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The legal, regulatory, and institutional evolution of fishing cooperatives in Alaska and the West Coast of the United States

Michael De Alessi [a,*], Joseph M. Sullivan [b], Ray Hilborn [a]

[a] School of Aquatic and Fishery Sciences, University of Washington, Box 355020 Seattle, WA 98105, USA
[b] Sullivan & Richards LLP, Fishermen's Terminal, 4005 20th Avenue West, Suite 221, Seattle, WA 98199, USA

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ABSTRACT

Between 1997 and 2011, fishing cooperatives on the West Coast of the U.S. and Alaska grew to cover almost 60% of U.S. West Coast and Alaska commercial fisheries. In those fisheries, cooperatives now manage capacity reduction and harvest limit compliance internally, transforming the way harvest limits are met—but not how they are set. Economic and regulatory incentives, both positive and negative, explain variations in cooperative structures and functions, particularly the level of participation, number of cooperatives within a fishery, and a shift in emphasis over time from internal quota setting and trading to managing non-target prohibited species avoidance. Ecological limits, which have generally been effective at sustaining fisheries on the Pacific coast, are still exogenous to cooperative management. Cooperatives commonly share information to avoid bycatch, but only coordinate harvests of target species to a very limited degree. Whether cooperatives evolve from effectively meeting external targets to either participating in the setting of limits (co-management) or moving beyond quota management into revenue sharing and coordinated fishing will depend on whether legal institutions and political objectives also evolve to allow new contractual and institutional arrangements.

1. Introduction

Farmers and fishermen have long understood that their livelihoods are determined to a large degree by harvest risks and market uncertainties outside of their control, and have formed cooperative associations to ameliorate those risks and uncertainties. The most successful fishing cooperatives "develop a wide variety of norms and institutions to share risks, establish de facto property rights over fish, reduce competition, ensure markets, gain access to information about locations of fish stocks, and so on" [1] p. 288]. These tasks are difficult under any circumstances, and legal constraints add another layer of complexity. The Fishermen's Collective Marketing Act (FCMA) of 1934 has been interpreted to allow cooperatives to add value to or collectively market products since its inception, but early on, some courts held that the antitrust law exemption within the FCMA did not extend to boycotts or strikes undertaken to raise ex-vessel prices [2]. In some cases, even limiting supply for reasons broader than merely increasing price was determined to be beyond the FCMA's protection. For example, in the 1950s a Texas shrimpers union that protected juvenile shrimp by setting minimum size limits (which also successfully raised dock prices) was found to be in violation of antitrust legislation [3]. It has been argued that the union's involvement was a deciding factor in the case, and that a non-union cooperative could have legitimately restricted supply under the FCMA [4]. Nevertheless, the Texas shrimpers case and other similar rulings, combined with severe penalties for antitrust violations, had a chilling effect on the ability of fishing cooperatives to reduce competition on the water [5].

Over time, courts began to interpret the FCMA, and the Capper-Volstead Act governing agricultural cooperatives, more liberally. When the Washington Crab Association beached their boats until their price was met by processors in 1964, an administrative decision by the Federal Trade Commission found nothing wrong with such limits on production because of the protections afforded by the FCMA [6]. To date there has been no definitive law or ruling on how or when fishing cooperatives may limit supply, but the FTC interpretation has grown stronger in recent years with the federally sanctioned growth in importance of fishing cooperatives in Alaska and the West Coast. To what extent these new institutions will be able to redefine competitive and cooperative relationships, remains an open question, which will depend on the evolution of both the economics of cooperative fishing and the external legal and regulatory constraints.

* Corresponding author at: School of Aquatic and Fishery Sciences, University of Washington, Box 355020 Seattle, WA 98105, USA Tel.: +1 206 543 4270.
E-mail addresses: dealessi@uw.edu (M. De Alessi), joe@sullivanrichards.com (J.M. Sullivan), rayh@uw.edu (R. Hilborn).

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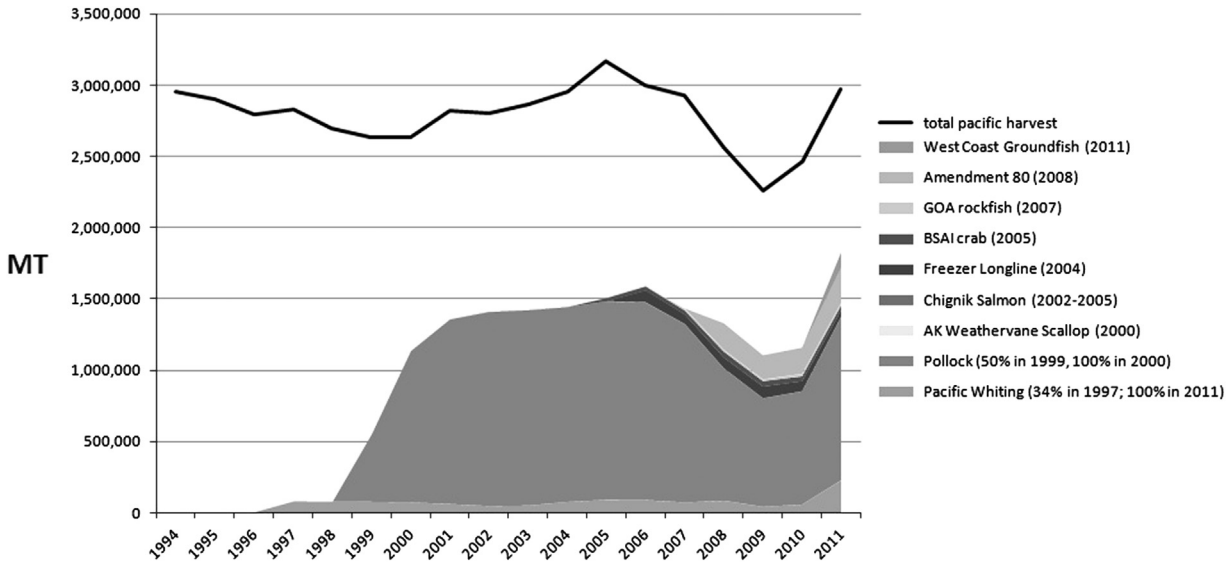

Fig. 1. Cooperative managed fisheries production by metric ton [15–23].

As FCMA law was evolving, so too were the theoretical arguments for defining access and harvest rights in fisheries, first by economists in the 1950s [7,8] and then famously in the late 1960s by Garret Hardin's argument that open access to valuable resources led to a "tragedy of the commons" [9]. By the 1980s, the notion of improving fisheries management by defining harvest rights in fisheries had strengthened to the point that both Iceland and New Zealand created widespread individual tradable quota (ITQ) regimes. ITQs defined fishery access rights and shares of the total allowable catch, and were allocated to individuals based on catch history. Associations of quota owners rapidly formed in both countries. In Iceland, two harvesting associations formed to lobby for either maintaining or re-allocating harvest shares based on boat size. Quota owning associations in New Zealand, on the other hand, formed around target species and undertook a broader range of activities, in some cases even coordinating fishing effort and directly influencing harvest limits by contributing scientific data, analysis, and risk assessments to stock assessment models [10,11]. In the United States, catch share systems, which include both individual and sector (group) allocations (shares of the total allowable catch), have gradually gained momentum since the early 1990s.

The first fisheries managed by tradable quotas in the United States were the Mid-Atlantic surf clam and ocean quahog fishery (1990), a small wreckfish fishery in the South Atlantic (1992), and the Alaska halibut and sablefish fisheries (1995). Each fishery suffered from overcapitalization and the race to fish, and each saw a dramatic drop in the number of active fishing vessels under ITQs (also commonly referred to as IFQ - individual fishing quotas). While reducing fishing capacity was an explicit goal, its effect on crew jobs, fishing communities and fish processors resulted in a political backlash. In the lead up to 1996 re-authorization of the Magnuson-Stevens Fishery Conservation and Management Act (which defines federal fishing policy), the Alaskan pollock fleet's efforts to obtain tradable fishing quotas in the legislation were resisted by processors who had been disadvantaged by the ITQ in halibut, and politically powerful Alaskan politicians who believed most of the economic gains would accrue to Washington state, where much of the North Pacific fishing fleet was based [12,2,13]. In the end, Congress not only refused to extend ITQs to the pollock fishery, it imposed a moratorium on any new quota programs until in the year 2000, later extended until late 2002.

Despite the moratorium, Francis Christy noted in 1996 that the evidence in favor of harvest rights was so strong that that their eventual adoption was "inexorable" [14]. In 1997, just 1 year later, the four owners of vessels in the catcher–processor sector of the Pacific whiting fishery formed the first modern fishing cooperative in the U.S. to address overcapitalization within their sector. The approach they adopted as an experimental effort has now grown to directly or indirectly govern almost 60% of the commercial catch of Alaska and the Pacific.

2. Fishing cooperatives in Alaska and the West Coast: 1997–2012

Since 1997, the proportion of the total allowable catch (TAC) in the fisheries of the West Coast of the United States harvested by cooperatives and other catch share arrangements has risen from 0% to almost 60% (Fig. 1). Cooperatives have formed in the Pacific whiting, Alaska pollock, Alaska crab, and the mixed stock groundfish fisheries off Alaska and the Pacific Coast. Each cooperative has formed within a harvesting sector composed of catcher–processors or catcher vessels (which either deliver to motherships or shoreside processors). In some cases, notably for inshore pollock, Bering Sea and Aleutian Islands (BSAI) crab, and Gulf of Alaska (GOA) rockfish, multiple cooperatives have formed within sectors.

Cooperatives form when a group of vessels or quota owners reach a contractual agreement to share resources, rules, and enforcement mechanisms. Cooperatives may manage internal quota allocations and transfers, negotiate prices with processors, manage bycatch and sideboard limits, and/or create risk pools to mitigate prohibited species catch (PSC) restrictions. The size and scope of cooperatives are largely determined by the legal, social, and economic hurdles to reaching agreements, described by institutional economists as transaction costs [25,26]. Aggregating information and managing cooperative operations on a day-to-day basis are other examples of transaction costs [27]. Factors such as a large or heterogeneous number of participants raise transaction costs (make agreement more difficult); sector allocations (reducing heterogeneity) and at-sea processing (where harvesting and processing occur within the same organization) reduce them. Measuring true transaction costs is notoriously difficult, but by taking a broad view of cooperative formation over time (Table 1), patterns of likely sources of transaction costs and shifting rationales for cooperative formation and function emerge.

Table 1
Alaska and West Coast cooperatives since 1997: year formed and possible transaction costs of cooperation [16–18,20–24].

Coop(s)	Year formed	Initial # of cooperatives	Active boats at inception (by port for risk pools)	Reduction in active vessels to 2011* (%)	Coop-initiated quota trading	Coop makes IFQ trades easier	High value catch (price or total value)	At-sea processing	Affiliation w/shoreside processors	Bycatch/ PSC limited by contract	Season limited by PSC before coop
PWCC[a]	**1997**	**1**	**10**	**30**	**Y**			**Y**			
PCC & HSCC	**1999**	**2**	**26**	**42**	**Y**		**Y**	**Y**			
Pollock Mothership	**2000**	**1**	**20**	**26**	**Y**		**Y**	**Y**			
Pollock inshore C-V	**2000**	**7**	**91**	**16**	**Y**		**Y**		**Y**		
Weathervane scallop	**2000**	**1**	**10**	**56**	**Y**		**Y**	**Y**			**Y**
Chignik salmon[b]	**2002**	**1**	**77**	**77**			**Y**				
BSAI crab[c]	**2005**	**15**	**243**	**83**		**Y**	**Y**		**Y**		
Freezer longliner	**2006**	**1**	**39**	**8**		**Y**		**Y**			**Y**
GOA rockfish[d]	**2007**	**10**	**32**	**13**		**Y**		**Y**	**Y**	**Y**	**Y**
Amendment 80[e]	**2008**	**1**	**24**	**0**		**Y**			**Y**	**Y**	**Y**
P-Whiting mothership	**2011**	**1**	**37**	**54**		**Y**		**Y**		**Y**	**Y**
W-C risk pools	**2011**	**3**	**14**	**0**							**Y**

[a] #s are post-AFA buyback of nine vessels.
[b] For Chignik salmon to 2005.
[c] See Table 2 for better consolidation indicator (after government buyout & with fewer part-time vessels).
[d] Not including vessels with negligible catch.
[e] Following 2007 buyback of three vessels.

- With the exception of Chignik salmon, sectors with more than 40 participants all had legal mandates tying vessels to shoreside processors, and multiple cooperatives formed.
- In general, a reduction in active participants underscores the level of overcapitalization and opportunity to cut fishing costs.
- High value species (per pound or in total volume) likely provide an economic incentive to form cooperatives.
- The importance of processing to cooperative formation is also highlighted; catcher–processors remove one layer of bargaining as compared to catcher vessels delivering to motherships or shoreside processors. Cooperatives in West Coast fisheries other than Chignik salmon and Pacific Coast groundfish are either composed of catcher–processors or have some type of mandated relationship with the processors receiving their catch.
- Within groundfish cooperatives, there has been a shift in emphasis over time from internally managing quota allocations and transfers of target species to internally managing PSC limits.

Low prospects for wealth generation through cooperation, coupled with the transaction costs of cooperation and political compromise, may also explain why cooperatives have not formed in other fisheries along the West Coast and Alaska. The largest fishery without catch shares or cooperatives is the Alaska salmon fishery, which accounts for 12% of the volume and 23% of the value of fisheries on the West Coast and Alaska[1] [15]. Salmon fisheries often have relatively large numbers of politically vocal, small boat participants with disparate economic interests. In 2010, for example, there were over 7500 permits fished out of over 11,000 registered with the state of Alaska [28].

[1] By species, the largest contributors are sockeye salmon (almost 4% by weight and 11% by value), pink salmon (approximately 6% of both volume and value), and chum salmon (2% and 3% accordingly).

California market squid is another significant fishery, accounting for 4% by volume and 2.5% by value in 2011 [15]. The squid season is highly variable, with catches ranging from a low of under 3000 t in 1998 to a high of over 130,000 t in 2010 [15]. As a result, vessels are more often limited by natural fluctuation than by limits on total allowable catch or bycatch, leaving them little reason to cooperate.

For those cooperatives that have developed since 1997, a description follows, with an emphasis on the economic, regulatory, and political attributes that either raised or lowered the transaction costs of cooperation.

2.1. *Pacific whiting*

- Pacific Whiting Conservation Cooperative (1997; catcher–processors)

Pacific whiting is a whitefish found off the coasts of California, Oregon, and Washington. Limited entry was introduced into the fishery in 1994, and in 1996, spurred by a recently recognized Makah Indian treaty right to a share of the harvest, the total whiting catch was allocated among the three sectors of the fishery—catcher–processors, motherships, catcher-vessels—and further divided with the Makah [29]. The catcher–processor sector was composed of four companies operating 10 boats, all of which also participated in the Bering Sea pollock fishery [2]. Upon receiving a sector allocation, these companies formed the Pacific Whiting Conservation Cooperative (PWCC) in 1997 to contractually allocate and transfer quota within their sector. Antitrust law was a concern, so the fleet waited until the Justice Department issued a favorable review in May 1997, after the start of the fishing season [2]. Following cooperative implementation, the number of active catcher–processors dropped, the recovery of product from landed weight increased (from 17% to 20% and later to 24%), the quality of fish produced improved, bycatch was reduced, and the fishing season lengthened [30]. While the number of active vessels has hovered around 6–7, the number of

companies dropped from 4 to 3 when one cooperative company bought out another in 2008 [31,32].

2.2. Alaska pollock

- Pollock Conservation Cooperative (1999; catcher–processors).
- High Seas Catcher-vessel Cooperative (1999; offshore catcher vessels).
- Mothership Fleet Cooperative (2000).
- Seven inshore catcher vessel cooperatives[2] (2000; inshore catcher vessels).

The Alaska pollock fishery is the largest fishery in the United States by weight, and also one of the most important economically. Many PWCC members participated in the pollock fishery, but without sector allocations, could not form a cooperative. In 1998, Congress adopted the American Fisheries Act (AFA), which allocated the pollock fishery among the catcher–processor, mothership fleet, and inshore catcher-vessel sectors and authorized harvesting cooperatives to allocate quotas internally [33]. The AFA allocated 10% of the fishery to CDQ[3] groups and allocated what remained among the inshore sector (50%), the catcher–processor sector (40%), and the mothership sector (10%) [34]. Under the AFA, inshore catcher vessels can only form cooperatives when 80% or more of the vessels that historically delivered to one processor agree to continue that relationship [35].

In 1999, the AFA catcher–processors formed the Pollock Conservation Cooperative (PCC) and the offshore catcher vessels that sold to the catcher–processors formed the High-Seas Catchers Cooperative (HSCC). The seven catcher vessels in the HSCC transferred their entire quota to the PCC, and have continued to do so each year since. Active vessels in the PCC fell by over 20% in the first year and despite a reduction in the TAC, the length of the season doubled [36]. The value of the catch also increased, primarily due to an increase in the product recovery rate, which over time increased by 50% [37]. The AFA identified all eligible vessels participating in PCC and HSCC by name, but only defined the qualifying criteria for the mothership and inshore sectors, delaying cooperative formation in those sectors until 2000 [38].

Since the pollock cooperatives formed, there have been inter-cooperative agreements within and between sectors to address issues of bycatch and "sideboards" (sideboard limits prevent rationalized fleets from shifting effort and capacity into non-rationalized fisheries) [38]. The inter-cooperative agreements apportion limits and may allow for some transfers. These agreements expanded to include prohibited species catch (PSC) limits when they were imposed [39]. And in 2004, inter-cooperative agreements concerning measures to reduce incidental catch of salmon were introduced [40].

2.3. Alaska scallops

- Alaska Weathervane Scallop Cooperative (2000; catcher–processors)

The weathervane scallop fishery occurs in both state and federal waters. The fishery is managed by the state of Alaska, but limited entry licenses are issued by the National Marine Fisheries Service (NMFS) for areas under federal jurisdiction, and an Alaskan legal moratorium limits the number of vessels that can fish in state waters [17]. In response to an influx of vessels that tripled harvest levels, Alaska imposed a vessel moratorium guideline harvest ranges (GHR, similar to a TAC), and strict bycatch limits for crab in 1993, and in 1997 NMFS created a limited license program [17]. Since 1993, each of nine scallop areas remain open until either the annual scallop TAC or the crab bycatch limit is reached, whichever comes first. In 2000, 6 out of 9 permit holders formed the Alaska Weathervane Scallop Cooperative, and since 2001, only 2–3 cooperative vessels have fished each year. According to one member of the cooperative, bycatch reduction "was an inherent reason for forming the Cooperative and continues to be the largest, by far, influence on Cooperative members" [41]. Since the cooperative formed, bycatch closures are uncommon (only once since 2000) and fishing rates have slowed to spread over a longer season [42].

As many as three vessels commonly fish outside of the cooperative. The cooperative does not receive a separate allocation of harvest or bycatch, but the non-cooperative operations catch relatively small amounts [41]. The cooperative, by contract, assigns transferable vessel allocations and crab bycatch caps [42]. The cooperative contractually limits harvests and bycatch by area; where crabs are not abundant only crab limits are enforced, where crab bycatch is not an issue only scallop limits are enforced, and in other areas there are limits set for scallops and crabs [41].

2.4. Alaska salmon

- Chignik Salmon Cooperative (2002–2005; catcher vessels)

In 2002, a group of fishermen in the sockeye salmon fishery in Chignik, Alaska responded to declining salmon prices by forming a harvesting cooperative aimed at reducing fishing costs through coordination of fishing effort [19]. State fishery managers agreed to split the allocation within the fishery proportionately between cooperative members and non-members (about 20% of the licensed fishermen did not join the cooperative). In 2002, 77 permit holders joined the cooperative, but only 20 actively fished that season [44]. In 2004, the cooperative gained another 10 members. The number of active, non-cooperative vessels fell to 13, but the number of active cooperative vessels remained at 20 [44]. After compensating the 20 active boats for fishing, all members of the cooperative shared the profits of fishing equally [19]. In 2005, the Alaska Supreme Court found the Chignik Salmon Cooperative to be in violation of Alaska's limited entry fishery program because "it allows people who are not actually fishing to benefit from the fishery resource" (quoted in [19]p 344]). The cooperative disbanded in 2006.

2.5. Bering Sea/Aleutian Islands crab

- Fifteen cooperatives (2005; catcher vessels and catcher–processors).
- Inter-Cooperative Exchange (2009; catcher vessels).

When the IFQ moratorium expired at the end of 2002, the Bering Sea/Aleutian Islands crab fishery—a high-value fishery with a very dangerous race to fish in compressed seasons—was ripe for rationalization. Rationalization, however, was perceived to change the negotiating leverage between harvesters and processors. To address this issue, the crab rationalization program included a complex "two-tier" system whereby 90% of the catcher vessel IFQs (the "A" shares) must be matched to individual processing quotas (IPQs) assigned to historic crab processors. The remaining IFQs (the "B" shares) are not subject to the IPQ match requirements. Special rules that combined IFQ and IPQ were also established for

[2] Akutan Catcher Vessel Association; Arctic Enterprise; Northern Victor Fleet Cooperative; Peter Pan Fleet Cooperative; Unalaska Fleet Cooperative; UniSea Fleet Cooperative and Westward Fleet Cooperative.

[3] Community Development Quotas (CDQs) set aside a share of the North Pacific groundfish, halibut, and crab, and other fisheries for the economic development of coastal communities in Alaska [43].

crab catcher–processors, which formed only a small portion of the fisheries. Quotas in the crab fishery are allocated over five species and six areas (the golden king crab fishery is split between the Eastern and Western Aleutian Islands). The two largest fisheries by volume and participation are the Bristol Bay Red King Crab fishery (BBR) and the Bering Sea Snow Crab fishery (BSS).

Under the law, a group of four or more quota owners may form a crab harvesting cooperative. These cooperatives cannot hold quota shares themselves, but can hold the annual IFQs generated by quota shares owned by a cooperative's members [20]. Cooperatives are not subject to limits on vessel quota harvests [45], and members of eligible cooperatives may collectively negotiate and (if necessary) arbitrate ex-vessel crab prices.

When crab rationalization began in 2005, fifteen cooperatives formed, often around groups who shared investors, delivered to the same processor, or had other formal or informal ties. In 2009, eleven cooperatives banded together to form the Inter-Cooperative Exchange (ICE) to rationalize quota transfer and price arbitration for the cooperative system itself. Two more cooperatives joined ICE in 2010, effectively bringing all of the non-processor affiliated cooperatives under the ICE umbrella [46]. All 13 cooperatives under ICE still exist in some form or another, but all of the reporting requirements now fall to ICE, so their activities are no longer publicly recorded.

2.6. Pacific cod

- Freezer Longline Conservation Cooperative (2006; catcher–processors)

Freezer longliners are a sector of catcher–processor boats between 110 and 180 feet that use longlines to target Pacific cod, as well as sablefish and Greenland turbot, and other commercially important but incidentally caught species such as rockfish, flounder, and pollock [46]. Vessel size limits constrain at-sea processing, so currently the primary product produced is headed and gutted whole fish. The fleet generally starts fishing in the Bering Sea and Aleutian Islands, then moves into the Gulf of Alaska when that season closes [46]. In 2000, a license limitation program defined the participants in the sector and set limits on their share of the BSAI catch (48.7% of the BSAI Pacific cod fishery in particular). PSC limits often curtail harvests of target species, so in 2006 a majority of the 39 active vessels formed a cooperative and assigned transferable caps on halibut harvests in the BSAI to each boat [47]. A sector allocation for the GOA was instituted in 2012.

2.7. Gulf of Alaska rockfish

- Central Gulf of Alaska Rockfish Pilot Program (RPP) (2007–2011).
  - Five inshore catcher vessel cooperatives.
  - Two to three catcher–processor cooperatives.
- Central Gulf of Alaska Rockfish Program (RP) (2012).
  - Seven inshore catcher vessel cooperatives.
  - Five catcher–processor cooperatives.

The Gulf of Alaska rockfish fishery is primarily a trawl fishery targeting Pacific Ocean Perch, northern rockfish, and pelagic shelf rockfish, as well smaller harvests of incidental species such as sablefish, thornyhead, shortraker, and rougheye rockfish, and Pacific cod [48]. Each sector (of catcher vessels and catcher–processors) also receives a Pacific halibut bycatch limit based on catch history. Before 2007, the fishery was a limited entry, derby fishery with a just a three week season in July, resulting in low quality harvests, conflicts with salmon processing, and high levels of bycatch and discards [48]. The Rockfish Pilot Program allowed quota holders to join cooperatives which were then allocated the aggregate harvest share of their members; non-members could participate in a limited entry fishery, subject to individual, non-transferable harvest caps. Virtually all catcher vessels joined co-ops during the RPP, and in the new RP, all quota holders must join a co-op to be eligible to fish (there is no limited entry fishery option).

Seven cooperatives formed in 2007, two catcher–processor cooperatives and five catcher vessel cooperatives. Under the terms of the pilot program, catcher vessel cooperatives were restricted to dealing exclusively with their "historical" processor (defined over a specific period) in Kodiak, Alaska. The RPP expired in 2011, but in 2010, the North Pacific Fishery Management Council adopted the RP, this time for a 10 year term. The RP slightly changed quota allocations and regulation of both PSC usage and sideboards. Cooperatives are still required to affiliate with a processor in Kodiak, but not necessarily their "historical" processor. There are also provisions to allocate quota to entities that participated in the "limited entry" fishery under the RPP.

Under the RP, individual fishing quotas may be transferred within sectors, subject to limits on accumulation by both individuals and cooperatives. Quota may also be transferred from catcher–processors to catcher vessels, but not the other way around. By sharing information and PSC trading, the fleet has generally been able to avoid bycatch triggers.

2.8. Non-pollock groundfish

- Amendment 80 fleet.
  - Alaska Seafood Cooperative (2008; catcher–processors).
  - Alaska Groundfish Cooperative (2011; catcher–processors).

The AFA rationalized the Bering Sea pollock fleet, but not trawlers targeting other groundfish species. The non-pollock groundfish fleet, also known as the "Head and Gut" fleet, operates in the BSAI and targets Pacific Ocean Perch, Atka mackerel, flathead sole, Pacific cod, rock sole, and yellowfin sole. Amendment 80, implemented by NMFS in 2008, allows non-AFA catcher–processors to form cooperatives and allocates harvests for the six target species. In 2008, seven companies owning sixteen non-AFA trawl catcher–processors (out of a total of 25 boats in the fishery) formed the Best Use Cooperative[4] [49]. In 2011, the remaining nine vessels formed a second cooperative, the Alaska Groundfish Cooperative [50]. There are no limits on how much quota cooperatives may hold, but there are limits on individual quota ownership and no vessel may harvest more than 20% of the total allocation.

Prior to the implementation of Amendment 80, PSC limits for halibut and Opilio, red King, and Bairdi crab severely limited the length of the season and the total annual catch. Now PSC limits are set for the cooperative as a whole [51]. PSC is not commonly transferred within the cooperatives. Instead, the cooperatives contract with Sea State, Inc. to set individual vessel PSC caps and to share information to avoid bycatch hotspots [52]. Each year the cooperatives hold PSC in reserve and impose strict financial penalties on vessels tapping into the reserve. By 2011, the fleet had reduced prohibited species catch below the new, stricter limits, harvests of target species increased, and the season was lengthened [53].

[4] The Amendment 80 Best Use Cooperative changed its name to the Alaska Seafood Cooperative in 2010 and includes the two boats (and two companies) that made up the Best Use Rockfish Cooperative under the Central GOA Rockfish Pilot Program.

Table 2
Indicators of wealth generation in Alaska and West Coast cooperatives [16–18,20–24].

Coop(s)	Year formed	Active vessels inception/ 2011	Reduction[a] in active fishing vessels (%)	Factor increase[a] in season length	Reduction[a] in PSC (%)
PWCC	**1997**	**10/7**	**30**	**8.3*x***	
PCC & HSCP	**1999**	**26/15**	**42**	**2.6*x***	
Pollock mothership	**2000**	**19/14**	**26**	**2.6*x***	
Pollock inshore C-V	**2000**	**97/81**	**16**	**2.6*x***	
Weathervane scallop	**2000**	**9/4**	**56**	**2.6*x***	
Chignik salmon[d]	**2002**	**87/20**	**77**	**2.5*x***	
BSAI crab (BSS—Opilio)	**2005**	**169/78**	**54**	**46.0*x***	
Freezer longliner	**2006**	**39/36**	**8**	**2.4*x***	**29**
GOA rockfish[c]	**2007**	**32/28**	**13**	**5.3*x***	**64**
Amendment 80	**2008**	**25/25**	**0**	**1.2*x***	**29**
P-Whiting mothership	**2011**	**37/17**	**54**	**12.4*x***	**80**
CA risk pools	**2011**	**14/14**	**0**		**93**

[a] From before coop formed to 2011.
[b] Chignik salmon #s compare 2001–2004.
[c] With three new entrants in 2012, consolidation is effectively zero.

2.9. Pacific whiting part II

- Whiting Mothership Cooperative (2011).
- Whiting Inshore Catcher Vessel Cooperative (in progress).

In 2011, 14 years after sector allocations in the Pacific whiting fishery led to the first modern fish harvesting cooperative on the West Coast, cooperatives were created for the mothership and shoreside catcher vessel fleets. All 37 eligible mothership-endorsed limited entry trawl permits formed the IFQ-holding Whiting Mothership Cooperative (WMC), which is allocated a catch share based on the aggregate catch history of the mothership endorsed catcher vessels, who commit their deliveries to a mothership prior to the opening of each annual season [54]. In the years leading up to 2011, fishing seasons were frequently shortened or restricted due to PSC limits. For some limits a single tow could close the fishery [54]. According to its first annual report, "one of the primary purposes of the WMC is the management of bycatch of the four allocated overfished rockfish species and Chinook salmon" [55]. The WMC allocates harvest quotas and PSC quotas and facilitates transfers of both [55]. Members have a contractual obligation to share and react to information on prohibited species harvests provided by Sea State, Inc, and the cooperative has also closed several areas to fishing by its members [55].

Shoreside Pacific Whiting catcher-vessels did not form a cooperative in 2011, but formed the Shorebased Whiting Cooperative (SWC) in the Spring of 2012 to establish constraining species risk pools among the fleet in California, Oregon, and Washington [56].

2.10. Risk pools in West Coast groundfish

- Fort Bragg, Ilwaco, and CA Central Coast (2011; catcher vessels)

In 2011 catch shares were implemented in the West Coast groundfish fishery, which covers over 90 different species including Pacific cod, sablefish, Pacific whiting, and many flatfish and rockfish species ranging throughout the federal waters off California, Oregon, and Washington. A number of the communities affected by this change cooperatively formed risk pools to mitigate the risks posed by incidental harvests of constraining species. Yelloweye rockfish, for example, had an annual catch limit of approximately 1600 pounds for the entire 2011 season. The related quota allocations among fishermen were small and irregular, with some holding no Yelloweye quota at all. Because every fisherman must cover their catch of a species managed under the program with quota to remain eligible to participate in the fishery, a relatively small incidental catch of a species such as Yelloweye could end their season.

With the help of The Nature Conservancy, the Fort Bragg Groundfish Association (CA), the Central Coast Sustainable Groundfish Association (CA), and the Ilwaco Fishermen and Marketing Cooperative (WA) signed an agreement to collectively manage the incidental catch of 8 constraining species by treating their collective quota for those species as an insurance pool, sharing catch information and adopting and enforcing local fishing rules designed to reduce the chances of early season closure. The three associations include 13 vessels of different gear types. In 2011, the risk pool participants harvested only 2% of their constraining species quota, while the rest of the fleet harvested approximately 30% [24]. In 2012 the Ilwaco cooperative formed its own risk pool, but maintained an interpool agreement with the Fort Bragg and Central Coast groups giving them preferred access to constraining species quota.

3. Discussion

3.1. Fishing cooperatives in Alaska and the Pacific Coast since 1997

What began in 1997 as an experimental effort by a small number of companies to consolidate and address overcapitalization in the Pacific whiting catcher–processor fleet has now grown to cover almost 60% of the commercial fisheries of Alaska and the Pacific Coast. Cooperatives have changed the economics of fishing, generating wealth by reducing capacity and waste and by managing external harvest limits on both targeted and prohibited species. Fishing company financials are generally proprietary, but fishery-wide revenues are readily available, and show that cooperatives accounted for 28% of West Coast and Alaska commercial fisheries revenues in 2011 [57]. Adding the IFQ-managed halibut and sablefish fisheries brings that number up to 43%.

While these figures are important, ex-vessel prices are as much a reflection of exogenous market forces as innovative economic organization. The real measure of success for an economic organization is wealth generation [58]. Closing open access and curtailing the race to fish results in wealth generation [59]. Using fewer boats over longer seasons and avoiding constraining species and PSC limits generates wealth. Table 2 highlights areas where cooperative fishing arrangements on the West Coast and Alaska have generated wealth though reductions in capacity (using fewer boats to catch the same amount of fish), longer seasons (fishing at a more economic pace in better weather, etc.), and more headroom under PSC limits in every fishery[5].

Cooperatives allow the fishing industry to move away from maximizing harvests or individual profits toward collectively

[5] The exact numbers in Tables 1 and 2 should be taken as rough estimates; there are always complicating factors. Seasons are lengthened because boats are able to plan harvests in other fisheries (taking nothing away from the relationship between longer seasons and wealth generation). In other cases, the reduction of active vessels may be exaggerated by boats that were "fishing for quota" in the period before implementation in the hopes of increasing allocations based on historic catch.

maximizing profit from the fishery as a whole. Anthony Scott [7] predicted something similar in comparing the economic (and ecological) consequences of open-access versus a theoretical sole-owner of a fishery. The comparison remains a useful one, especially when considering what might be possible with greater cooperation and coordination within and among fishing cooperatives.

For every legally-sanctioned cooperative, regulators and legislators balanced economic, political, and social outcomes such as the economic rationalization of the fishing fleet (especially consolidation and reorganization of fishing effort) with its effect on similarly overcapitalized processors, on maintaining businesses in remote coastal communities, and on protecting crew jobs. Many of these restrictions and mandates have both direct and transactional costs. Economists estimated that restrictions on quota transfers reduced the value of halibut IFQ by roughly 10% [60]. A more recent review of the costs of restrictions on catch shares, ranging from restrictions on quota leases and sales, ownership eligibility, and inter-sector transfers, among others, estimated that reduction in value caused by restrictions imposed on the West Coast groundfish fishery is also about 10% [61]. Tradeoffs that decrease the value and wealth created are to be expected when programs are implemented with both economic and social objectives [61]. In other cases, laws and regulations reduce the transaction costs of cooperation by, for example, grouping similar operations within sector allocations or by only allowing quota transfers within cooperative structures. And many restrictions are essential to reaching the political compromise necessary to create sector allocations and catch shares in the first place.

There is growing evidence that co-management—giving the industry a greater role in ecological, as well as economic management of the fishery—may reduce conflict within the industry, facilitate monitoring and enforcement, and reduce the likelihood of overexploitation [27]. In New Zealand, where catch shares are less restricted than in the United States, some fishing industry associations have taken on the management of both fishing effort and scientific fishery evaluation. The New Zealand Rock Lobster Industry Council and the Paua Industry Council, for example, have shelved quota to lower harvests, collect scientific data at a finer scale than government scientists, and actively participate in setting criteria for harvest models [62,63,11].

Many fishing cooperatives in the U.S. currently rely on an interpretation of antitrust law that allows them to rationalize the harvesting of fish, but not to collude on price setting. While agricultural cooperative law is interpreted to allow cooperatives to restrict supply to raise prices, to date fishing cooperatives have harvested the full amount of available catch limits set by regulatory agencies, and as a result, their authority to limit supply has not been tested.

Studies that calculate the financial costs of legal and regulatory restrictions generally make static comparisons, such as between restricted quota prices and unfettered quota prices for the same species. But the Chignik Salmon Cooperative did more than facilitate quota trading; it created a new, innovative contractual arrangement. All of the members agreed to a revenue sharing arrangement that included compensating the 20 boats (out of 77 member vessels) actively fishing. The cooperative designated one member as the fleet director who, by dictating where fishing would take place, tried to maximize the returns of the fleet rather than any one vessel [64]. The cooperative was also working to increase the value of the harvest, both by keeping live fish in holding pens to await processing and by working to market Chignik salmon along the lines of Copper River salmon, which commonly receives prices 4–5 times greater than later runs of Alaska salmon [65]. While Chignik salmon never received a price similar to Copper River salmon, the price received during the cooperative years was over 25% higher than in the surrounding non-cooperative years [66]. After 4 years, the cooperative was undone when the Alaska Supreme Court ruled that the State Board of Fisheries exceeded its statutory authority by adopting the allocation structure that supported it.

The economic, regulatory, and environmental constraints imposed on cooperatives made the system viable in the first place. As the rationales for cooperative formation evolve, those constraints have evolved too, but it is worth considering their effect on cooperative structure, and how they affect the ability of cooperatives to create new institutional arrangements to internalize transaction costs, lead to better enforcement, and generate wealth. It is difficult to envision the fishing industry setting its own PSC limits or enforcing large marine protected areas, but it is not a stretch to imagine greater coordination within and between sectors and across target species. Every groundfish cooperative already contracts with Sea State, Inc. to monitor data on harvest and bycatch, primarily to avoid prohibited species hotspots. That information could also be used to direct vessels toward target species instead of away from prohibited ones, or to coordinate vessels across groundfish species.

4. Conclusions

The economic historian and Nobel Laureate Douglass North [67] noted that the “rules of the game” set by economic, legal, and political institutions are fundamental to economic success because they “define and specify competitive and cooperative relationships in the market place”. The greatest increases in wealth and economic productivity occur when these rules allow new forms of competitive and cooperative relationships to take advantage of opportunities ranging from economies of scale to risk sharing to reducing information costs [68].

Fifteen years ago cooperatives in Alaska and West Coast fisheries began to internalize quota transfers and fleet consolidation, and shortly thereafter began collectively managing caps on prohibited species catch. The success of the PWCC led directly to cooperatives in all sectors of the Alaska pollock fishery, the scallop fishery, and, for a brief period, the Chignik salmon fishery, before the IFQ moratorium ended in 2002. The Weathervane Scallop Cooperative was the first instance where bycatch avoidance and strict PSC limits played an important role in cooperative formation. Since then, bycatch and PSC limits have only grown in importance as factors contributing to cooperative formation, especially in fisheries such as West Coast groundfish, where constraining species quota allocations are extremely small and unevenly distributed. For the two Pacific whiting cooperatives formed in 2011, the number of vessels actively fishing remained largely unchanged, highlighting a shift from economic rationalization to flexibility under strict PSC limits in cooperative function.

Cooperatives have transformed the fisheries they participate in, lengthening seasons, increasing the percentage of target species TAC that is harvested, reducing bycatch, and creating risk pools to manage constraining species catches. Yet apart from the initial innovation of cooperatively managing sector allocations and creating internal transfer markets and flexibility, subsequent changes in cooperative function have all been reactive—to IFQ allotment and to constraining species catch limits in particular. Some cooperatives, notably the PCC, have budgets allotted to scientific research and work cooperatively with NMFS on data collection and research questions, and all cooperative members help to fund the onboard observer program. But no cooperatives are funding their own independent research or analysis of scientific data. Cooperatives work together advising members where *not* to fish (to avoid prohibited species and bycatch), and there is revenue sharing when quota is stacked on vessels, but little or no

effort to coordinate when and where the fleet fishes to raise fleet wide catch-per-unit-effort and profit.

Economists have noted that while catch shares or individual transferable quotas may not maximize the rents in a fishery, "an agreement to coordinate fishing dates and locations among fishermen might" [64]. West Coast cooperatives are already sharing data on harvest through Sea State, Inc. to monitor bycatch hotspots and to avoid prohibited species. There is no reason not to use the same type of service to improve scientific data on the fishery more generally, and to direct fishing effort fleet-wide for target species. No doubt this is the next step in Francis Christy's "inexorable" march toward fuller property rights and wealth creation in fisheries, but under the current legal and regulatory environment in the United States, it may be some time before those opportunities present themselves.

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