon to higher value frozen products. Figure 8 displays the percent of total wholesale value by product form while Figure 9 displays the information by percent of net weight by product form. In both value and weight, the shift away from lower value canned salmon to higher value frozen product is evident beginning in the early 2000's.

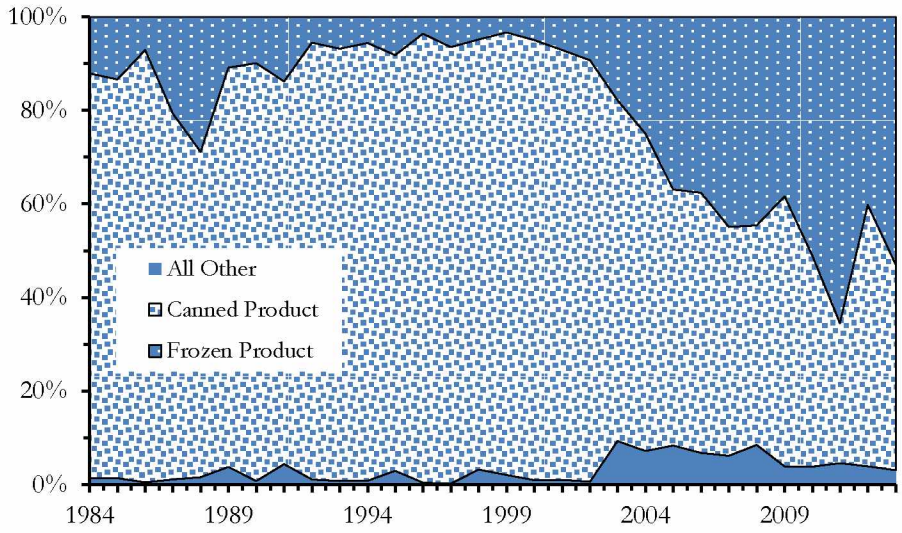

Figure 8. Southeast Pink Salmon percent of total wholesale value by product form, 1984-2013 (ADF&G, 2014).

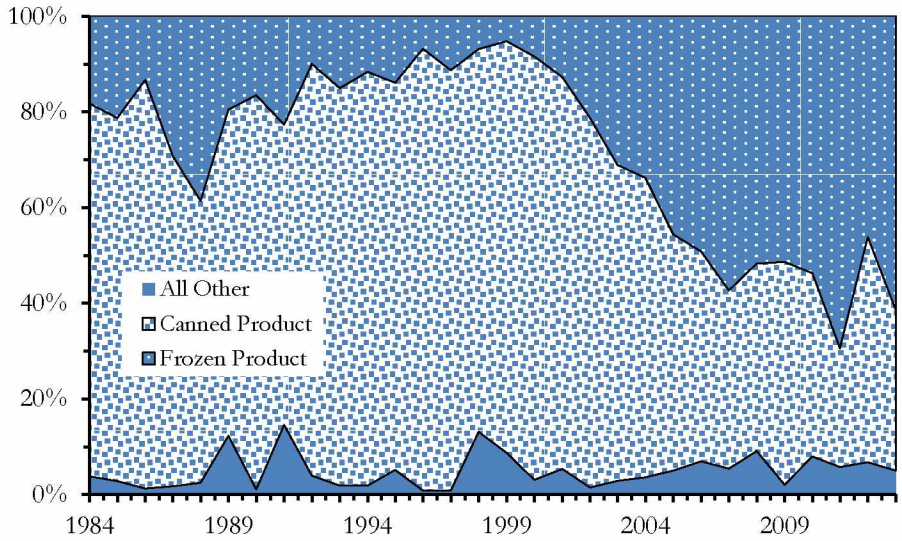

Figure 9. Southeast Pink Salmon percent of net weight by product form, 1984 – 2013 (ADF&G, 2014).

Mean Gross Earnings per Permit Fished

Mean real gross earnings per permit fished is an index of the return to fishing an S01A permit. Mean gross earnings fell to $95,329 per permit fished in 2002, a fifth of the relative high of $462,760 in 1989 and 18% of the 2013 high of $523,137. Figure 10 presents the mean real estimated gross earnings per LEP fished and the number of LEPs fished in the S01A fishery. While not every permit

fished earns an equal share of the fishery's revenue, variations in mean earnings per permit highlight the decline in earnings during the early 2000's and recent increases. The year 2013 stands out as a record year buoyed by a record Pink Salmon return and harvest in Southeast Alaska (Gray et al., 2014). Recall that the CFEC issued a total of 419 permanent LEPs, but that the CFEC does not only issue permanent LEPs. While a fisher's application is being decided by CFEC adjudications, the fisher receives an interim entry permit that allows entry into the fishery. An interim entry LEP cannot be transferred and is not considered permanent. Allocation of permanent permits can take many years. Figure 11 rescales Figure 10 and provides the mean gross earnings per total permits (fished or unfished and permanent or interim) in the fishery. Appendix 1 provides time series information on the count of permanent and interim entry permits renewed in the fishery. Figure 10 counts all permits fished in the fishery whether they were permanent LEPs or interim entry permits that were fished while an applicant was waiting for final adjudication of their permit.

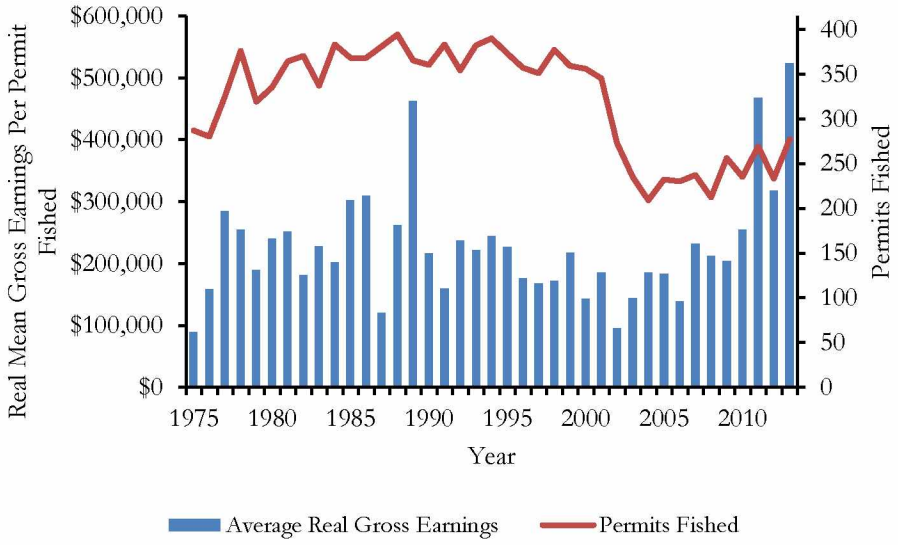

Figure 10. Mean real gross earnings per fished limited entry permit and number of fished limited entry permits in the Southeast Alaska S01A fishery, 1975-2013 (CFEC, 2014).

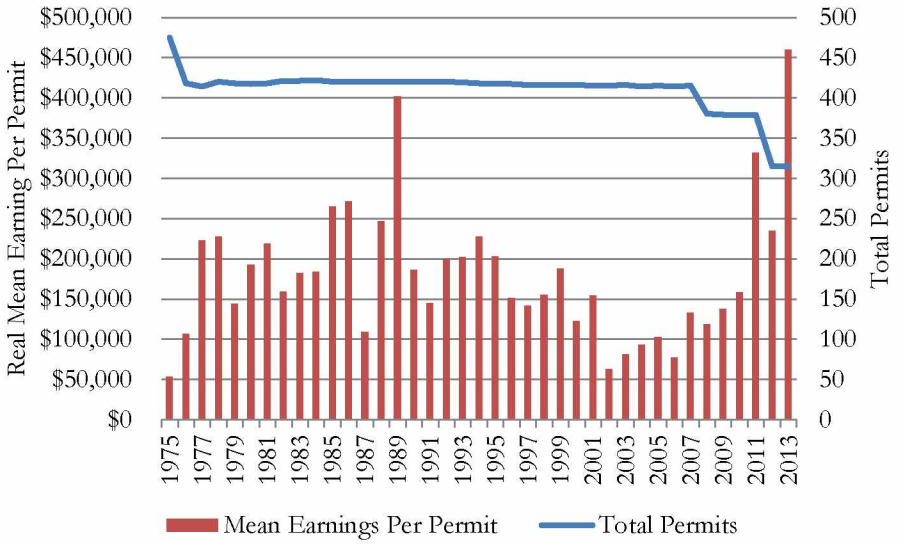

Figure 11. Mean real gross earnings per limited entry permit (fished or unfished and permanent or interim) and total number of limited entry permits in the Southeast Alaska S01A fishery, 19785-2013 (CFEC, 2014).

Permit Value

The asset value of LEPs reflects the discounted net present value of expected earnings in perpetuity (Karpoff 1984a; Karpoff 1984b; Huppert et al., 1996; Knapp, 2011). Expected earnings are informed by past earnings (Karpoff, 1984a; Knapp, 2011). Thus, changes in the market value of LEPs can be used as a measure of changes in permit-holder expectations about future earnings. Huppert et al. (1996) found that for Alaska drift gillnet salmon LEPs, the LEP system created enduring economic rents that are capitalized in the asset value of the LEP.

Each Southeast seine LEP is a homogenous use right. The permit, when renewed annually with the CFEC allows the permit holder access to harvest salmon in the commercial salmon seine openings throughout the Southeast Alaska salmon registration area. The majority of permit transactions within this fishery have been by sale transaction (Shriver et al., 2014, p. 125). Roughly one quarter of all permit transfers are registered as gifts, 2.1% through trade, and 2% through "other" means (Shriver et al., 2014, p. 92). As a homogenous good, the value of every S01A LEP is identical. In this analysis like Karpoff (1983b), the LEP is treated as a capital asset, a use-right that entitles the right-holder to an expected flow of income over time.

LEP prices are determined in the open market through willing exchanges between individuals. When the LEP market is in equilibrium, the market-clearing price will be equal to the value placed on it by the marginal permit holder (Muse, 1990). The value the marginal permit holder places on the permit should equate to the present value of the stream of expected future net benefits the permit holder expects to receive from the use-access the permit explicitly confers to the holder (Huppert et al., 1996). If the market price of the LEP was higher than the value placed on the permit by the fisherman, then the fisherman would sell their LEP and the new equilibrium market price would be somewhat lower (Muse, 1990). The reverse is also true, if the market value of the LEP was lower than the reservation price of the marginal fisherman, prospective entrants would bid up the price of LEPs (Muse, 1990). The marginal fisherman may not be the least productive fisher. The marginal fisherman could be that the most productive fisher, as the most productive fisher may have the highest opportunity cost (Muse, 1990). Assuming that fishers are rational individuals they will buy and sell their use-permits in a manner that they think will be the most beneficial to them.

Information on permit prices is easily accessible to fishers. The CFEC reports monthly estimates and annual average permit values for each limited fishery (CFEC, 2014). In addition, multiple permit brokerages publish listing for permits wanted and permits listed for sale. Likewise, fishery performance information is also easily accessible—historical gross earnings estimates, by fishery, are available online from CFEC. The ADF&G also publishes salmon run projections so that fishers have preseason estimates of the number and age-composition of fish in the upcoming harvest year. Additionally, annual meetings between AMBs, researchers, hatcheries, processors, and S01A fishermen are held to discuss the previous season and plan for the following.

Figure 12 displays a time-series graph of annual average estimates of S01A LEP value from 1982 through 2013 (CFEC, 2014). These estimates represent mean arms-length transactions (Shriver et al., 2014). Excluded from CFEC permit value reports are those permits sold for prices substantially below the mean as well as transactions that reflect transfers to relatives or close friends (Shriver et al., 2014). Nominal annual average estimated permit values are graphed in blue and real (inflation adjusted, base 2013) permit values are graphed in red. LEP prices were elevated by strong exvessel salmon prices and gross earnings in the late 1980's and early 1990's. The two vertical lines delineate buyback years. The nadir of S01A LEP value occurred in 2002, when in inflation-adjusted dollars, the permit value was $29,310. When the price of salmon fell, the concomitant drop in permit prices was a signal that fishers did not believe the remuneration of participation in the fishery would be worth as much as it had been in the recent past. Since that time, there has been a sharp increase in real permit prices; permit value reached a new high of $300,800 in 2013. What is not clear from the raw

numbers, and will be explored in this analysis, is the extent to which the rise in permit value is due to the buybacks rather than increases in catch and price.

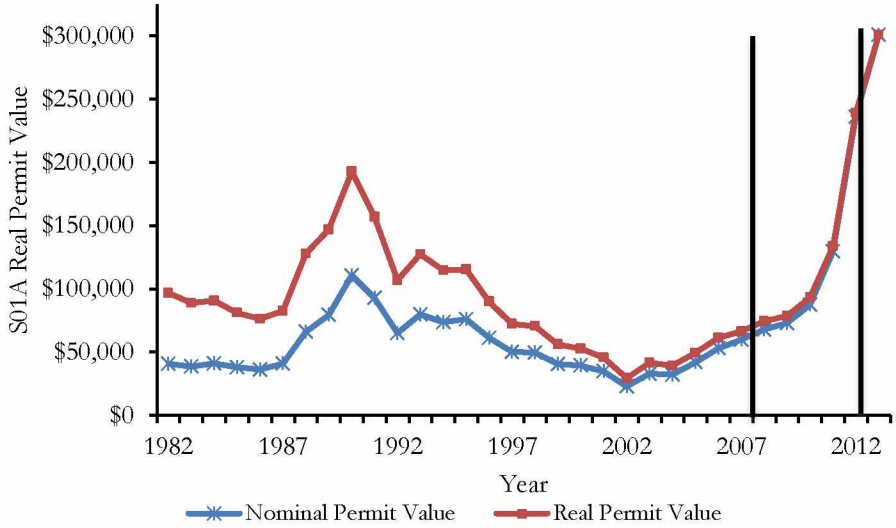

Figure 12. Real and nominal S01A LEP value fishery 1982 – 2013 (CFEC, 2014).

Northern Economics (2014) reviewed the buyback in the S01A LEP fishery and speculated that the rise in LEP value beginning in 2010 was fueled in part by speculation over the impeding buyback. In the long-run supply of S01A LEPs shown in Figure 3, the supply of LEPs is fixed by the amount the state has issued. In the short-run, the transactional market for S01A LEPs, the number of permitees willing to sell their permits will change with a rise in permit value caused by a shift in demand. The buyback financed by the federal loan used in 2012 was known long before the bidding process actually began. This may have caused an increase in demand for S01A permits leading up to the buyback, as shown in the short-run model in Figure 13.

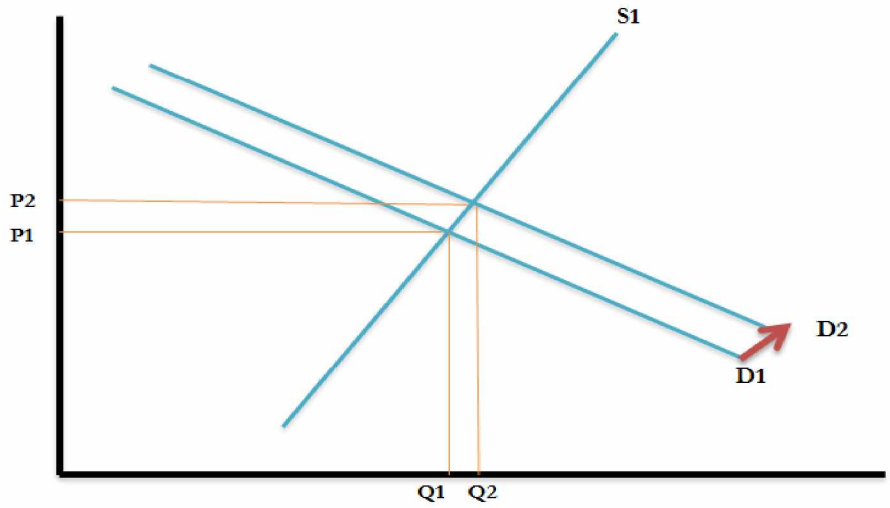

Figure 13. Conceptual representation of changes in the equilibrium price of S01A LEPS in response to increased (D1 to D2) short-run demand precipitated by planned buyback of permits.

Permit Latency

Beginning in the 1990's and continuing into the early 2000's, the price of Alaska salmon dropped across the state, including in the S01A fishery. Increased production of farmed Atlantic salmon and a shifting demand in global salmon markets reduced willingness to pay for Alaskan salmon and reduced exvessel prices throughout Alaska (Herrmann et al., 1993; Herrmann, 1994; Barnett et al., 2003; Williams et al., 2009). Because catches stayed roughly constant, gross earnings for Alaska salmon fisheries dropped in concert with the decline in exvessel prices. The reduction in current and expected future gross earnings caused the asset value of salmon LEPs to drop, leaving many permitees with debt burdens in excess of the market value of their permits. As a consequence of low exvessel prices, unsustainable debts, and high operating costs, many permitees did not fish their LEPs. These latent (un-fished) permits allowed larger average catches for those who continued fishing and thus helped reduce the erosion of their average gross earnings. Fishery participation in the S01A fishery (permits fished) dropped from a high of 394 permits fished in 1988 to a low of 209 permits fished in 2004 (Figure 14). Note the substantial decrease in participation beginning in 2001; in 2004, nearly half of all permits were not fished (Figure 14).

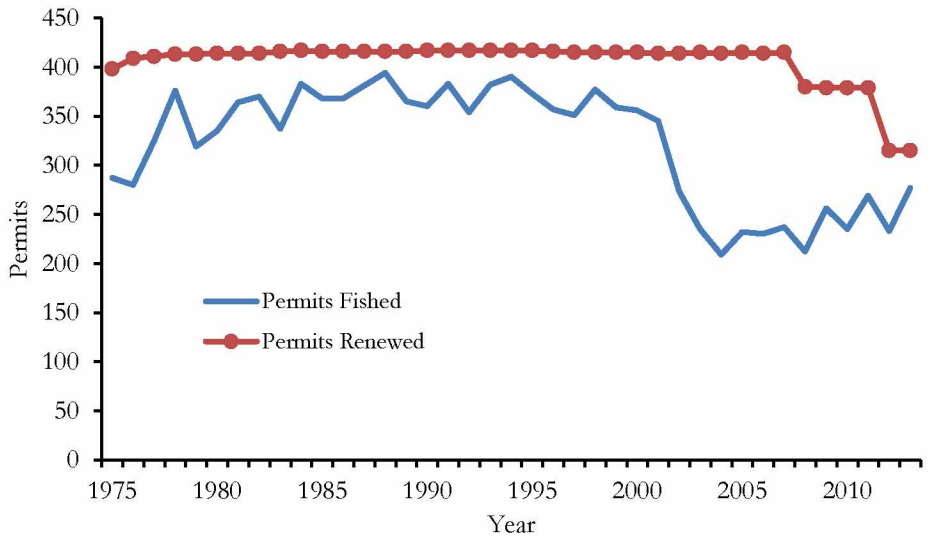

Figure 14. Permits renewed and fished in the S01A fishery, 1975 – 2013, (CFEC, 2014).

Momentum for Buyback

In response to the economic crash of Alaska's salmon fisheries in the late 1990s, Alaska's salmon fishermen, policy makers, and processers explored ways to improve the market for Alaska wild salmon, increase product quality, reduce costs, and restructure Alaska's salmon fisheries (CFEC, 1998).

As real exvessel salmon prices started to slowly recover, so did mean gross earnings. As returns increased, the specter of increased participation (and lower returns) from latent LEPs returning to the fishery loomed large over permitees. Many ideas were proposed to restructure Alaska's limited salmon fisheries to allow greater returns to permitees (Barnett et al., 2003). S01A permitees through, the non-profit corporation the Southeast Revitalization Association (SRA), worked with state and federal government to pursue changes in state law to allow a private buyback of S01A LEPs. The SRA was the first salmon fishery organization organized under 2002 legislation that encouraged formation of regional salmon fishery organizations for the purpose of fleet consolidation.

The SRA pursued both federal grant money and a federally backed fishery reduction loan to purchase and permanently retire S01A LEPs. The SRA's original plan had been to use the federal grant money in conjunction with the federally-backed fishery reduction loan. In praxis, the process of modifying a federal program to a state-permit fishery took longer than stakeholders expected (PSVOA, 2008). The SRA was the first to try use the federally backed fishery reduction loan under Section 312 (b) of

the *Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006* (MSA) to retire permits from a state-managed fishery (P.L. 109-479). All other programs using the fishery reduction loan program for buyback have been for federally managed fisheries.

ADF&G Management of the Southeast Alaska Salmon Purse Seine Fishery

The ADF&G manages the S01A fishery based on inseason assessments of the primarily target species, Pink Salmon and Chum Salmon to meet escapement goals and provide for sustained yield harvests (Gray et al., 2014). Regulations allow salmon purse seine fishing in designated districts that are open and closed to fishing set by AMBs through EO. Figure 15 is a map of the districts. ADF&G splits the large area open to salmon seine fishing in Southeast into two management areas for purposes of forecasting, inseason management, and calculating harvest. The two sub-management areas are Southern Southeast (Districts 1 – 7) and Northern Southeast (Districts 9-14). Although subdivided into two distinct areas for management purposes, S01A LEP holders are free to fish in any area open to fishing as the entire area in one salmon registration area. AMBs coordinate management across the sub-districts to distribute seine effort (Gray et al., 2014). Inseason management actions made by AMBs are predicated by inseason assessments of run strength based on aerial and foot surveys of spawning grounds, test fishing, and dockside sampling (Gray et al., 2014).

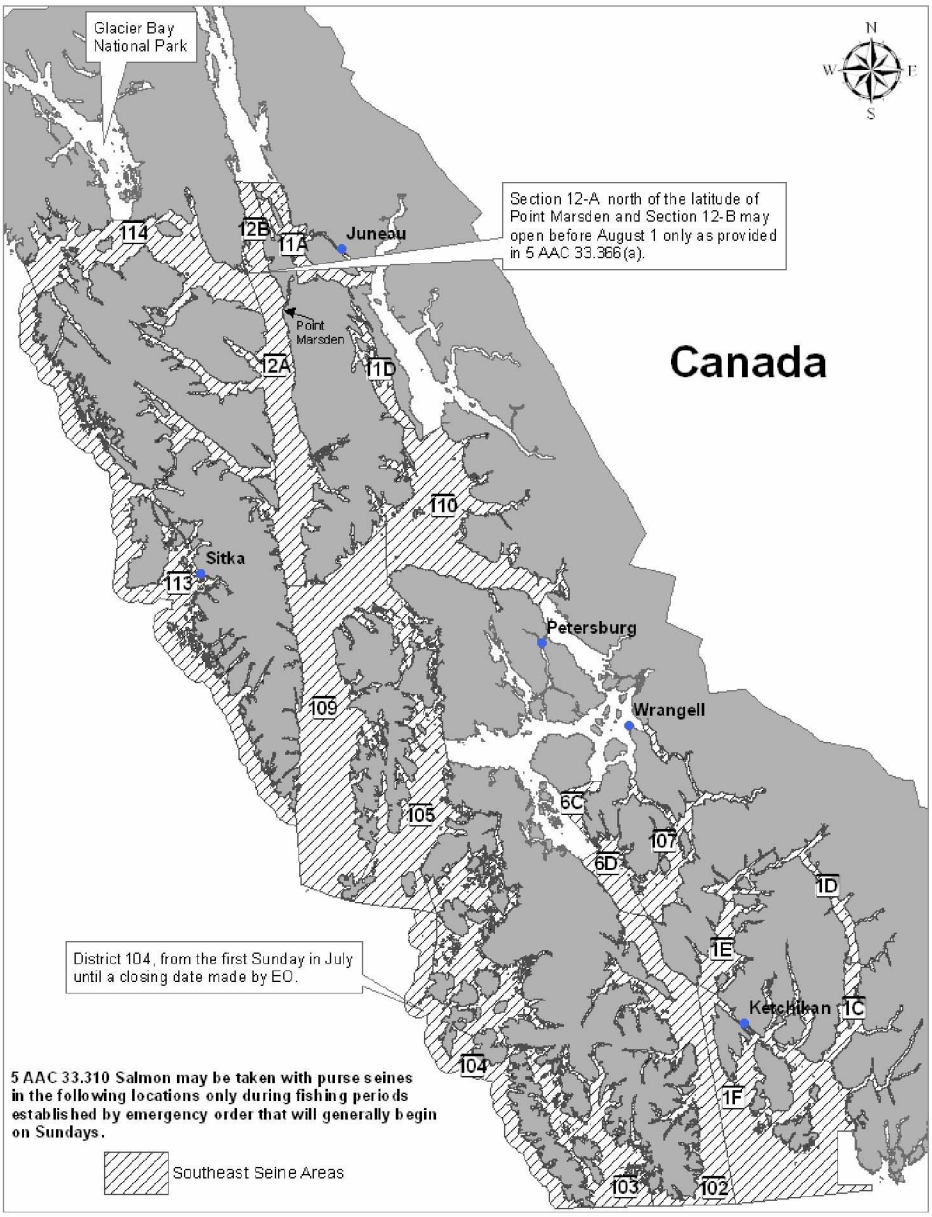

Figure 15. Southeast Alaska purse seine fishing areas (ADF&G, 2014).

Alaska statutes limit the length of salmon seine vessels to 58 feet overall (AS 16.05.835). Regulations dictate the confines of seine nets allowed in the fishery (5 AC 33.332). The vessel length limitation was implemented before limited entry as a means to control effort. The percentage of limit seiners in Southeast increased from 4.8% in 1978 to over 50% in 2008 and mean vessel horsepower has increased from 218 horsepower to 335 horsepower over the same period (Iverson and Farrington, 2010).

The fishery's harvest is augmented by hatchery-produced salmon produced by the Northern Southeast Regional Aquaculture Association, the Southern Southeast Regional Aquaculture Association, Douglas Island Pink and Chum, Inc., and Armstrong-Keta, Inc. These hatchery-produced salmon that return are part of the commercial common property fishery. In 2013, hatchery-produced salmon were harvested in six Terminal Harvest Areas where hatchery reared fish enter terminal areas near hatchery release sites and nine hatchery cost recovery locations (Gray et al., 2014). Management focus is concentrated on managing the harvest of wild stocks and the harvest of hatchery fish according to allocative decisions approved by the Board of Fisheries (Gray et al., 2014).

2008 Buyback of 35 S01A Permits

In November of 2005, Congress allocated $3 million dollars in grant money to the SRA for fleet consolidation.[9] The SRA used the federal grant, administered by ADF&G, to purchase and retire 35 S01A LEPS in 2008 using a voluntary, reverse auction. The SRA's goal was to retire at least 10% of the permanent S01A LEPs (SRA, 2008). At the time of initial notice of auction was mailed to all S01A permitees in March, 2008 there were 415 permanent permits (Shriver et al., 2014). A total of 82 bids were submitted to the SRA (SRA, 2008). Individual bids ranged from $44,000 to $700,000 (nominal) (SRA, 2008). At the time of the bidding process, the published LEP value was reported by the CFEC was $65,600 (nominal) (2014). The SRA initially accepted 35 bids for a total of $2,798,115 (nominal). Some bidders withdrew their bids after they were accepted by the SRA, so the next highest bids were accepted for a new grand total of $2,870,355 (nominal) (SRA, 2008). The accepted bids were not included in permit price calculations for CFEC permit value report (CFEC, 2014). The 2008 buyback successfully retired 35 permits from the S01A fishery, or 8.4% of all S01A LEPs.

2012 Buyback of 64 S01A Permits

Congress first passed legislation to authorize a reduction loan for the S01A fishery in December 2004 as part of the *Consolidated Appropriations Act, 2005* (P.L. 108-447). The law authorized a fishing capacity reduction program for the Southeast Alaska purse seine fishery with a federal loan of $50 million with a 30-year term and $500,000 directed to the Pacific Coastal Salmon Recovery for the cost of the loan (P.L. 108-447 Title II, Division B, §209). The original federal reduction loan (P.L. 108-447) authorization was amended in January, 2007, by passage of the *Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006* (P.L. 109-479). The amendment reduced the

[9] Conference Report on H.R. 2862, Science, State, Justice, Commerce and Related Agencies Appropriations Act.

fleet reduction loan from $50 million to $25 million (P.L. 109-479 §121). In addition, the law exempted the Southeast Alaska Fisheries Communities Capacity Reduction from §312 of the Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1861a) except for subsections (b)(1) (c) and (d). Section 312 (b)(1)(c) states that the program, "is cost-effective and, in the instance of a program involving an industry fee system, prospectively capable of repaying any debt obligation incurred under section 1111 of title XI of the Merchant Marine Act, 1936." Section (d) mandates that the program is subject to referendum approved by a majority of the permitees. The law set a 3% fee ceiling on fees paid by the remaining permitees and set the term of the loan for 40 years. Additionally, the law clarified that the program, "shall be conducted under Alaska law by the Southeast Revitalization Association" (P.L. 109-479 §121).

At the end of November 2011, the SRA sent bid packets to every holder of a valid S01A permit using permit holding and address information from the CFEC (SRA, 2012). Unlike the 2008 program, all bids were irrevocable, meaning that a bidder could not withdraw or modify their bid once submitted (76 FR 61985). In addition, the reduction plan had to be approved by NMFS and approved by a majority of the fishery's LEP holders in a referendum vote. Seventy-four bid packets were returned by the December 28, 2011 deadline (SRA, 2012). The SRA ranked the bids from lowest dollar amount to highest dollar amount. In nominal terms, the lowest dollar bid was $175,000 and the highest was $350,000 (SRA, 2012). At the time of bidding, December 2011, the published CFEC permit value was $152,800 (nominal) (CFEC, 2014). The SRA had to make the determination whether the number of accepted bids would be, "sufficient to achieve a substantial reduction in harvest capacity and increases in economic efficiencies" (76 FR 61987).

Of the 74 bids, the SRA accepted 64, for a sum of $13,133,030 (nominal) and an average price per permit of $205,204 (SRA, 2012). Of the accepted bids, the bids ranged from $175,000 to $240,000 (SRA, 2012). The 10 non-accepted bids ranged from a low of $248,000 to a high of $350,000 and a mean price of $268,450 (SRA, 2012). These 10 bids were not accepted by the SRA because they were determined to be, "… an excessive deviation from current fair market values, and, therefore, not cost-effective" (SRA, 2012). Moreover, the SRA maintained that if they accepted bids in excess of $240,000, a vital segment of permitees might vote against the buyback in the referendum vote (SRA, 2012).

The SRA notified the 63 individual bidders (one individual had 2 accepted bids) that their bids were accepted (SRA, 2012). Unlike the 2008 buyback administration, once the SRA accepted the 64 bids,

the permitees were contractually obligated to follow through with relinquishment, on the condition that the majority of permitees in the S01A fishery approved the plan by referendum.
The SRA submitted the *Capacity Reduction Plan for the Southeast Alaska Salmon Purse Seine Fishery* to NMFS in January, 2012 (SRA, 2012). The Reduction Plan included the SRA's supporting rationale that the plan would be cost effective, achieve the maximum sustainable reduction in capacity at the least cost, increase harvesting productivity for post-reduction permitees, improve flexibility in the conservation and management of the fishery and that the post-reduction fishery would be capable of repaying the loan (76 FR 61985). The SRA presented two main reasons why the reduction was cost effective. First, the average price of the 64 accepted bids was reasonably related to current market LEP value and the fair market price the SRA believed would result from the removal of LEPs. Second, the SRA concluded that the cost of the loan was justified by the reduction in fishing capacity.

It is interesting to note that the SRA projected that the average 2012 CFEC published permit value would be close to the mean accepted bid amount of $205,204 (nominal) (SRA, 2012). In fact, the 2012 average permit value was $236,000, nearly $31,000 more than the mean accepted bid price.[10] The reasoning behind the SRA's confidence in permit value increases post-reduction were articulated as:

> The present fair market value is predicated on a total of 379 permits. If the Plan is approved and subject to a successful referendum, 315 permits or 83.1% of the existing permit total will remain eligible to participate in the fishery. The SRA maintains this reduction will result in a substantial increase in the fair market value of the remaining permits to a level equal or greater than the average accepted bid amount (SRA, 2012).

The conclusion of the SRA's Reduction Plan succinctly summarizes the SRA's reasoning behind implementing a reduction plan even as the economics of the fishery were improving:

> The SRA recognizes there has been a substantial change in circumstances since the 2006 enactment of federal legislation to establish and implement this program. The initial motives for creating the program were predicated on stagnant exvessel salmon prices and lack of processing capacity, which were threatening the very economic viability of the fishery. Today the overriding motivation is to stabilize harvest productivity by those now participating in the fishery while maintaining orderly management of the fishery. Although the circumstances and challenges may have changed, the SRA maintains the solution remains the same - sustainable and cost-effective reduction in fishing capacity. Fortunately, the correctness of the SRA decision is ultimately and rightly left to the permit holder in the referendum process (SRA, 2012).

[10] Accepted bid amounts were not used to calculate the published CFEC permit value.

NMFS approved the SRA's Reduction Plan on February 24, 2012 (77 FR 12568). In March, 2012, NMFS published a list of all 379 S01A permitees who were eligible to vote in the referendum in the Federal Register, a request for comments on the list, and notice of public meetings (77 FR 12568). NMFS held the informational public meetings in Seattle, WA, Petersburg, AK, Ketchikan, AK, and Sitka, AK (77 FR 12568). The referendum ballots were sent to each permit holder on March 30, 2012 (77 FR 19004). The vote was to approve the post-reduction fee of no greater than 3% of exvessel value to repay the $13,133,030 forty-year-term loan to purchase and permanently retire the 64 permits approved by the SRA, and subsequently NMFS. NMFS had to receive the ballots no later than 5 P.M. on April 30, 2012 to be considered valid (77 FR 19004). If a permit holder held more than one permit, they received one ballot for each permit they held (77 FR 19004).

NMFS received 269 votes within the voting period (77 FR 26744). Of the 269 votes, 215 approved the industry fees system necessary to repay the federal reduction loan. As the number of approval votes exceeded the necessary majority (190), the referendum was successful. NMFS published notice in the Federal Register with the names and permit numbers of permitees who would receive payments from NMFS (77 FR 26744).

In June of 2012, once NMFS received notice from the CFEC that permitees had relinquished their permits, payments were disbursed to the 63 former permitees (77 FR 26744). The reduction loan, amortized over a forty-year period, is to be repaid by the remaining S01A permitees. The exvessel fee to repay the loan has a ceiling of 3%, but NMFS can adjust the rate. If payments during the forty-year term at the 3% level are not sufficient to repay the loan, NMFS reserves the right to extend the term of repayment until the loan is paid in full. If ADF&G does not open the fishery during a year, the loan continues to accrue interest even though fee revenue is not collected (77 FR 26744).

NMFS published notice in the Federal Register that fee payment collection to service the reduction loan would begin on July 22, 2012 (77 FR 41754). The initial fee was set to 3% of exvessel value (including bonus payments) (77 FR 41754). Regulations mandate that the first buyer (processor) of salmon delivered under an S01A permit must collect the fee and disburse payments to NMFS on a monthly basis. NMFS uses ADF&G fish tickets and Commercial Operator's Annual Reports to verify fee payments. In June of 2013, NMFS revised the fee rate to 1.5% to be effective June 1, 2013 (78 FR 33810). NMFS reviews the tax rate each year to adjust for changes in anticipated fishery gross earnings. This means that in years when the fishery's earnings are expected to be low, the rate will be adjusted upward and represent a larger share of fishermen's earnings.

3.0 Methods and Analysis

Data Sources

ADF&G ENCOAR Database

The Commercial Operator's Annual Report (COAR) (ADF&G, 2014) is required by the Alaska Department of Fish and Game for all operations that buy, process, and/or sell fishery resources in Alaska (5 AAC 39.130 and 50 CFR 679). One section of the report is devoted to exvessel purchases, where processors provide information on average exvessel prices paid to fishers. Another section of the report is devoted to wholesale production. Production data includes processed product forms and wholesale price information.

CFEC Permit File

The CFEC permit file contains data on persons who hold or have held CFEC LEPs (CFEC, 2014). It originates from CFEC permit renewal and transfer forms. A CFEC LEP may be held by more than one person in a year but only one person at a time. LEPs may be transferred between individuals on a permanent or temporary (emergency) basis. An emergency transfer is a temporary transfer between individuals in the event of an emergency or unforeseen event. The Permit data file contains a field indicating the declared residency of permitees. When a permit holder renews an existing permit, or receives a permit through permanent transfer, they must declare whether they are a resident of Alaska. The CFEC permit file was used to identify the number of S01A LEPs renewed each year and all market transactions of LEP transfers and LEP value.

CFEC Gross Earnings File

The CFEC Gross Earnings File (CFEC, 2014) was used as a source of exvessel price and gross earnings estimates. The CFEC Gross Earnings file is based upon ADF&G fish tickets and is enhanced with CFEC data on fishing permits and estimated gross earnings. Earnings information is derived primarily through CFEC analysis of fish tickets and COAR data. Average exvessel price-per-pound estimates are calculated for each area (Southeast Alaska, Prince William Sound, Kodiak, etc.), species, gear, and delivery type (gutted, in-the-round, etc.) reported on fish tickets. These average prices are then applied to fish ticket line item data to estimate gross earnings. Gross earnings were calculated for the S01A fishery using a number of filters. Only commercial catches were used to calculate gross earnings. Gross earnings were adjusted for inflation using CPI, with 2013 as the base year.

Buyback Cohort Summary Statistics

The individuals who sold their LEPs in the buybacks are of interest in terms of equity, distribution, and motivations. The two cohorts of individuals who sold permits in the buyback were, by in large, older (average of 58 years) nonresidents who used the buybacks as an opportunity to leave the fishery. The 2008 cohort was comprised of 74% nonresidents and 26% residents (CFEC, 2014). The 2012 buyback cohort was comprised of 67% nonresidents and 33% residents (CFEC, 2014).

Figure 16 presents the permit holdings of the 2008 buyback cohort before and after buyback; it compares permit holding at year-end 2007 with year-end 2013. Figure 16 presents only permit holdings so this does not mean that the permits were actively fished. Appendix 2 provides a time-series by individual of S01A LEP holdings. Appendix 2 does not follow the longevity of the particular LEP that was sold in the buyback, rather it is a time-series following the 2008 buyback cohort and whether at year-end they held an S01A LEP. There were no conditions set on future participation in the fishery. Six out of the 35 individuals who sold a LEP in the 2008 round still held a S01A LEP after the buyback was completed. Out of the 35 individuals in the 2008 buyback cohort, 24 (68.5%) did not hold any Alaska fishery permits at year-end 2013. The individuals could still hold permits in other states. The other 11 individuals in the cohort held at least one Alaska fishery permit at year-end 2013.

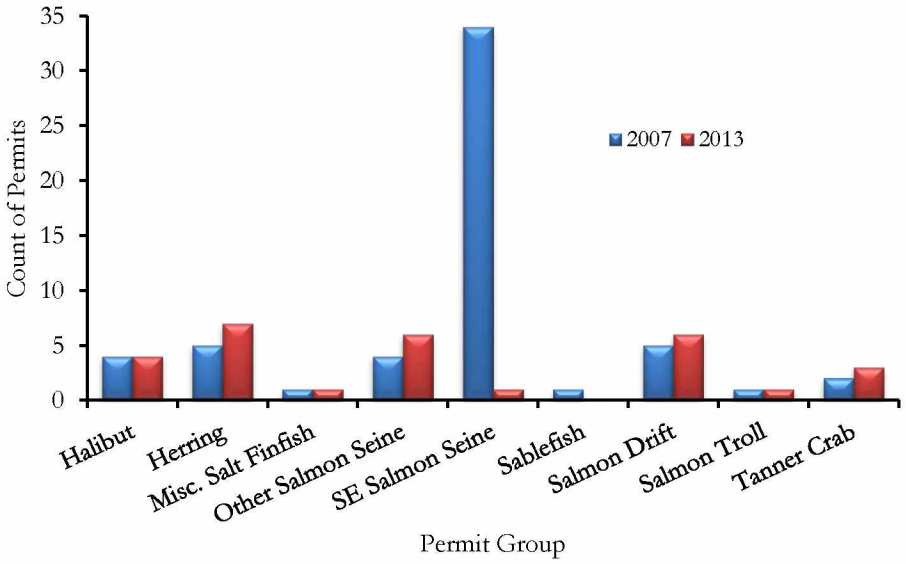

Figure 16. CFEC permit holdings by the 2008 buyback cohort before and after buyback (CFEC, 2014).[11]

[11] Note here that while the halibut fishery is managed by NMFS RAM, IFQ fishers still require a non-limited CFEC halibut permit to land their harvest in the State of Alaska.

Figure 17 presents the permit holdings of the 2012 buyback cohort before and after buyback; it compares permit holding at year-end 2011 with year-end 2013. Figure 17 presents only permit holdings, this does not mean that the permits were actively fished. Appendix 3 provides a time-series by individual of S01A LEP holdings. Appendix 3 does not follow the longevity of the particular LEP that was sold in the buyback, rather it is a time-series following the 2012 buyback cohort and whether at year-end they held an S01A permit. Five out of the 63 individuals who sold LEPs in the 2012 round held a S01A LEP post-buyback. Out of the 63 individuals in the 2012 buyback cohort, 35 (55.6%) did not hold any Alaska fishery permits at year-end 2013. The individuals could still hold permits in other states. The other 28 individuals in the cohort held at least one Alaska fishery permit at year-end 2013.

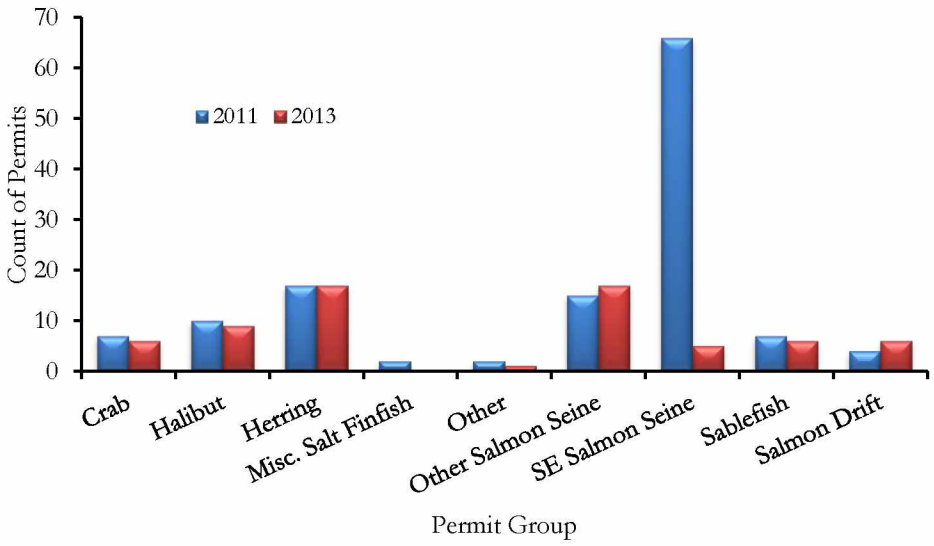

Figure 17. CFEC permit holdings by the 2012 buyback cohort before and after buyback (CFEC, 2014).[12]

Figure 18 presents information about the length of time LEPs sold in the 2008 buyback were held by the individual who sold their LEP in the buyback. The majority of LEPs sold in the 2008 buyback were held for less than 10 years where years held is the number of years the LEP sold in buyback was held by the individual who sold it. Figure 19 presents similar information about the 2012 buyback LEP holding duration. The majority (68.8%) of LEPs sold in the 2012 buyback were held for more than 10 years.

[12] Note here that while the halibut fishery is managed by NMFS RAM, IFQ fishers still require a non-limited CFEC halibut permit to land their harvest in the State of Alaska.

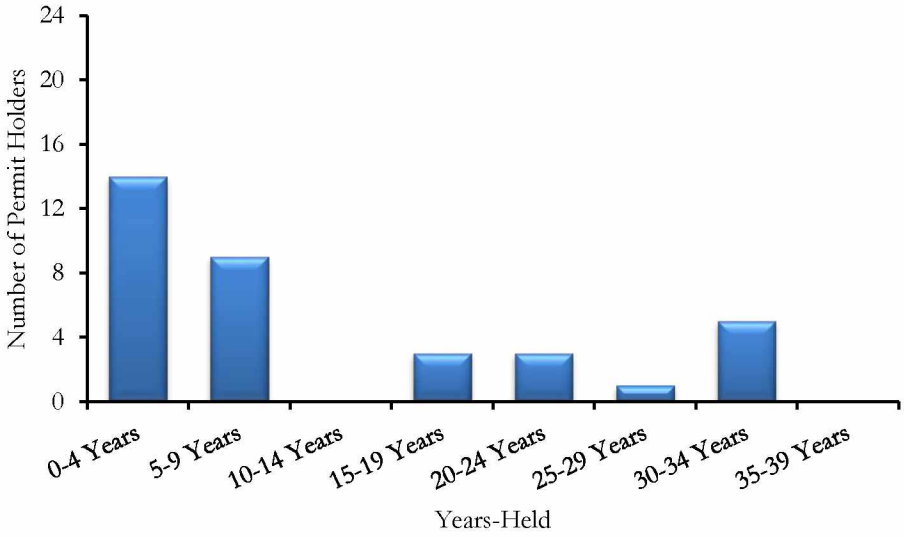

Figure 18. Frequency distribution of the number of years that 2008 buyback LEPs were held before buyback (CFEC, 2014).

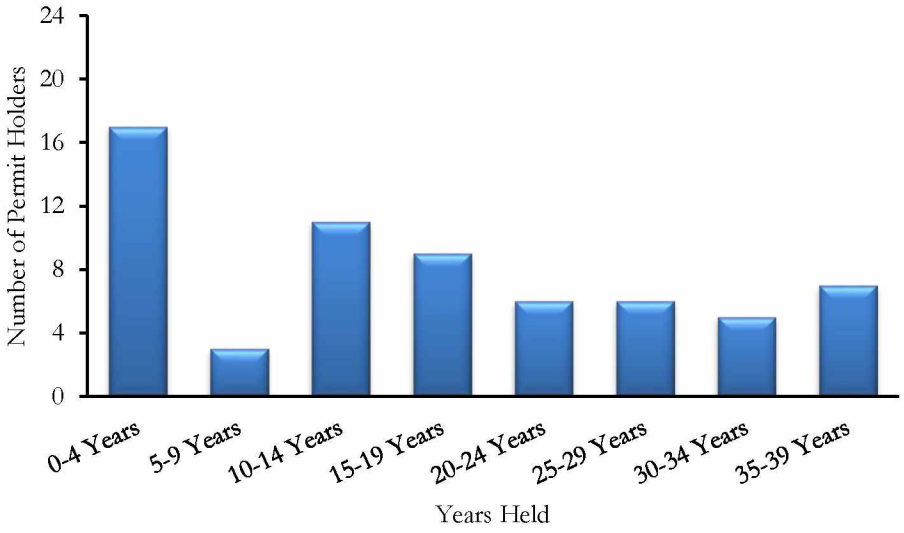

Figure 19. Frequency distribution of the number of years that 2012 buyback LEPs were held before buyback (CFEC, 2014).

Figure 20 presents the age category of individuals who sold a LEP in the 2008 buyback. Over 74% of individuals in the 2008 buyback cohort were over the age of 50. The mean age at the time of buyback was 58.3 years. Figure 21 presents the age distribution of the 2012 buyback cohort. The individual who sold two LEPs in the 2012 buyback is represented twice in the distributional graph. Over 81% of the 2012 buyback cohort was over the age of 50 at the time of buyback. The mean age in the 2012 buyback cohort was 58.7 years.

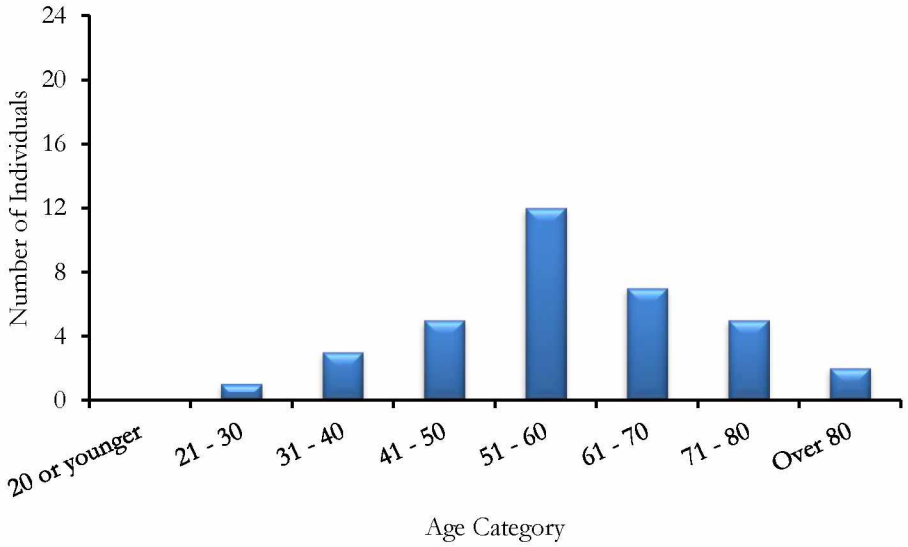

Figure 20. Age distribution of 2008 buyback cohort (CFEC, 2014).

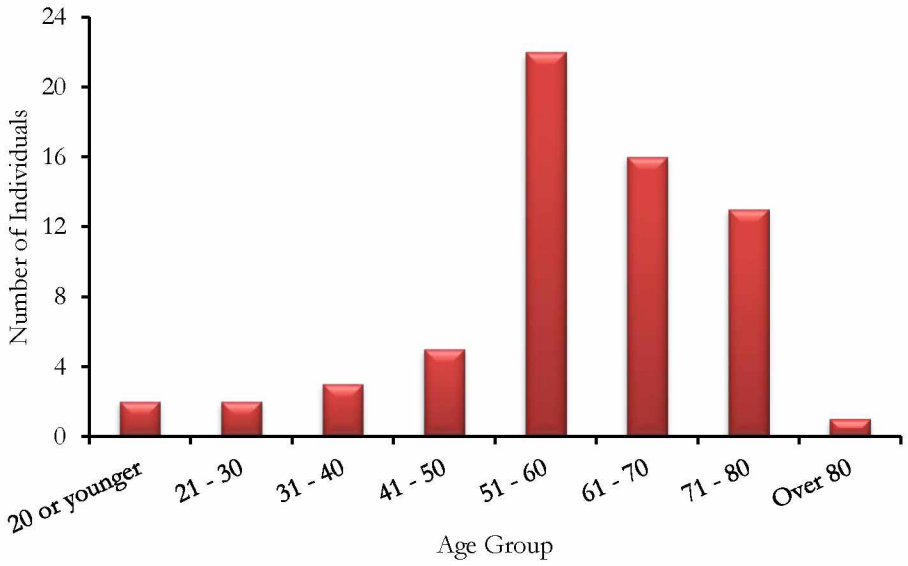

Figure 21. Age distribution of 2012 buyback cohort (CFEC, 2014).

It is important to know whether the LEPs bought in the buyback were actively fished or latent. If all LEPs were actively fished, the buybacks would have reduced active capacity, whereas if all the retired LEPs were latent, active capacity would not have been reduced. Appendices 4 and 5 present information about the fishing activity of the LEPs sold in the 2008 and 2012 buybacks. The tables represent whether the permit was associated with a landing in ADF&G fish tickets regardless of who

held the LEP. An "L" denotes the LEP was latent.[13] Over 80% of the 35 LEPs sold in the 2008 buyback were latent (not associated with landings in the five years prior to the 2008 buyback). Over 70% of the 64 LEPs sold in the 2012 buyback were latent (not associated with landings in the five years prior to the 2012 buyback). This means, that for the most part, the two buyback programs succeeded in removing potential rather than active fishing capacity.

Additional Bid Solicitation

The authorizing regulations did not limit the use of federal loan to a one-time deal (50 CFR 600.1107). As of this writing, the SRA still has $10.34 million available to purchase additional LEPs. The SRA opened up two additional rounds of bidding, one between December 28, 2012 and January 25, 2013 and the other between April 28, 2014 and May 30, 2014. The third and fourth rounds of bidding did not produce any bids that met with SRA approval. Nevertheless, it is interesting to compare how bid amounts changed across years.

Table 4 provides summary statistics from the bids during the four rounds of bidding (Robert Kehoe, SRA, personal communication). The number of bids offered decreased in each round, from a high of 82 bidders willing to part their permits in 2008, to only 9 in the last round in 2014. The minimum bid offered in each round has continued to rise, from a low of $47,608 (real) in 2008, to a low of $319,927 (real) in the last round in 2014. The mean and median bids have likewise followed an upward trend. The CFEC published permit value has increased during each period of bidding. The average deviation ((Bid – CFEC permit value)/ # of bids) from the CFEC's published permit value in the month bidding was open has likewise increased. The percent deviation is the average deviation from the CFEC permit value divided by the published permit value. The bids for 2008, 2012, and 2013 are statistically significant different from LEP sales in those same years. There is not enough data for 2014 permit sales to test significance. Table 5 presents the results of testing the difference between rounds of bidding. All rounds of bidding were statistically different from each other at the 1% level of significance except for the 2013 and 2014 rounds of bidding.

[13] An "L" in the years before 1990 may indicate either a permanent permit with no landings or a permit that the CFEC had not yet issued.

Table 4. Bid comparison matrix between all four rounds of bidding, 2013 dollars (CFEC, 2014; SRA, 2014).

	2008	2012	2013	2014
Total Number of Bids	82	74	11	9
Number of Accepted Bids	35	64	0	0
Minimum Bid	$47,608	$177,563	$265,000	$319,927
Maximum Bid	$757,397	$355,127	$450,000	$442,976
Mean Bid	$127,239	$216,449	$355,773	$383,147
Median Bid	$103,872	$202,930	$360,000	$388,835
Standard Deviation	$95,407	$28,551	$47,203	$38,465
CFEC Permit Value In Month of Bidding	$70,979	$155,038	$251,400	$306,441
Mean Deviation From CFEC Permit Value	$56,261	$61,411	$104,373	$38,465
Percent Deviation From CFEC Value	79.3%	39.6%	41.5%	25%

Table 5. Statistical significance (two tail p-values) of estimated difference between mean bid price during four rounds of bidding.

	2008	2012	2013	2014
2008	~	<.0001	<.0001	<.0001
2012	<.0001	~	<.0001	<.0001
2013	<.0001	<.0001	~	0.192
2014	<.0001	<.0001	0.192	~

Two things are apparent. First, fewer permitees are willing to offer up their permits in each progressive round of bidding. Second, those that are willing to offer up their permit do so at progressively higher reservation prices.

Dependent Variable

Yearly real (2013 base) permit value was used as the dependent variable. Permit values were adjusted using the U.S. Department of Labor's Consumer Price Index with 2013 as base. Real permit values are available for 1978 – 2013; 36 observations. Although, permit values are reported on a monthly basis, harvests are only made in the summer months. This particularity to commercial fishing data necessitated the use of annual data. Figure 22 presents the trend and correlation analysis output for annual real permit value: a time series plot of the observations, the corresponding autocorrelation function (ACF), partial autocorrelation function (PACF), and inverse autocorrelation function (IACF). The ACF and PACF graphs suggest that real annual permit prices follow an autoregressive AR(1) process (the ACF tails off slowly and the PACF cuts off after lag 1). The inverse autocorrelation function is not of much functional use in evaluation of these data as it is generally

used to identify seasonal autoregressive models and the yearly real permit price is not seasonal data. Like Karpoff (1984) and Huppert, Ellis, and Noble (1996), the AR(1) model is part of an adaptive expectations model where past profit (here lag of mean real gross earnings per permit fished) and LEP value in the last time period will explain permit price in the current time period.

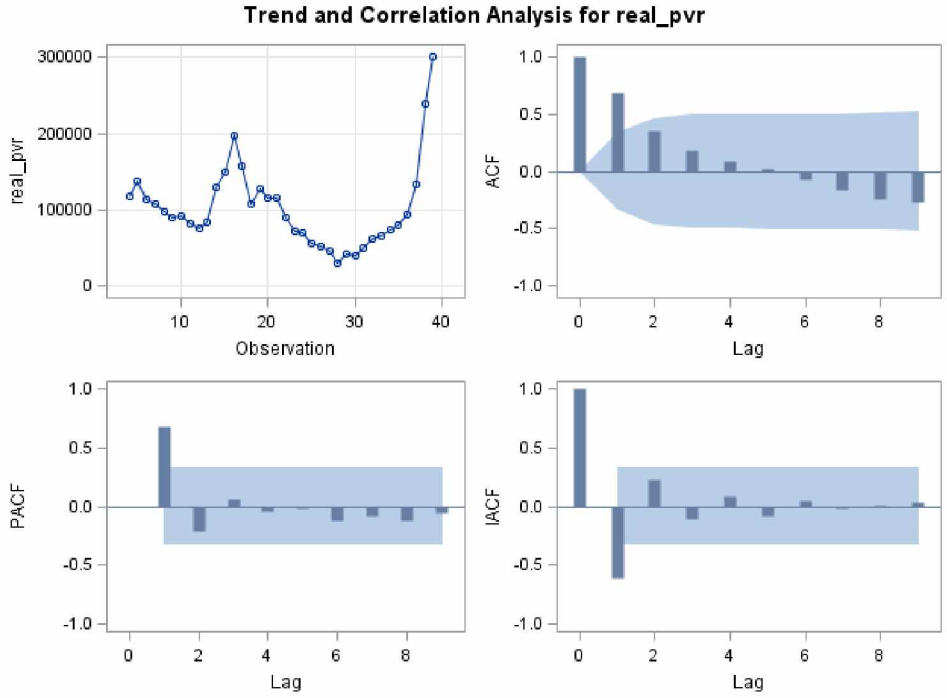

Figure 22. Trend and correlation analysis for annual mean real permit value.

Because a similar pattern of ACF and PACF values could arise from a random walk process, real annual mean permit prices were tested for the presence of unit roots. If annual mean permit prices are driven by a random walk process, their use as a dependent variable could lead to spurious conclusions about the influence of the explanatory variables. Testing for the presence of unit roots can proceed from the assumption that these data are characterized by a random walk (or random walk with drift or trend) or from the assumption that these data are not characterized by a random walk (or random walk with drift or trend). The most popular test statistic for the former hypothesis is the Augmented Dickey-Fuller (ADF) while the preferred test for the latter hypothesis is the Kwaitkowski-Phillips-Schmidt-Shin (KPSS) (Kwiatkowski et al, 1992). The choice between these hypotheses is not arbitrary but is instead driven by consideration of the relative likelihood that the observations result from the presence of deterministic trends or the presence of stochastic trends. Stochastic trends are characteristic of many financial time series and thus could be descriptive of variations in the price of LEPs. However, unlike most financial assets, salmon LEPs cannot be

purchased for pure speculation. Instead purchases must be approved by CFEC and are subject to a test of intent to fish. Moreover, empirical estimates conclude that LEP prices reflect the discounted expected value of net revenues which are determined by the quantity of expected salmon returns and expected exvessel prices (Karpoff, 1984b; Huppert et al., 1996; Newell et al., 2007). There is general agreement that salmon returns follow a stochastic nonlinear autoregressive process (the spawner-recruit relationship). Although some authors (e.g., Asche et al., 1999) have treated salmon prices as non-stationary time series processes, other authors (e.g., Herrmann et al., 1993; Williams et al., 2009) continue a tradition of representing salmon prices as the outcome of the interplay of systems of structural supply and demand relationships. Table 6 presents the results of KPSS test for stationarity for which we fail to reject the null hypothesis, and conclude that the series is trend stationary and thus suitable for use as a dependent variable in a structural time series regression model.

Table 6. KPSS test results for real yearly permit price.

Type	Lags	Eta	Prob10pr	Prob5pr	Prob1pr
Single Mean	3	0.127	0.347	0.463	0.739
Trend	3	0.129	0.119	0.146	0.216

Independent Variables

Table 7 presents the correlation analysis between real permit value and possible independent variables. These data were the data readily available within the CFEC Gross Earnings and Permit Files. As a first step, the correlation, or extent of linear association, between real permit value and the possible explanatory variables was examined. Some of these variables are highly correlated with each other or are factors in the product of one of the variables, i.e., Chum pounds and Chum real exvessel price per pound. This initial correlation table allows a comparison of the relationship between the independent variable, real permit value, and possible explanatory variables. All the correlation coefficients show expected sign and magnitude, except for Chum pounds. Not all of these variables were suitable for use in model estimation; if all variables had been included, problems of multicollinearity would have arisen. For example, lagged total gross earning and lagged mean gross earnings are highly collinear. Lagged real mean gross earnings was selected for inclusion in the model because it had a stronger relationship to real permit value than did the lag of real total gross earnings. Because pounds landed and exvessel prices are used to calculate gross earnings, they could not be included.

Table 7. Pearson correlation coefficient (r) table for real permit value.

Variable	r	Prob |ρ| ≠ 0	OBS
Binary buyback dummy	0.191	0.264	36
Chum pounds	-0.186	0.279	36
Chum real gross earnings	0.290	0.086	36
Chum real exvessel price/lb.	0.279	0.010	36
Lag of real mean gross earnings	0.696	<.001	36
Lag of real total gross earnings	0.541	0.001	36
Pink pounds	0.109	0.526	36
Pink real gross earnings	0.527	0.001	36
Pink real exvessel price/lb.	0.311	0.064	36
Lag of real permit price	0.861	<.001	35
Second lag of real permit price	0.535	0.001	34

Lag of Real Permit Price

The lag of real permit price was used for an autoregressive model of level one. Graphical analysis of the ACF and PAC (Figure 15) indicate that an AR(1) model would be an appropriate time-series model. Following Karpoff (1984) and Huppert et al. (1996), the AR(1) model was used to represent an adaptive expectations framework where past profit (here lag of mean real gross earnings per permit fished) and LEP value in the last time period will explain permit price in the current time period.

Binary Buyback Dummy Variable

The binary buyback dummy variable was set equal to 0 for years before 2008 and 1 for all years after. Although there were two distinct rounds of buyback, one in 2008 and 2012, there are yet not enough observations following the 2012 buyback to support creation of a second distinct buyback dummy variable. The binary buyback dummy variable was included as part of the models to test whether the buyback caused a statistically significant increase in real permit value in the years when buyback reduced the number of LEPs.

Lag of Real Mean Gross Earnings per Permit Fished

Mean real gross earnings per permit fished is an index of the return to fishing an S01A permit. The previous year's mean gross earnings per permit fished provides a signal to other fishers of what the returns to fishing an LEP in the fishery might be. Although mean gross earnings does not incorporate any factor of the costs associated with an operation, information on costs is not reasonably available and therefore net real earnings cannot be calculated or used. Figure 23 provides trend and correlation analysis for mean real gross earnings per permit fished.

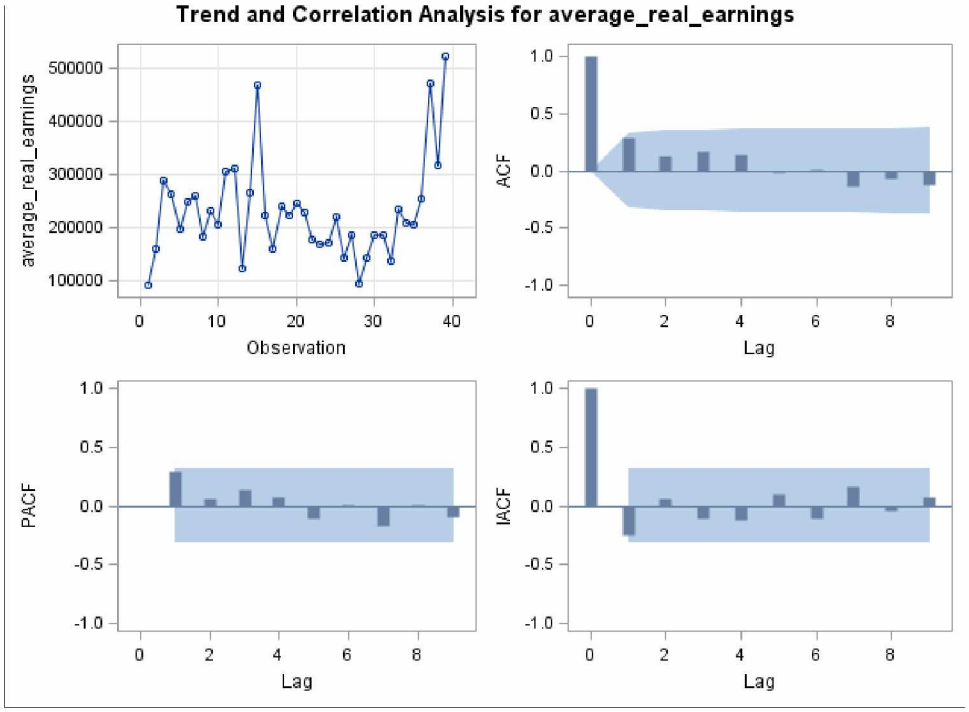

Figure 23. Trend and correlation analysis for mean real gross earnings per permit fished.

Table 8 provides the KPSS test for stationarity for which we fail to reject the null hypothesis, and conclude that the series is trend stationary.

Table 8. KPSS test results for mean real gross earnings per permit fished.

	Lags	**Eta**	**Prob10pr**	**Prob5pr**	**Prob1pr**
Single Mean	3	0.158	0.347	0.463	0.739
Trend	3	0.144	0.119	0.146	0.216

Models

The SAS ETS® AUTOREG procedure was used to estimate the AR (1) model of yearly permit value. This is in line with an adaptive expectations model where past profit (here lag of mean real gross earnings per permit fished) and LEP value in the last time period will explain permit price in the current time period (Karpoff, 1984; Huppert et al., 1996). The buyback binary variable was added to test whether the buyback had a statistically significant impact on LEP value. Three candidate models were tested in linear form, log-log form and log-level form, where PP_{t-1} is the lag of real permit value,

D_t is the dummy buyback variable, $AvgRev_{t-1}$ is the lag of real average earnings, and u_t is a white noise error term. All models included a lag of the dependent variable (real permit price) which may cause concern with problems of serial correlation and biased estimates of the model coefficients.

Model 1: $PP_t = \beta_0 + \beta_1 PP_{t-1} + \beta_2 D_t + \beta_3 (AvgRev_{t-1}) + u_t$

Model 2: $ln(PP_t) = \beta_0 + \beta_1 ln(PP_{t-1}) + \beta_2 D_t + \beta_3 ln(AvgRev_{t-1}) + u_t$

Model 3: $ln(PP_t) = \beta_0 + \beta_1 (PP_{t-1}) + \beta_2 D_t + \beta_3 (AvgRev_{t-1}) + u_t$

Table 9 presents the parameter estimates from each model. At the 10% level of significance, all models provide that the buyback did increase real permit values as expected by examination of the long-run and short-run models provided in Figures 3 and 14. The buyback coefficient in each model has the expected sign. That is, the estimated coefficient suggests that the buyback had a positive real effect on permit value.

Table 9. Coefficient estimates for Model 1 (linear), Model 2 (log-log), and Model 3 (log-linear). Standard errors of coefficients are included in parenthesis below the coefficient estimates. Statistical significance is indicated by asterisks, triple asterisk (***) indicates significance at the 1% level, (**) at the 5% level, and (*) at the 10% level.

Variable	Model 1	Model 2	Model 3
Intercept	-31,968 (11,492)	-0.846 (1.381)	10.223 (0.116)
Lag of Real Permit Price	0.857*** (0.094)	0.861*** (0.095)	8.010 E-8*** (9.53 E-9)
Binary Buyback Dummy Variable	29,779** (10,081)	0.241** (0.097)	0.176* (0.102)
Lag of Mean Real Earnings	0.204*** (0.055)	0.197 (0.140)	1.680 E-8** (5.556 E-8)

Table 10 presents corresponding estimates of four goodness of fit statistics for each model: Akaike's information criterion (AIC), the corrected Akaike's information criterion (AICc), Schwarz's Bayesian information criterion (SBC), and the R-square. In order to provide cross-model comparisons of goodness of fit, the predicted values from Model 2 and Model 3 were exponentiated to calculate each model's explained variance, which was then in turn used to calculate the AIC, AICc, SBC, and R-square values reported in Table 10. Model 2 has the highest R-square—it fits best. However, Model 1

also fit well (R-square = 0.871) and it has lower values for AIC, AICc, and SBC. Thus it is preferred to Model 2. Model 3, the log-linear model, performed so poorly that it was outperformed by naïve forecasts (a negative R-square indicates that the sum of squared errors of the model forecasts is larger than the sum of squared deviations of the dependent variable).

Table 10. Goodness of fit comparison between models.

Model	AIC	AICc	SBC	R-Square
Model 1	800.522	801.855	806.743	0.871
Model 2	824.711	826.011	832.487	0.881
Model 3	934.245	935.545	935.545	-1.710

Model 1 is the linear model. The lag of real permit price can be interpreted to mean that after controlling for buyback and last year's mean gross earnings, each $1 increase in last year's permit price can be expected to increase the current year's permit price by $0.857. Likewise the lag of mean real earnings can be interpreted as each dollar increase in the previous year's real mean gross earnings will increase the current year's permit value by $0.204, holding all other variables constant. The binary buyback coefficient can be interpreted to mean that after controlling for all other variables, the buyback increased permit values by $29,779. The three independent variables have expected signs. As the basic supply and demand models predicted, the buyback increased permit values. Figure 24 provides the fit diagnostics for for Model 1. The studentized residual plot does show some pattern of over and then underestimation consistent with serial correlation. The percent residuals graph does show that the residuals are fairly normally distributed. The ACF graph still shows a statistically significant correlation at lag 1, which means there may be some structure remaining in the time series of these data for real permit price that the model does not capture.

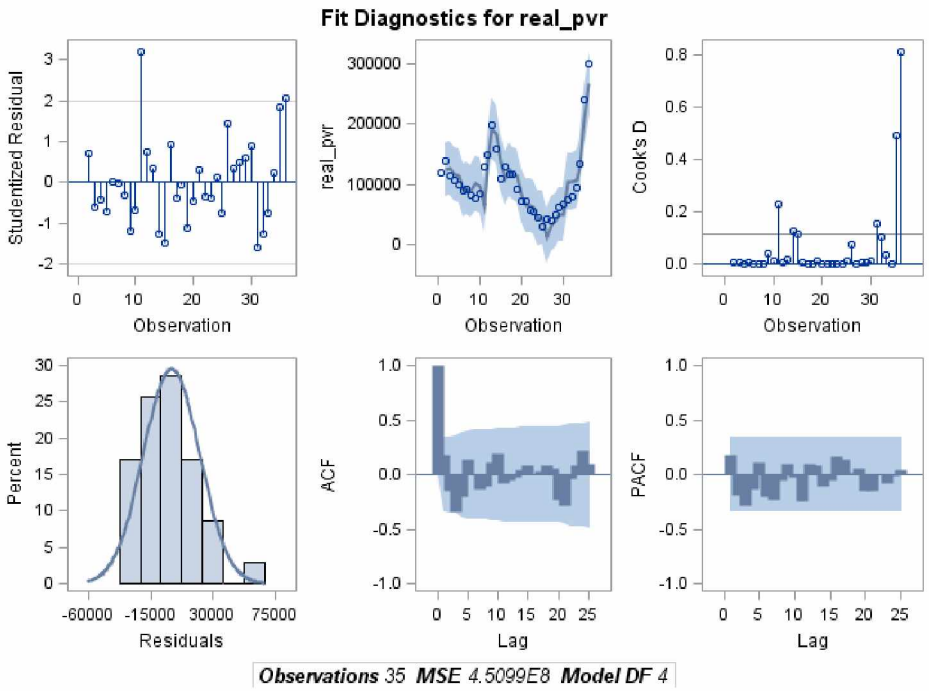

Figure 24. Model 1 fit diagnostics.

Model 2 is the log-log model. The logged lag of real permit value can be interpreted to mean that after controlling for buyback and the previous year's mean gross earnings, a 1% increase in the previous year's permit value will increase the current year's permit value by 0.861%. Similarly, a 1% increase in the previous year's real mean earnings will increase the current year's permit value by 0.197%. The binary buyback dummy variable suggests that after controlling for increases in the previous year's permit value and mean gross earnings, the buyback increased permit values by 24.1%. Figure 25 provides the fit diagnostics for for Model 2. The studentized residual plot does show some pattern of over and then underestimation consistent with serial correlation. The percent residuals graph does show that the residuals are fairly normally distributed. The ACF graph still shows a statistically significant correlation at lag 1, which means there may be some structure remaining in the time series of these data for real permit price that the model does not capture.

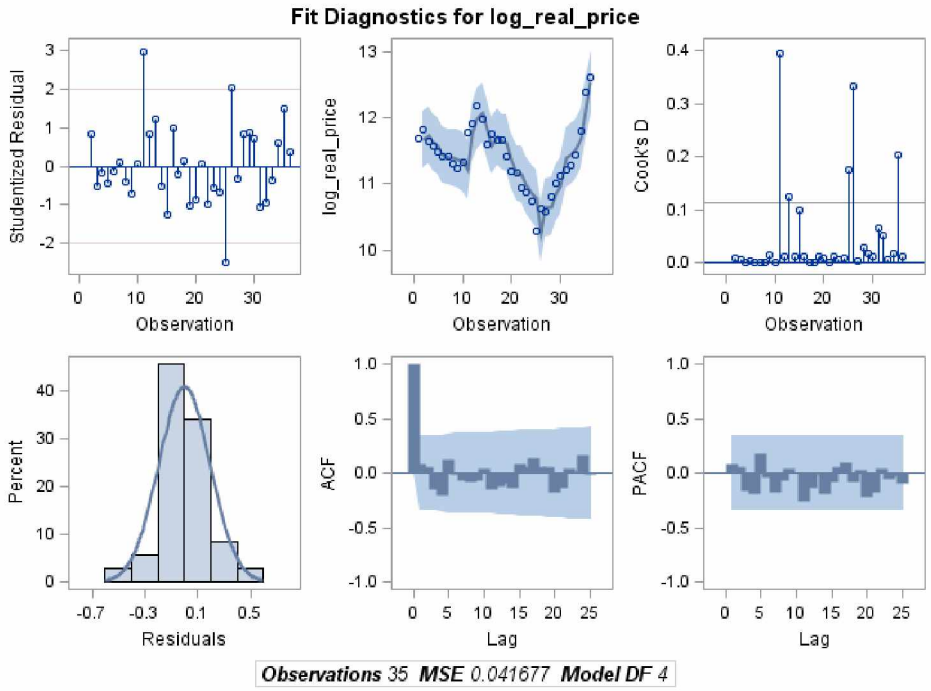

Figure 25. Model 2 fit diagnostics.

Model 3 is the log-linear model. The lag of real permit price can be interpreted as after controlling for buyback and the previous year's mean gross earnings, a 1% increase in last year's permit value will increase the current year's permit value by 0.008%. Similarly, a 1% increase in the previous year's mean real earnings will increase the current year's permit value by 0.002%. The binary buyback dummy variable suggests that after controlling for increases in the previous year's permit value and mean gross earnings, the buyback increased permit values by 17.6%. Figure 26 provides the fit diagnostics for for Model 3. The studentized residual plot does show some pattern of over and then underestimation consistent with serial correlation. The percent residuals graph does show that the residuals do not exhibit the same extent of normality as the graphs from Model 1 or Model 2. The ACF graph still shows a statistically significant correlation at lag 1, which means there may be some structure remaining in the time series of these data for real permit price that the model does not capture.

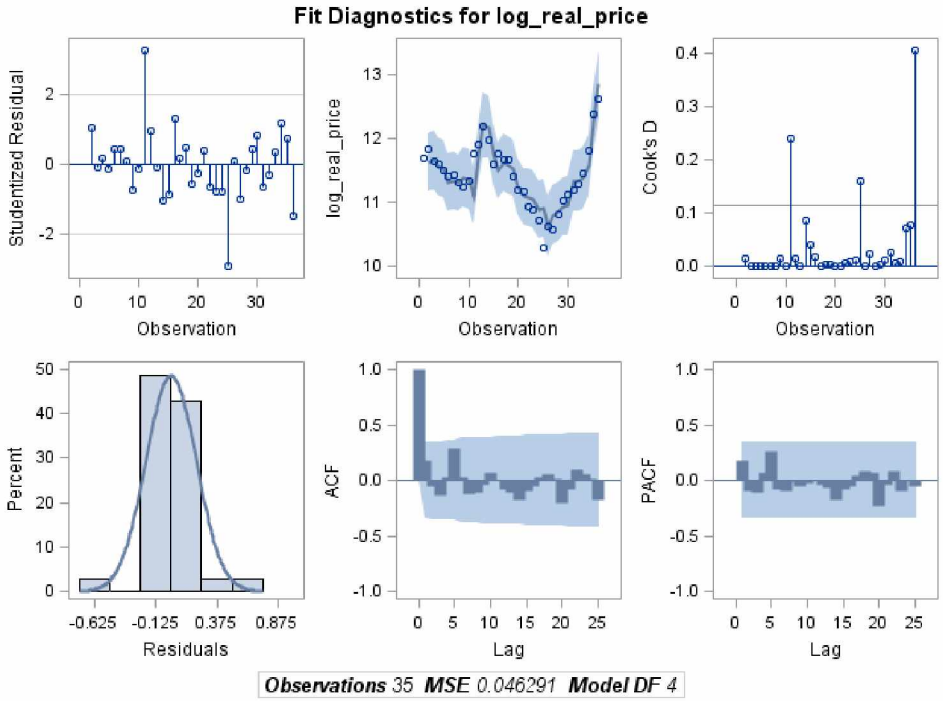

Figure 26. Model 3 fit diagnostics.

4.0 Program Evaluation and Conclusion

The SRA's buyback programs in 2008 and 2012, together retired 99 S01A LEPs. The impetus and momentum for buyback in the fishery was not conservation, or to address market failure, but rather to address policy objectives outlined by LEP holders. By 2004, nearly half of the fleet had voted with their feet, and either because of lack of market or low economic returns, these permitees did not fish their LEPs. Permitees, through the SRA wanted to permanently reduce the number of permits in the fishery using a buyback.

Government motivation for intervening in markets, such as the market for S01A LEPs, is that there may be conditions that prevent markets from achieving efficient outcomes. The most common sources of market failure in the provision of environmental goods or the exploitation of natural resources are: externalities, public goods, unowned and common property, market power, or asymmetric information (Randall, 1983). None of these are important features of the market for S01A permits. Information on the value of LEPs is readily available to buyers and sellers, so information is not asymmetric. Although the number of permits is limited by the state and will become more so under the buyback, the S01A fishery is only one of many salmon fisheries in Alaska and so the buyback is unlikely to create opportunity for S01A LEP-holders to influence the market

price of salmon or of their LEPs. And finally, salmon LEPs do not have the characteristics of public goods nor are there externalities in the market for LEPs.

Despite the lack of economic imperative for government intervention in the market for S01A LEPs, the programs can be evaluated in light of their stated goals:

1. Reduce fishing capacity by permanently revoking a substantial number of permits.
2. Promote economic efficiency.
3. Improve flexibility in the conservation and management of the fishery.
4. Obtain the maximum reduction in permits at the least cost.

A concern in any buyback is that those remaining in the fishery will increase their fishing effort/capacity to meet or exceed pre-buyback effort/capacity (GAO, 2000; Grafton and Nelson, 2005). That is, those remaining will use the increase in returns resulting from buyback to invest in larger vessels and/or gear that is more efficient which thwarts some purposes of buyback, namely capacity reduction, resource conservation and management improvements. In the case of the S01A LEP fishery, Alaska Board of Fisheries and ADF&G regulations along with in-season management by ADF&G regulate effort in the fishery. Mangers noted that effort in 2013 increased by 42 permits in comparison to 2012 in their Annual Management Report. However, they attribute this increase in effort to high odd-year Pink Salmon forecast and return (Gray et al., 2014). The increase in fishing effort in number of LEPs fished caused by the increased forecast and return could have been greater if the buybacks had not removed LEPs. LEP holders may use the increase in profitability to invest in more efficient fishing capital.

The buyback did not change the fundamental drive of fishers to increase effort at the margins to temporarily gain a larger slice of the pie, a process that increases harvest costs to all (Criddle, 2012; Criddle and Shimizu, 2014). The buyback programs were both successful in reducing latent fishing capacity but their effect is not binding because it did not prevent the fleet from harvesting the maximum permissible catch, it did not lead to a marked increase in season length, nor did it eliminate all latent capacity. As each limited entry permit confers the same access to fish within the regulatory constraints of fishing in Alaska state waters, the removal of latent, inactive LEPs removed potential fishing capacity, but not active fishing capacity.

Economic conditions in the fishery have improved. In 2013, the fishery landed over 334 million pounds of salmon, the largest harvest since records have been kept. LEP values have increased from a low of $29,310 (real) to a high of $300,800 at year-end 2013. Average real earnings per permit

fished had increased from a low of $95,329 in 2002, to $212,119 in 2008, $317,539 in 2012 and to a record high of $323,137 in 2013. While increases in exvessel prices and in harvests have undoubtedly factored into the upturn in LEP value, the removal of 99 S01A LEPs from the long-run supply of LEPs also contributed to the increase in LEP value. Model 1, the best performing model indicated that the buyback increased average real permit value by $29,779.

ADF&G area management biologists manage the Southeast salmon purse seine fishery. The AMBs made note of the buyback removal of LEPs in their annual management report but they did not confer any judgment on the effects of the buyback on management in the fishery (Gray et al., 2014). The year 2013 was a record forecast and harvest of Pink Salmon and it is not possible to separate the increase in effort caused by the record run and steady exvessel price from the increase in profitability caused by removal of LEPs in the buyback.

Buyback Administration

To satisfy their goal of retiring the most LEPs for the least cost, the SRA used voluntary, reverse auctions to determine which bids to accept in each buyback round. The reverse auction format ranks bids from lowest to highest and accepts all bids up to the available funds or those within an acceptable bid range. Recall that the SRA did not accept all bids in the 2008 buyback round because they were constrained by the available grant amount. In the 2012 buyback, the SRA did not accept all bids because they determined some bids to be too far above fair market value. The 2008 buyback allowed bidders to revoke their bids after SRA acceptance; the 2012 buyback did not.

A fishery buyback can proceed in one of two general ways. The first is a "big bang" approach, where the buyback administrator purchases the permits (or vessels) in one round (Groves and Squires, 2007). The second, temporally spread method, involves multiple rounds of buying and retiring permits and/or vessels. Although the SRA's original plan had been to pool the federal grant money together with the federally backed fishery reduction loan, in praxis, the process of applying a federal program to a state-permit fishery took longer than expected. Consequently, the SRA chose to use each funding source separately; the grant money first in 2008 and the federally backed reduction loan in 2012.

There are distinct drawbacks and advantages of administering a buyback in multiple rounds. Groves and Squires (2007) offer a succinct discussion on some of the drawbacks to designing a buyback program with multiple rounds:

> Buybacks conducted in stages also offer a number of disadvantages. Prices may increase as multiple rounds progress. With the removal of a license or vessel, supply falls and the remaining licenses increase in value, partly because fewer vessels or licenses remain, and also partly because of any gains in economic rents that are capitalized into the vessel or license price. In addition, with multiple rounds, there can be a strategic behavior in which the sellers know that they can submit bids in later round and may try to increase their bids by delaying (i.e., there is an option, which can be factored into the price). Vessel and license buyback prices may also end up inadvertently serving as a price floor in the secondhand vessel or license market. … Multiple rounds can also raise administrative costs (Groves and Squires, 2007).

Likewise, Groves and Squires (2007) summarize some of the advantages of multiple round of bidding:

> Buybacks conducted in stages offer several advantages: revealed common information allows gauging of the bid market and beneficial learning, adjusted payments target particular groups of fishers or desired vessel numbers or capacity level, the criteria for accepting bids can be adjusted, and fishers have the chance to reformulate their bids as they better understand the buyback market and buyback program. Multiple rounds of bidding also help dampen the frequency of "stink bids" (i.e., those bids than aim to obtain a payment exceeding the amount the bidder thought the government would purchase) (Groves and Squires, 2007).

It is possible that a "big bang" buyback, whereby the SRA would have used both the federal grant money and loan money at the same time for a one-shot buyback auction, may have been a more efficient and economical way of administering the buyback programs, versus the temporally spread administration of multiple bidding rounds.

On the other hand, the multiple rounds of bidding could be seen as beneficial in that it slowed the removal of LEPs from the fishery. Without an optimum number or range established by the CFEC, there is the potential risk that the buyback could reduce the size of the fleet to such an extent that it is deemed too exclusive. The slower pace allows the market forces prevailing at the time of each round to dictate the ultimate extent of LEPs bought and retired. As an example, rounds three and four did not result in any accepted bids and ultimately only 99 S01A permits were retired and 315 permanent, transferable LEPs remain in the fishery. At the present, those numbers appear to be socially acceptable, in that; there have been no formal legal claims that the fishery has become too exclusive. In 2013, there were still 39 latent permits. The existence of these latent permits, in a record setting year, suggests that the buyback did not remove all latent capacity and is not constraining the fishery. It remains conjecture whether a big bang approach, albeit efficient, would have produced a similar, socially acceptable outcome.

Effort Spillover

A concern about buybacks in general is that the effort purchased and retired will spill over into other fisheries. Examination of 2013 year-end permit holdings does not show a marked transfer of permit holdings from the Southeast salmon seine fisheries to other fisheries. It appears, that many of the individuals who sold LEPs in the buybacks, used the opportunity to retire from commercial fishing in Alaska as 68.5% and 55.6% of the first and second buyback cohorts respectively held no permits at year-end 2013 even though there were no conditions set on future participation in the fishery. Six out of the 35 individuals who sold LEPs in the 2008 round held a S01A permit after the buyback was completed. Similarly, five out of the 63 individuals who sold LEPs in the 2012 round held S01A LEPs after the buyback was completed.

Cost Burden of Buyback

The SRA used both federal grant money and a federally backed loan to retire permits. Both programs were voluntary, but only the 2012 buyback required majority consent from the fleet. The cost burden of retiring the permits fell partly on the U.S. taxpayer, and partly on the remaining permitees in the S01A fishery. This is a cost burden that permitees formally accepted by referendum and taxpayers accepted informally through the votes of their congressional representatives. Implicit in the permit holder vote was a belief that the benefits of financing the permit buyback to retire the 64 permits would exceed the costs at overall and individual levels. Permitees had to decide whether removing 64 additional permits from their fishery, many of them latent, was worth financing a $13.1 million dollar loan over a forty-year period. The exvessel tax to repay the loan is an ad valorem tax, that is, in proportion to the value of the fishery: everyone, large or small, pays an equal percent of their revenues. Thus, highliners pay more towards repayment of the loan. However, because the tax rate is structured to repay the loan over a fixed time, there is a regressive character to the taxation—when earnings in the fishery are low, the tax rate rises to the maximum 3% to meet loan service requirements while the tax rate falls when earnings are high because under those conditions a lower tax rate is sufficient to service the loan.

Legal Implications

There is not an established optimum range of permits for the S01A fishery. The SRA never requested that the CFEC conduct an optimum number study in the fishery. An optimum number study can take many years, years that the SRA wanted to avoid. There was an inherent optimism that a buyback was always just around the corner. In practice, securing the federal reduction loan took far longer than expected. Should an individual or group make a legal challenge over the exclusivity of the

fishery, the CFEC would need to conduct an optimum number study to examine the fishery's status and there is a potential that the CFEC would have to issue more LEPs into the fishery.

Moving Forward

Many of the ramifications and the final appraisal of the effectiveness of the buyback of permanent LEPs in the Southeast Alaska salmon purse seine fishery will have to wait until the loan that is financing the buyback has been paid in full, some 39 years down the road. By then, there can be a final accounting of whether the cost burden borne by the post buyback fishery exceeded or equaled the benefits derived from the removal of the LEPS through the buyback. The very simple models presented in this analysis showed that the buybacks did contribute to the increase in real LEP value. Future research on this subject would benefit from looking at different exogenous variables, such as a proxy for operational costs or engine horsepower or an interaction variable between buyback and real mean earnings per permit fished. The auction methods and design used in the multiple rounds of bidding would benefit from additional research. Evaluation of the strategic behavior and auction strategies of the auction participants is another area that would benefit from additional research.

Alaska is a unique legal environment where LEP management and the limitation of access that is inherent within this system must be balanced with the constitutional constraints that require LEP management to, "impinge as little as possible on the open fishery clauses" of the Alaska Constitution (Johns v. State). Time will show whether the buyback absent the optimum number determination made by the CFEC will stand any legal challenges, should they arise. In the short-term in light of the program's stated goals, the buyback was a qualified success in increasing the asset value of S01A permits and removing latent fishing capacity from returning to the fishery as exvessel prices and harvests increased. The larger programmatic and institutional issue that faces Alaska's salmon fisheries remains, that the pernicious drive to invest caused by the race for fish remains present as well as competition from farmed salmon (Criddle, 2012; Criddle and Shimizu, 2014). The current North Pacific Ocean regime is one that by in large supports Pink and Chum Salmon abundance (Hare and Francis, 1995; Ruggerone et al., 2010). However, the cyclic nature of salmon abundance related to ocean regime changes independent of decreases in abundance caused by inland habitat degradation may reverse and cause decreases in abundance similar to that seen in the late 1940s and 1970s (Hare and Francis, 1995; Ruggerone et al., 2010). Whether LEP management and effort regulation through the Board of Fisheries and ADF&G management will be sufficient to meet any future economic and or biological capacity challenges remains to be seen.

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Appendix 1. S01A permit renewal, fishing activity, total and mean estimated gross earnings, and total and mean harvest (CFEC, 2014)

Year	Permits Renewed			Fishing Activity				Estimated Gross Earnings		Harvest	
	Interim Entry	Permanent	Total	Permits Fished	People with Landings	New Entrants	Latency Rate	Real Total	Mean Real per Permit Fished	Total Net Pounds	Mean Net Pounds per Permit Fished
1975	77	398	475	287	293	293	39.6%	$25,489,672	$88,814	17,509,020	61,007
1976	9	409	418	280	281	47	33.0%	$44,460,939	$158,789	25,883,556	92,441
1977	3	411	414	325	326	51	21.5%	$92,356,924	$284,175	63,851,805	196,467
1978	7	413	420	376	379	61	10.5%	$95,664,265	$254,426	68,404,065	181,926
1979	5	413	418	319	319	25	23.7%	$60,287,087	$188,988	42,544,063	133,367
1980	3	414	417	335	336	32	19.7%	$80,382,869	$239,949	62,202,123	185,678
1981	4	414	418	364	364	33	12.9%	$91,502,203	$251,380	79,086,530	217,271
1982	7	414	421	370	373	26	12.1%	$66,942,577	$180,926	87,175,608	235,610
1983	5	416	421	337	341	22	20.0%	$76,673,929	$227,519	118,972,749	353,035
1984	5	417	422	383	386	40	9.2%	$77,468,475	$202,268	104,330,035	272,402
1985	4	416	420	368	370	32	12.4%	$111,229,366	$302,254	173,906,154	472,571
1986	4	416	420	368	370	17	12.4%	$113,776,970	$309,177	171,047,122	464,802
1987	4	416	420	381	384	26	9.3%	$45,926,164	$120,541	39,084,124	102,583
1988	4	416	420	394	399	28	6.2%	$103,291,171	$262,160	48,902,193	124,117
1989	4	416	420	365	369	28	13.1%	$168,907,567	$462,760	198,783,697	544,613
1990	3	417	420	360	367	23	14.3%	$78,075,508	$216,876	106,726,738	296,463
1991	3	417	420	383	388	31	8.8%	$61,009,117	$159,293	183,301,397	478,594
1992	3	417	420	354	356	16	15.7%	$83,797,960	$236,717	134,066,977	378,720
1993	2	417	419	382	392	36	8.8%	$84,554,360	$221,346	203,684,672	533,206
1994	1	417	418	390	398	37	6.7%	$95,227,551	$244,173	217,313,218	557,213
1995	1	417	418	373	379	20	10.8%	$84,679,934	$227,024	197,982,775	530,785
1996	1	416	417	357	362	25	14.4%	$62,915,977	$176,235	278,605,327	780,407
1997	1	415	416	351	355	24	15.6%	$58,900,789	$167,809	157,562,074	448,895
1998	1	415	416	377	382	34	9.4%	$64,676,287	$171,555	221,502,553	587,540
1999	1	415	416	359	364	18	13.7%	$78,108,012	$217,571	295,817,146	824,003
2000	1	415	416	356	360	32	14.4%	$50,952,235	$143,124	141,311,987	396,944
2001	1	414	415	345	349	27	16.9%	$64,038,533	$185,619	251,106,570	727,845
2002	1	414	415	273	275	7	34.2%	$26,024,757	$95,329	171,261,409	627,331
2003	1	415	416	235	238	8	43.5%	$33,735,935	$143,557	212,125,504	902,662
2004	0	414	414	209	210	3	49.5%	$38,648,517	$184,921	207,074,131	990,785
2005	0	415	415	232	233	14	44.1%	$42,548,833	$183,400	226,686,936	977,099
2006	0	414	414	230	230	6	44.4%	$31,850,097	$138,479	96,044,907	417,587
2007	0	415	415	237	238	9	42.9%	$55,053,385	$232,293	185,241,396	781,609
2008	0	380	380	212	214	12	44.2%	$44,969,166	$212,119	81,369,600	383,819
2009	0	379	379	256	259	17	32.5%	$52,163,775	$203,765	139,042,512	543,135
2010	0	379	379	235	237	14	38.0%	$59,904,836	$254,914	112,463,547	478,568
2011	0	379	379	269	270	27	29.0%	$125,870,532	$467,920	231,270,312	859,741
2012	0	315	315	233	238	10	26.0%	$73,986,471	$317,539	114,078,774	489,608
2013*	0	315	315	277	281	25	12.1%	$144,909,071	$523,137	334,349,151	1,207,037

*2013 gross earnings are calculated using preliminary exvessel price estimates which do not include any post-season adjustment payments paid to fishers.

Appendix 2. 2008 Cohort Year-end S01A Permit Holdings, 1975 – 2013 (CFEC, 2014)

Name	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Permit Holder 1																																								<1
Permit Holder 2																																									<1
Permit Holder 3																																	X							1
Permit Holder 4																																	X							1
Permit Holder 5																																	X							1
Permit Holder 6																																X	X							2
Permit Holder 7																																X	X							2
Permit Holder 8										X																						X	X							3
Permit Holder 9								X					X																				X							3
Permit Holder 10																														X	X	X	X							4
Permit Holder 11																																X	X			X	X			4
Permit Holder 12																															X	X	X	X	X					5
Permit Holder 13																												X	X	X	X	X	X							6
Permit Holder 14																												X	X	X	X	X	X							6
Permit Holder 15																												X	X	X	X	X	X							6
Permit Holder 16																											X	X	X	X	X	X	X							7
Permit Holder 17																											X	X	X	X	X	X	X							7
Permit Holder 18																										X	X	X	X	X	X	X	X							8
Permit Holder 19																																X	X	X	X	X	X	X	X	8
Permit Holder 20																									X	X	X	X	X	X	X	X	X							9
Permit Holder 21																						X	X	X	X			X	X	X	X	X	X							10
Permit Holder 22																				X	X	X	X	X	X	X			X	X	X	X	X							12
Permit Holder 23																		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							16
Permit Holder 24														X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							20
Permit Holder 25										X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X							22
Permit Holder 26											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							23
Permit Holder 27						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							28
Permit Holder 28	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							29
Permit Holder 29	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							33
Permit Holder 30	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							33
Permit Holder 31	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							33
Permit Holder 32	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							33
Permit Holder 33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X			35
Permit Holder 34	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			37
Permit Holder 35	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		38

Appendix 3. 2012 Cohort Year-end S01A Permit Holdings, 1975 – 2013 (CFEC, 2014)

Name	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Permit Holder 1																																					X			1
Permit Holder 2																																					X			1
Permit Holder 3																																					X			1
Permit Holder 4																																					X			1
Permit Holder 5																																				X	X			2
Permit Holder 6																																				X	X			2
Permit Holder 7																																				X	X			2
Permit Holder 8																																			X	X	X			3
Permit Holder 9																																			X	X	X			3
Permit Holder 10																															X	X				X	X			4
Permit Holder 11																																	X	X	X	X		X		5
Permit Holder 12																																			X	X	X	X	X		5
Permit Holder 13																														X	X	X	X	X	X	X				7
Permit Holder 14																													X	X	X	X	X	X	X	X				8
Permit Holder 15																		X	X												X	X	X	X	X	X				8
Permit Holder 16																												X	X	X	X	X	X	X	X	X				10
Permit Holder 17																												X	X	X	X	X	X	X	X	X				10
Permit Holder 18																												X	X	X	X	X	X	X	X	X				10
Permit Holder 19																											X	X	X	X	X	X	X	X	X	X				11
Permit Holder 20																											X	X	X	X	X	X	X	X	X	X				11
Permit Holder 21																										X	X	X	X	X	X	X	X	X	X	X				12
Permit Holder 22																							X	X	X	X	X	X	X	X	X						X	X	X	12
Permit Holder 23																										X	X	X	X	X	X	X	X	X	X	X				12
Permit Holder 24																								X	X	X	X	X	X	X	X	X	X	X	X	X				14
Permit Holder 25																									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	15
Permit Holder 26																							X	X	X	X	X	X	X	X	X	X	X	X	X	X				15
Permit Holder 27																							X	X	X	X	X	X	X	X	X	X	X	X	X	X				15
Permit Holder 28					X	X	X																	X	X	X	X	X	X	X	X	X	X	X	X	X				17
Permit Holder 29																					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				17
Permit Holder 30																				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				18
Permit Holder 31																				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				18
Permit Holder 32																				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				18
Permit Holder 33	X	X	X	X	X	X	X	X	X	X	X																				X	X	X	X	X	X	X			18
Permit Holder 34																			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			19
Permit Holder 35	X	X	X	X	X	X	X	X	X																		X	X	X	X	X	X	X	X	X	X	X			20

Name	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Permit Holder 36																	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			21
Permit Holder 37															X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			21
Permit Holder 38																	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			21
Permit Holder 39																X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			22
Permit Holder 40															X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			23
Permit Holder 41															X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			23
Permit Holder 42														X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			24
Permit Holder 43													X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			25
Permit Holder 44													X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			25
Permit Holder 45												X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			26
Permit Holder 46											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			27
Permit Holder 47							X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			28
Permit Holder 48										X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			28
Permit Holder 49								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			30
Permit Holder 50				X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			30
Permit Holder 51						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			32
Permit Holder 52					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			33
Permit Holder 53				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			34
Permit Holder 54		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X			35
Permit Holder 55	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			36
Permit Holder 56	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			36
Permit Holder 57	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			37
Permit Holder 58	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			37
Permit Holder 59	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			37
Permit Holder 60	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			37
Permit Holder 61	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			37
Permit Holder 62	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			37
Permit Holder 63		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	38

Appendix 4. Permit Latency of the 35 S01A Permits Retired in the 2008 Buyback (CFEC, 2014)

Permit	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Years With Landings	Years Without Landings
Permit 1																												L				L		31	2
Permit 2																															L	L		31	2
Permit 3	L				L				L																								L	29	3
Permit 4															L	L													L					30	3
Permit 5		L	L						L																					L	L	L		27	4
Permit 6																												L			L	L	L	29	4
Permit 7																													L	L	L	L	L	28	5
Permit 8																													L	L	L	L	L	28	5
Permit 9																													L	L	L	L	L	28	5
Permit 10																													L	L	L	L	L	28	5
Permit 11	L																												L	L	L	L	L	27	5
Permit 12			L	L	L																						L	L	L	L			L	25	7
Permit 13													L			L						L							L	L	L	L	26	7
Permit 14																									L		L		L	L	L	L	L	26	7
Permit 15		L				L																	L						L	L	L	L	L	25	7
Permit 16																										L	L	L	L	L	L	L	L	25	8
Permit 17						L																				L		L	L	L	L	L	L	25	8
Permit 18	L												L														L	L	L	L	L	L	L	24	8
Permit 19																		L					L				L	L	L	L	L	L	L	24	9
Permit 20		L										L						L					L	L					L	L	L	L	L	23	9
Permit 21						L																				L	L	L	L	L	L	L	L	24	9
Permit 22	L	L			L	L																	L					L	L	L	L	L	L	22	9
Permit 23	L																								L	L	L	L	L	L	L	L	L	23	9
Permit 24					L						L	L					L						L					L	L	L	L	L		23	10
Permit 25																				L				L	L	L	L	L	L	L	L	L	L	22	11
Permit 26		L	L								L					L									L	L	L	L	L	L	L	L	L	20	11
Permit 27			L	L	L			L							L	L												L	L	L	L	L	L	21	11
Permit 28	L	L				L										L	L	L				L	L					L	L	L	L	L	L	19	12
Permit 29						L		L										L				L	L		L	L	L	L	L	L	L			21	12
Permit 30		L																				L	L	L	L	L	L	L	L	L	L	L	L	20	12
Permit 31	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L													L	L	L	L	L	L	12	18
Permit 32	L				L				L						L	L		L	L	L	L	L	L	L		L	L	L	L	L	L	L	L	13	19
Permit 33	L										L	L			L		L	L	L		L	L	L	L	L	L	L	L	L	L	L	L	L	13	19
Permit 34	L														L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	13	19
Permit 35	L	L	L	L	L		L	L	L		L	L	L	L	L	L	L	L	L		L	L		L	L		L	L	L	L	L	L	L	5	25
Total Not Fished in Year	**11**	**9**	**6**	**4**	**8**	**7**	**2**	**4**	**5**	**1**	**5**	**5**	**4**	**2**	**7**	**8**	**5**	**8**	**4**	**3**	**4**	**8**	**11**	**7**	**9**	**11**	**15**	**22**	**29**	**30**	**31**	**31**	**29**		
Percent	**31%**	**26%**	**17%**	**11%**	**23%**	**20%**	**6%**	**11%**	**14%**	**3%**	**14%**	**14%**	**11%**	**6%**	**20%**	**23%**	**14%**	**23%**	**11%**	**9%**	**11%**	**23%**	**31%**	**20%**	**26%**	**31%**	**43%**	**63%**	**83%**	**86%**	**89%**	**89%**	**83%**		

Appendix 5. Permit Latency of the 64 S01A Permits Retired in the 2012 Buyback (CFEC, 2014)

Permit	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Years with Landings	Years Without Landings
Permit 1																																						37	0
Permit 2		L																																				36	1
Permit 3																																	L		L		35	2
Permit 4																																	L			L	35	2
Permit 5	L																															L					35	2
Permit 6		L	L																				L														34	3
Permit 7																																	L		L	L	34	3
Permit 8																																L	L	L		L	33	4
Permit 9															L	L					L												L		L		32	5
Permit 10	L		L			L	L																										L				32	5
Permit 11																														L		L	L	L	L			32	5
Permit 12																												L	L	L	L	L	L					31	6
Permit 13	L																													L	L	L	L			L		31	6
Permit 14	L	L																										L	L					L	L	L		30	7
Permit 15																															L	L	L	L	L	L	L	30	7
Permit 16																														L	L	L	L	L	L	L	L	29	8
Permit 17																								L	L					L	L	L	L	L	L			29	8
Permit 18				L																									L	L	L	L	L	L	L			29	8
Permit 19																					L							L		L	L			L	L	L	L	29	8
Permit 20																													L	L	L	L	L	L	L	L		29	8
Permit 21	L	L	L		L																								L					L		L	L	29	8
Permit 22	L																											L	L	L	L	L	L			L		29	8
Permit 23																													L	L	L	L	L	L	L	L	L	28	9
Permit 24															L			L													L	L	L	L	L	L	L	28	9
Permit 25			L																											L	L	L	L	L	L	L	L	28	9
Permit 26						L			L																			L	L	L		L	L			L	L	28	9
Permit 27																												L	L	L	L	L	L	L	L	L		28	9
Permit 28												L	L	L	L	L																L	L	L		L		28	9
Permit 29	L	L																								L			L	L	L				L	L	L	28	9
Permit 30																											L	L		L	L	L	L	L	L	L	L	27	10
Permit 31																												L	L	L	L	L	L	L	L	L	L	27	10
Permit 32																												L	L	L	L	L	L	L	L	L	L	27	10
Permit 33																												L	L	L	L	L	L	L	L	L	L	27	10
Permit 34		L	L		L	L	L																										L	L	L	L	L	27	10
Permit 35																								L	L	L		L	L	L				L	L	L	L	27	10

Permit	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Years with Landings	Years Without Landings
Permit 36														L								L	L		L	L	L	L					L	L	L	L		26	11
Permit 37																										L	L	L	L	L	L	L	L	L	L	L		26	11
Permit 38		L	L																										L	L	L	L	L	L	L	L	L	26	11
Permit 39								L																			L	L	L	L	L	L	L	L	L	L	L	25	12
Permit 40																						L	L				L	L		L	L	L	L	L	L	L	L	25	12
Permit 41						L																					L	L	L	L	L	L	L	L	L	L	L	25	12
Permit 42		L		L																								L	L	L	L	L	L	L	L	L	L	25	12
Permit 43												L							L								L	L		L	L	L	L	L	L	L	L	25	12
Permit 44																						L	L		L	L	L	L	L	L	L	L		L	L		L	24	13
Permit 45	L	L		L																								L	L	L	L	L	L	L	L	L	L	24	13
Permit 46														L	L							L	L	L				L	L	L	L	L	L	L			L	24	13
Permit 47	L	L			L																L		L						L	L		L	L	L	L	L	L	24	13
Permit 48	L	L																L	L						L				L	L	L	L	L	L	L	L	L	23	14
Permit 49		L			L																	L	L					L	L	L	L	L	L	L	L	L	L	23	14
Permit 50										L		L						L							L	L		L	L	L		L	L	L	L	L	L	23	14
Permit 51																				L			L	L	L	L		L	L	L	L	L	L	L	L	L	L	22	15
Permit 52	L	L															L	L	L		L							L	L	L	L	L	L	L		L	L	22	15
Permit 53														L	L	L	L	L	L								L	L	L	L	L		L	L	L	L	L	21	16
Permit 54	L	L	L		L										L	L												L	L	L	L	L	L	L	L	L	L	21	16
Permit 55	L	L			L	L					L				L	L												L	L	L	L	L	L	L	L	L	L	20	17
Permit 56	L		L		L	L		L	L	L	L	L	L	L	L															L	L	L			L	L	L	19	18
Permit 57								L	L		L	L								L	L	L	L	L	L	L		L	L	L	L	L	L			L	L	18	19
Permit 58																		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	17	20
Permit 59	L	L	L		L	L	L	L															L	L	L	L		L	L	L	L	L	L	L	L	L	L	16	21
Permit 60	L	L			L	L	L	L	L	L	L				L		L	L				L				L		L	L		L	L	L	L	L	L	L	14	23
Permit 61						L	L		L	L						L	L	L	L	L				L	L	L	L	L	L	L	L	L	L	L	L	L	L	14	23
Permit 62	L				L		L		L		L		L		L	L	L	L				L	L		L	L	L	L	L	L	L	L	L	L	L	L	L	12	25
Permit 63	L	L										L	L	L	L	L	L	L	L	L	L				L	L	L	L	L	L	L	L	L	L	L	L	L	12	25
Permit 64	L	L	L		L	L	L		L		L	L	L		L	L		L				L	L		L	L	L	L	L	L	L	L	L	L	L	L	L	9	28
Total not Fished	19	19	10	3	11	10	7	5	7	4	6	7	5	6	12	9	6	11	7	5	7	10	13	8	14	15	14	36	39	46	44	46	49	53	46	51	45		
Percent	30%	30%	16%	5%	17%	16%	11%	8%	11%	6%	9%	11%	8%	9%	19%	14%	9%	17%	11%	8%	11%	16%	20%	13%	22%	23%	22%	56%	61%	72%	69%	72%	77%	83%	72%	80%	70%		