Results based management of bycatch in a catch share fishery

Gretchen Anne Harrington¹, Stefanie Lyn Moreland²

Abstract

This paper explores using results based management to minimize the Bering Sea pollock (Theragra chalcogramma) fishery’s bycatch of culturally and economically valuable Chinook salmon (Oncorhynchus tshawytscha). The pollock fishery is the largest single species fishery, by volume, in the United States, annually generating over a billion dollars in revenue. This fishery is managed under the American Fisheries Act, a catch share program that identifies the eligible vessels and processors and allocates pollock quota among these participants. In Alaska, after escapement goals have been met, Chinook salmon harvests are fully utilized by subsistence, commercial, sport, and personal use fisheries.

Results based management is being implemented through incentive agreements–industry-developed contractual arrangements–which enact incentives for each vessel to avoid Chinook salmon bycatch. The incentive plans are one component of a management plan that limits Chinook salmon bycatch, sets performance standards, and increases federal bycatch monitoring. Federal regulations establish the performance-based requirements for the incentive plans, recognizing that an incentive plan can be more responsive and adaptive than regulations to the inherent variability in Chinook salmon bycatch and that the ease and cost of salmon avoidance differs by vessel. Incentive plans can be more effective because they can use tools, such as fees and penalties, not available to government managers. Participants demonstrate the incentive plan’s efficacy to managers and the public through annual reports, shifting the burden of proof to the pollock industry to show that they are minimizing their impact on Chinook salmon.

Keywords: results based management, pollock, Chinook salmon, bycatch management, Alaska fisheries

The views expressed in this paper are the authors and do not necessarily represent the views or official position of the Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, or the State of Alaska. Any errors or other deficiencies contained herein are the sole responsibility of the authors.

¹ National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Region, P.O. Box 21668, Juneau, AK 99802, (907) 586-7445, gretchen.harrington@noaa.gov.
² State of Alaska Department of Fish and Game, P.O. Box 115526, Juneau, AK 99811, (907) 465-6155, stefanie.moreland@alaska.gov.
In this paper, we describe a new results based management tool, incentive plan agreements (IPAs). IPAs are industry-developed and implemented contractual arrangements that provide incentives for each vessel to avoid Chinook salmon bycatch at all times while fishing for pollock. We defined results based management as creating the structure to motivate fishery participants to apply processes and resources to achieve targeted results. Results based management is aimed at achieving important changes in the way fishery participants operate and improving performance by defining expected results, monitoring and evaluating progress towards the achievement of expected results, reporting on performance, and integrating lessons learned into management decisions. In this case, the result is to minimize Chinook salmon bycatch to the extent practicable.

IPAs are part of a comprehensive program developed by the North Pacific Fishery Management Council (Council), one of eight regional councils established by the Magnuson-Stevens Fishery Conservation and Management Act to oversee management of fisheries in the United States’ exclusive economic zone. In April 2009, the Council recommended to NOAA Fisheries the Chinook salmon bycatch management program as Amendment 91 to the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area. NOAA Fisheries approved Amendment 91 on May 14, 2010, and published implementing regulations on August 30, 2010 (NOAA Fisheries 2010). NOAA Fisheries is implementing the program for the 2011 Bering Sea pollock fishery.

I. Bering Sea pollock fishery

The pollock fishery is the largest single species fishery, by volume, in the United States, annually generating over a billion dollars in revenue. This fishery is managed by NOAA Fisheries under the American Fisheries Act (AFA), a type of “rights-based” or “catch share” program. The AFA identifies the eligible vessels and processors and allocates pollack quota among these participants. Each year, NOAA Fisheries sets a total allowable catch (TAC) for the pollock fishery. Under the AFA, NOAA Fisheries allocates a percent of the pollock TAC to the Community Development Quota (CDQ) Program, the AFA inshore sector, the AFA catcher/processor sector, and the AFA mothership sector. NOAA Fisheries further divides the pollock allocations annually between two seasons, the A season and the B season.

The AFA allows for the formation of fishery cooperatives to further subdivide the pollack allocations among cooperative participants through private contractual agreements. The cooperatives manage these allocations to ensure that individual vessels and companies do not harvest more than their agreed upon share, facilitate transfers of pollock among the cooperative members, and enforce contract provisions. NOAA Fisheries monitors pollock harvest and bycatch by all vessels.

II. Chinook salmon bycatch in the pollock fishery

Chinook salmon are caught incidentally in the nets as fishermen target pollock. Culturally and economically valuable species like Chinook salmon, which are fully allocated and, in some cases, facing conservation concerns, are managed as prohibited species in the pollock and other Alaska fisheries. As a prohibited species, fishermen must avoid salmon bycatch, and any salmon bycatch must either be donated or returned to sea as soon as practicable, with minimum injury, after an observer has determined the number of salmon and collected any scientific data or biological samples.
The Bering Sea pollock fishery catches up to 95 percent of the Chinook salmon taken incidentally as bycatch in the Bering Sea and Aleutian Islands groundfish fisheries. The total amount of Chinook salmon taken as bycatch in the pollock fishery varies substantially from year to year. From 1992 through 2001, the average Chinook salmon bycatch in the Bering Sea pollock fishery was 32,482 fish. By catch increased substantially from 2002 through 2007, to an average of 74,067 Chinook salmon per year. A historic high of approximately 122,000 Chinook salmon were taken in the Bering Sea pollock fishery in 2007. However, Chinook salmon bycatch has declined in recent years to 20,559 in 2008 and 12,414 in 2009. For the 2010 pollock A season, and the pollock B season that opened on June 10, bycatch rates are comparable to the low bycatch rates in 2009.

The causes of the decline in Chinook salmon bycatch in 2008, 2009, and 2010 are unknown but most likely due to a combination of factors, including changes in abundance and distribution of Chinook salmon and pollock, and changes in fleet behavior to avoid salmon bycatch. Changes in fleet behavior include experimental use of gear modified with a salmon escapement panel and modifications to the rolling hot spot system from what was in place during the peak bycatch year, 2007.

Chinook salmon bycatch also varies seasonally, by sector, and among vessels due, in part, to the different fishing practices and patterns each sector uses to fully harvest their pollock allocations. In most years, the majority of Chinook salmon bycatch occurs during the A season. Since 2002, catcher vessels in the inshore sector typically have caught the highest number of Chinook salmon and had the highest bycatch rates by sector in both the A and B seasons. The catcher vessels in the inshore sector typically harvest pollock relatively near shore and deliver to shorebased processing facilities. Expanding a catcher vessel’s distance to fishing grounds or increasing time between successful tows within a single trip extends the period fish are in the vessel’s hold, reducing quality and value of the delivery. The catcher/processor, mothership, and CDQ sectors, which harvest pollock offshore, have typically had lower Chinook salmon bycatch rates.

In years of historically high Chinook salmon bycatch in the Bering Sea pollock fishery (2003 through 2007), the rate of Chinook salmon bycatch averaged 52 Chinook salmon per 1,000 tons of pollock harvested. With so few salmon relative to the large amount of pollock harvested, Chinook salmon encounters are difficult to predict or avoid. Industry agreements that require vessel-level cooperation to share information about areas of high Chinook salmon encounter rates probably are the best tool that fishermen currently have to quickly identify areas of high bycatch and to avoid fishing there. However, predicting these encounter rates will continue to be difficult, primarily because of the current lack of understanding of the biological and oceanographic conditions that influence the distribution and abundance of salmon in the areas where the pollock fishery occurs.

Chinook salmon taken in the pollock fishery originate from Alaska, the Pacific Northwest, Canada, and Asian countries along the Pacific Rim. Estimates vary, but more than half of the Chinook salmon bycatch in the pollock fishery originate from western Alaska. Western Alaska includes the Bristol Bay, Kuskokwim, Yukon, and Norton Sound areas. Significant uncertainty limits the utility of these estimates because the genetic samples on which the estimates were based were collected opportunistically and we’re not representative of the geographic and temporal scope of the fishery. A systematic sampling protocol is now in place for salmon on taken as bycatch in the pollock fishery, which will greatly improve the understanding of the origins of salmon bycatch.
NOAA Fisheries developed an adult equivalent model to estimate the amount of Chinook salmon bycatch that would have returned as adults to specific regions of origin. The model takes into account a number of factors that drive whether a salmon caught in a given year would have returned to its river of origin in that year, in a future year, or would not have returned due to ocean mortality. The model also assesses where fishing effort occurred and other factors that drive the amount of Chinook salmon estimated to be from different river systems. This model and its results are described in detail in the Bering Sea Chinook Salmon Bycatch Management Final Environmental Impact Statement (NOAA Fisheries 2009).

III. Importance of Chinook salmon

In Alaska, after escapement goals have been met, Chinook salmon are fully utilized by subsistence, commercial, sport, and personal use fisheries.

Salmon harvested for subsistence use in rural Alaska communities are of nutritional, cultural, spiritual, and economic importance. Subsistence fisheries provide an estimated 230 pounds of food per person annually in rural Alaska, nearly all salmon (Fall et al. 2009). Approximately 60 percent of the wild foods harvested for subsistence use in rural Alaska communities is from subsistence fisheries (Wolfe and Utermohle 2000). The remoteness of these communities, centuries of dependence on salmon, and limited availability of alternative food sources make subsistence harvests of salmon integral to life in much of rural Alaska. Many rural Alaska communities rely on a “mixed, subsistence-market economy,” where economic well-being is a function of both market and non-market sectors (Tuck and Huskey 1986, Wolfe and Walker 1987). Revenue from commercial salmon fishing by rural residents is used to support modern subsistence fishing and hunting practices, which require inputs such as fuel, outboard motors, gillnets, and other supplies that must be purchased from outside the region.

In 2007, the most recent estimate of subsistence harvests of salmon on in Alaska, just over one million salmon were harvested in subsistence fisheries. Statewide, approximately 160,000 of these fish (16 percent) were Chinook salmon. Most subsistence fishery harvests are by households in western Alaska, including the Yukon, Kuskokwim, Bristol Bay and Northwest Alaska areas, which in total accounted for approximately 66 percent of the total estimated statewide subsistence salmon harvest. Three of these areas accounted for approximately 90 percent of the estimated subsistence harvests of Chinook salmon (Fall et al. 2009). While these numbers are relatively low compared to total number of salmon harvested in subsistence fisheries, Chinook salmon are the largest and generally most preferred of the Pacific salmon species in these areas, and represent an important component of these households’ diet.

The number of Chinook salmon taken commercially in western Alaska fisheries in recent years is similar to that taken annually for subsistence use in the same region. All commercial salmon fisheries in Alaska are limited to entry and require a State of Alaska limited entry permit to participate. More than 11,000 limited entry permits for salmon fisheries are issued each year, and approximately 75 percent are issued to Alaska residents (CFEC 2009).

In 2007, the commercial harvest of Chinook salmon from Western Alaska areas was moderate to low: 179 Chinook salmon were taken from the Kuskokwim Area; 33,634 from the Yukon River; and 62,670 from the Bristol Bay area. The total commercial Chinook salmon harvest across western Alaska was 96,483 fish in 2007, and from 2003 to 2007, ranged from 87,549 to 172,731 Chinook salmon. Annual subsistence harvests of Chinook from the same area and period ranged from 123,504 to 151,752 fish (NOAA Fisheries 2009). Chinook salmon ex-vessel prices are substantially higher than prices for any other salmon species. While some direct harvest of
Chinook salmon occurs in these areas, most Chinook salmon catch is taken incidentally to harvests of other salmon species. Chinook salmon on commercial harvests have been impacted by price and availability of markets for lower value salmon species.

Sport fisheries represent another important component of harvests. Chinook salmon sport fishing opportunities support guided and unguided activity across the state. In western Alaska, annual sport catches of Chinook salmon were 18,703 fish in 2007, approximately one-quarter the estimated number of sport harvests statewide. Nearly half the sport harvest of Chinook salmon statewide is from Cook Inlet and adjacent watersheds (NOAA Fisheries 2009).

IV. The complex problem

The biologically optimal amount of Chinook salmon bycatch is not a static number. Chinook salmon bycatch in the pollock fishery is highly variable, and the biologically optimal amount of Chinook salmon bycatch in any given season or area is highly variable and not predictable with existing information. No estimates exist of Chinook salmon abundance in the ocean, however, based on annual returns to river systems, Chinook salmon experience large annual fluctuations in abundance. Therefore, there is no abundance information on which to set a biologically allowable level of removal. An any hard cap would only protect Chinook salmon when they are abundant but not offer any incentives for reducing bycatch below that cap when Chinook salmon abundance is low (Sugihara and Hao, undated). Therefore, setting just a hard cap on the amount of bycatch would not provide the necessary protection when Chinook abundance was low and could constrain pollock harvests when Chinook salmon abundance was high.

While the biologically optimal amount of Chinook salmon bycatch would be theoretically possible to determine with sufficient information, given the cultural significance of and the dependence on Chinook salmon, there is no socially optimal amount of Chinook salmon bycatch. As a result, a system of individual bycatch quotas or similar perceived right to harvest an allocation of Chinook salmon would not achieve policy objectives.

Therefore, the problem was how to minimize Chinook salmon bycatch in every year to achieve the lowest amount of bycatch for that year in a way that also facilitates the continued harvest of pollock.

V. Chinook salmon bycatch management program

The Chinook salmon bycatch management program addresses this problem with an innovative approach that combines a maximum limit on the number of Chinook salmon that can be caught with an industry-developed IPA to implement incentives for each vessel to avoid Chinook salmon bycatch. In summary, this program establishes two Chinook salmon prohibited species catch (PSC) limits (60,000 Chinook salmon and 47,591 Chinook salmon) for the Bering Sea pollock fishery. A PSC limit is the maximum amount of Chinook salmon that can be caught in a given year. For whichever PSC limit is in effect, NOAA Fisheries will issue A season and B season Chinook salmon PSC allocations to the catch er/processor sector, the mothership sector, the inshore cooperatives, and the CDQ groups. Chinook salmon allocations remaining from the A season can be used in the B season (“rollover”). Entities can transfer PSC allocations within a season and can also receive transfers of Chinook salmon PSC to cover overages (“post-delivery transfers”).

NMFS will issue transferable allocations of the 60,000 Chinook salmon PSC limit to those sectors that participate in an IPA and remain in compliance with the performance standard.
Sector and cooperative allocations would be reduced if members of the sector or cooperative decided not to participate in an IPA. Vessels and CDQ groups that do not participate in an IPA would fish under a more restrictive opt-out allocation of Chinook salmon. If a whole sector does not participate in an IPA, all members of that sector would fish under the opt-out allocation.

PSC allocations for sectors and cooperatives limit the amount of Chinook salmon that can be caught in each season to prevent excessive bycatch in high abundance/high encounter years. Allocating Chinook salmon at the same PSC sector and cooperative level as the pollock allocation enables the pollock fleet to use their existing or ganizational arrangements to manage bycatch by each vessel as pollock catch is managed by vessel.

The IPA component is an innovative approach for fishery participants to design industry agreements with incentives for each vessel to avoid Chinook salmon bycatch at all times and thus reduce bycatch below the PSC limits. Regulations establish the results based requirements that each IPA must accomplish and a process for the pollock industry participants to develop, and for NMFS to approve, the IPA. Each IPA must contain a written description of the following:

1. The incentive(s) for each vessel to avoid Chinook salmon bycatch under any condition of pollock and Chinook salmon abundance in all years;
2. The rewards for avoiding Chinook salmon bycatch, penalties for failure to avoid Chinook salmon bycatch at the vessel level, or both;
3. How the incentive measures in the IPA are expected to promote reductions in a vessel’s bycatch rates relative to what would have occurred in absence of the incentive program;
4. How the incentive measures in the IPA promote Chinook salmon bycatch savings in any condition of pollock abundance or Chinook salmon abundance in a manner that is expected to influence operational decisions by vessel operators to avoid Chinook salmon bycatch; and
5. How the IPA ensures that the operator of each vessel governed by the IPA will manage his or her bycatch to keep total bycatch below the performance standard for the sector in which the vessel participates.

Any number of different incentive plans could meet these regulatory requirements and federal regulations are flexible in allowing the pollock fleet to modify the IPAs as performance information becomes available to ensure that the IPAs meet the program goals. As designed, an IPA can be more responsive and adaptive than federal regulations and can use tools not available to federal managers, such as substantial fees and penalties based on vessel performance. To ensure participants develop effective IPAs, participants submit annual reports to the Council that evaluate whether the IPA is effective at providing incentives for vessels to avoid Chinook salmon at all times while fishing for pollock.

The sector-level performance standard ensures that the IPA is effective and that sectors cannot fully harvest the Chinook salmon PSC allocations under the 60,000 Chinook salmon PSC limit in most years. Each year, each sector will be issued an annual threshold amount that represents that sector’s portion of 47,591 Chinook salmon. For a sector to continue to receive Chinook salmon PSC allocations under the 60,000 Chinook salmon PSC limit, that sector must not exceed its annual threshold amount more than two times within 7 consecutive years. If a sector fails this performance standard, it will permanently be allocated a portion of the 47,591 Chinook salmon on PSC limit.
NOAA Fisheries will issue transferable allocations of the 47,591 Chinook salmon PSC limit to all sectors, cooperatives, and CDQ groups if no IPA is approved or to the sectors that exceed the performance standard.

Transferability of PSC allocations is expected to mitigate the variation in the encounter rates of Chinook salmon by catch among sectors, CDQ groups, and cooperatives in a given season by allowing eligible participants to obtain a larger portion of the PSC limit in order to harvest their pollock allocation or to transfer unused allocation to other entities. When a PSC allocation is reached, the affected sector, inshore cooperative, or CDQ group would have to stop fishing for pollock for the remainder of the season even if its pollock allocation had not been fully harvested.

VI. IPAs as results based management

The IPAs are the results based management component of the Chinook salmon bycatch management program. The IPA concept was created with the understanding that, with proper incentives, pollock fishing vessels will change their behavior to avoid Chinook salmon bycatch and that fishery participants are best able to create and implement effective incentives. IPAs encompass five dimensions of results based management, namely:

- management for results takes account of uncertainty;
- specified results that are measurable, monitorable, and relevant;
- organizational arrangements that ensure authority and responsibilities are aligned with results;
- processes for monitoring and communicating results; and
- capacity and ability to learn and adapt to improve results.

The IPA component takes into account the inherent uncertainty in the biologically optimal level of Chinook salmon bycatch and the variability of encounter rates by requiring that the IPAs provide incentives for each vessel to avoid Chinook salmon bycatch under any condition of pollock and Chinook salmon abundance in all years. In this way, the IPA incentives can adapt to varying Chinook salmon abundance and, equally important, the changing locations of aggregations of Chinook salmon in the Bering Sea. The specified results, both in terms of the amount of bycatch by each vessel and effectiveness of the IPA’s incentives at minimizing bycatch, are measurable, monitorable, and relevant.

The IPA component uses the catch share program structure of the AFA, a type of rights-based management system. The AFA defines the fishery participants, which is necessary because IPAs are private contractual arrangements among fishery participants. Under the AFA, fishery participants have an allocation of pollock and have existing incentives to cooperate to harvest the pollock allocation. In cooperating to harvest pollock, participants have increased efficiency, product quality, and profits. The Chinook salmon PSC allocations to sectors, cooperatives, and CDQ groups facilitates cooperation within these existing groups to avoid bycatch through the IPAs. The organizational arrangements established to manage the pollock allocations provide the foundation for IPA development and implementation.

The IPA representative will submit the IPA for review and approval by NOAA Fisheries. The IPAs must comply with the performance-based provisions in the federal regulations, but the IPA participants determine how best to structure the IPA to achieve results. The regulatory requirements for the IPA are performance based because fishery participants have more tools available to them to create incentives to minimize bycatch at the vessel level than could be proscribed through federal regulations. The regulations implementing IPAs are specifically
designed to allow industry initiative within defined limits, but do not prescribe the means. This structure enables the IPA participants to determine the organizational arrangements necessary to ensure authority and responsibilities are aligned with results.

Specific results will be monitored in three primary ways. First, NOAA Fisheries will monitor and report the number of Chinook salmon caught by each vessel in each season and the number of Chinook salmon attributed to each PSC allocation. Every pollock vessel will carry an observer to monitor and report that vessel’s Chinook salmon bycatch. NOAA Fisheries will use this information to deduct Chinook salmon from each PSC allocation and ensure that PSC allocations are not exceeded. This data allow for evaluation of each vessel’s relative performance, spatially and temporally, and differences within and between sectors that may inform an assessment of vessels’ responsiveness to the program.

Second, communicating results and substantive review of the IPAs will occur annually as part of the Council’s public process and be based on the performance of the IPAs. The IPA representative will submit an annual report to the Council that will be the primary tool through which the Council will evaluate whether the IPA is meeting the goals. The IPA annual report must contain:

1. a comprehensive description of the incentive measures in effect in the previous year;
2. a description of how these incentive measures affected individual vessels;
3. an evaluation of whether incentive measures were effective in keeping salmon bycatch below levels that would have been achieved in the absence of the measures; and
4. a description of any amendments to the terms of the IPA that were approved by NOAA Fisheries since the last annual report and the reasons that the amendments to the IPA were made.

Third, an economic data collection program, currently under development, would provide data for NOAA Fisheries and the Council for use in verifying conclusions drawn by industry in the IPA annual reports. The proposed economic data collection program, once implemented, would provide quantitative information useful for evaluating the effectiveness of the IPA incentives, the PSC limits, and the performance standard at reducing salmon bycatch in times of high and low levels of salmon abundance, and how IPAs affect where, when, and how pollock fishing and Chinook salmon bycatch occur.

By design, IPAs are adaptive and can be modified as necessary to improve performance. IPA participants can amend the IPA to improve performance at any time by submitting an amended plan for NOAA Fisheries approval. The IPAs may be amended in response to the Council’s review to better achieve the program goals. Furthermore, if analysis prepared after the IPAs are in effect demonstrates that the program goals are not being met, the Council and NOAA Fisheries could revise the program and implement new management measures.

VII. Will IPAs work?

The big question is: Will IPAs be effective at providing incentives for each vessel to avoid Chinook salmon bycatch? A lot of controversy surrounded the development of the IPA concept. The concern was that Chinook salmon bycatch would only be minimized if exact measures were proscribed in federal regulations that the pollock fleet would not develop and impose effective incentives on itself (NOAA Fisheries 2010). However, given the existing catch share management of the pollock fishery and the complex problem, results based management should
be more effective than command and control regulations because participants determine how best to manage themselves to achieve results.

In developing the IPA concept, pollack fishery participants identified and analyzed different types of plans and tools that would provide incentives for vessels to avoid Chinook salmon bycatch (At-Sea Processors Association 2009, United Catcher Boats Association 2009, Kochin et al. 2008, Sugihara et al. 2009, Wilen 2009). While these may not be the same tools that the final IPAs use, they provide a good understanding of the principles used in the IPAs. They make clear the potential for improved bycatch reductions under a dynamic vessel-based incentive program relative to a hard cap alone in seasons of low encounters with Chinook salmon on the fishing grounds. In seasons with high Chinook salmon encounter rates, when PSC levels would be constraining, the incentive structure provides flexibility for the fishery participants to choose the most efficient means to balance their directed fishing opportunity within PSC limits.

Numerous papers have been written about the benefits of rights-based management for fisheries, from economic efficiencies to improved resource stewardship (Wilen 2006, Hilborn et al. 2005, National Research Council 1999). However, resource stewardship is generally limited to the target fishery for which the participants have received an allocation. Combining results-based management, such as IPAs, with a catch share program can ensure that the benefits from allocating a public resource are more than minimizing costs and maximizing profits. Results-based measures enhance the catch share program to provide incentives to achieve conservation goals, in this case minimizing Chinook salmon bycatch. This approach is expected to direct resources towards solutions that address the problem rather than incentivize new investment and changes in behavior targeted only at minimally meeting a rigid federal regulation.

By design, the IPAs put the burden of proof on fishery participants to show how they are meeting the specific goals set in regulation. However, with the underlying uncertainty with Chinook salmon ocean abundance, it will not be possible to definitively determine, in the near future, whether bycatch amounts are the result of fishing practices or Chinook salmon abundance and distribution. Given this inherent uncertainty, IPAs were implemented as part of a comprehensive program that includes a total limit on the annual and seasonal amount of Chinook salmon bycatch and vessel monitoring to accurately account for each salmon caught in the pollock fishery. Additionally, the systematic protocol for genetic sampling of salmon on taken as bycatch in the pollock fishery will greatly improve the understanding of the origins of salmon bycatch.

VIII. References


Wilen, J. E. 2009. Analysis of Alternative Incentive Plans for Reducing Salmon Bycatch in the Pollock Fishery. Comments prepared for submission to the North Pacific Fisheries Management Council for the April 2009 meeting. URL:
