Session O:
Experiences in including economic and social information to fisheries analysis and advice: why, how and by whom?

Title: **The design of hybrid individual incentive mechanisms for bycatch reduction**[1]

Author**:** Alan C. Haynie

Abstract**:**

After Chinook salmon bycatch reaching record levels in 2006 and 2007 in the Bering Sea pollock fishery, the North Pacific Fishery Management Council (Council) began consideration of a Chinook bycatch catch limit or hard cap that would close the fishery if it were reached. Because bycatch and salmon abundance are only partially correlated, the optimal method to reduce bycatch will both prevent an excessive level of bycatch and protect salmon at periods of lower bycatch encounters that are present at times when stocks are weak and protection is most important. After NMFS determined that it was legally unable to impose fees for the secondary purpose of protecting salmon at low abundances, the Council presented industry with a choice: a fixed hard cap of 47,591 salmon per year or a hard-cap of 68,392 salmon with an industry-operated individual-incentive program that would provides incentives for salmon reduction at all salmon and pollock conditions. Here we feature characteristics of programs that will protect salmon during high and low encounter periods and the specifics of programs proposed by industry. We discuss the efficiency and effectiveness of these programs and discuss the importance of having individual bycatch quota under a hard cap which could otherwise erode benefits in the rationalized fishery. The Council passed a plan amendment that will go in place in 2011 that will allow for the implementation of a hybrid incentive system, potentially efficiently protecting salmon at all abundance levels.

Keywords: bycatch, incentive programs, bycatch quota, bycatch fee.

*Contact Author***:**

Alan C. Haynie
NOAA/NMFS, Alaska Fisheries Science Center – F/AKC2
7600 Sand Point Way NE, Bldg 4, Seattle, WA 98115; phone: (206)526-4253;
Alan.Haynie@noaa.gov

NOTE: This manuscript does not necessarily reflect the views of the National Marine Fisheries Service, the National Oceanic and Atmospheric Administration, or the U.S. Department of Commerce As this work is preliminary, all opinions and errors are those of the author.

[1] A related paper is being presented in Session M, "From mobile closures to individual incentives: Chinook salmon bycatch reduction efforts in the Bering Sea pollock fishery." That paper discusses spatial management measures and compares spatial and incentive management approaches.

The design of hybrid individual incentive mechanisms for bycatch reduction

Introduction

After salmon bycatch levels reached record levels in 2006 and 2007 in the Bering Sea pollock fishery, the North Pacific Fishery Management Council (Council) began consideration of a Chinook catch limit, or "hard cap," that would close the fishery if it were reached. Because knowledge of the relationship between Chinook bycatch in the pollock fishery and salmon in-river abundance is incomplete and not perfectly correlated, the optimal method to reduce bycatch will both prevent what managers estimate is an excessive level of bycatch and will protect salmon at periods of lower bycatch encounters that are present at times when stocks are weak and therefore protection most important.

After NMFS determined that it was legally unable to impose fees below a hard cap for the secondary purpose of protecting salmon at low abundances, the Council presented industry with a choice: a fixed hard cap of 47,591 salmon or a hard cap of 68,392 salmon with an industry-designed and operated individual-incentive program that would provide incentives for bycatch reduction at all salmon and pollock abundances for all vessels. Because of previously successful self-enforcement of voluntary rolling hotspot (VRHS) closures by the pollock industry, the Council believed in the ability of industry to create effective plans and there was an existing framework of civil legal agreements under which industry could potentially develop binding and effective incentives plans.

Here we feature characteristics of programs that will protect salmon during high and low encounter periods and the specifics of programs proposed by industry. We discuss the efficiency and effectiveness of these programs and discuss the importance of having individually allocated bycatch under a hard cap, which could otherwise erode the benefits of a rationalized fishery. We conclude with a discussion of the Council's April 2009 action and a brief discussion of the plans presented by industry as part of this process.

Internalizing the externality & avoiding the race for bycatch

Bycatch is an environmental externality problem. The action of a person or company choosing to undertake the action produces a negative impact (i.e., externality) on the environment. This negative effect may be any type of pollution, such as smog or noise, or bycatch. Importantly, the damage from the action is not borne solely by the actor generating the pollution but by society or other groups. There is limited or no benefit from the "good behavior" of reducing pollution or bycatch and the costs of any good behavior are solely borne by the actor, while benefits are experienced by society or others. A secondary aspect of the externality is that it radically discourages individual innovation, because there is so little to be individually gained from technological innovation because the benefits are collectively shared.

The standard approach to an externality is to "internalize the externality." This means that society requires polluting actors to bear the full social costs of their actions, which will create the efficient level of resource consumption.

Economists recognize that decisions are made at the margin. Actors decide whether or not "one more unit" is worth it – people do not make all or nothing decisions but with each additional unit of a good or bad, they choose whether or not it is worth paying the price for another unit. In pollution terms, society wants to reduce pollution until the Marginal Abatement Cost (MAC) equals the Marginal Damage (MD) of pollution. This is the socially efficient level of pollution; at other points, the cost of additional pollution is higher than the costs of preventing it and the benefits of additional prevention are lower than their costs.

How do regulators induce agents of environmental externalities to the point that MAC=MD? Fees (also called taxes or charges) and quotas are the standard mechanisms that can be used to internalize environmental externalities. If an additional unit of pollution will be very harmful (mercury, for example), quotas provide more certainty on how much pollution (or bycatch) occurs because we know that some exact total will not be exceeded. If the costs of pollution control may be excessive and we do not have a strong reason to fix the total quantity, fees provide a certain per-unit cost and a maximum cost for any given level of pollution (or bycatch).

Bycatch is an environmental externality but has distinct features that typically can not be accurately internalized with a standard quota or fee system. A fixed quota will not work properly because the optimal level of bycatch is variable – the right cap is not the same each year. A standard fee system will not work because there was a policy choice by the Council that there is a level (i.e., hard cap) over which bycatch is excessive, regardless of what the pollock industry might be willing to pay for it. Because MAC and MD vary with salmon abundance, a fee would be both too high and too low as conditions changed.

Describing the socially efficient level of bycatch

So given this discussion about the limitations of quotas and fees for efficiently addressing the bycatch problem, how can we achieve the socially efficient level of Chinook bycatch in the pollock fishery? The socially efficient level of bycatch is where the marginal abatement cost (MAC) = the marginal damage (MD) (i.e., the cost of pollock fishery avoiding that salmon (MAC) = impact of the salmon loss on its other uses/users (MD)). Unfortunately, we don't know exactly how many salmon this is and it is constantly changing. The Council approximates this upper limit with its policy choice of the hard cap, but recognizes that the point where this is the case is not fixed though time. Social efficiency can only be achieved through a hybrid system that sets an upper limit but provides bycatch-reducing incentives at all levels below the hard cap.

An optimal system will adjust with changes in salmon abundance. When salmon abundance is lower than average, it is easier to avoid salmon but the marginal damage of catching a salmon at any given level of total bycatch is higher than average. When salmon abundance is higher than average, it is harder to avoid salmon but the marginal damage of catching a salmon at any given level of total bycatch is lower than average.

There are two reasons why salmon bycatch may increase. First, this may occur because salmon abundance increases. If this is case, the marginal damage from additional bycatch is lower at any given amount of bycatch. Alternatively, salmon abundance may be constant, but additional salmon have moved onto the pollock fishing

grounds. If this is the case, bycatch is high but the marginal damage from additional salmon will still be high.

In the pollock fishery, we do not fully understand the relationship between bycatch levels and salmon abundance; therefore, high Chinook encounters may imply either of these states of nature. A hybrid system that combines a cap (at some level) with incentives at lower levels of abundance will provide protection under each possibility.

Key features of a good incentive system

In designing an incentive system, actors must be able to respond to the incentives. If people were told they would have to pay for every breath they took, they would not be able to stop breathing. Further, the response to the incentives must meet the intent of the rule-makers. A good incentive system will allow salmon savings to occur where and when it is least expensive. If this is not the case, simply put there is less conservation at a greater cost. For fisheries managers, this often means that we are better off allowing flexibility across time when there is not a biological reason to restrict bycatch to one period instead of the period that comes before or after it. Actions which restrict how an actor reduces bycatch also add costs to the system.

A key feature of an effective system is the allowance of tradability. Why is tradability important? It ensures that we are not wasting resources – trade maximizes the amount of salmon that is saved per dollar of avoidance costs and minimizes the cost of avoidance for every salmon saved. Different vessels have fundamentally different abilities to avoid bycatch. A trading system provides incentives for vessels that can cost-effectively reduce bycatch to do so in order that they might sell saved allocations to others. The option to trade also reduces the risk to vessels of searching for lower bycatch areas (that may be expected to be lower on average but could produce higher bycatch on a particular haul).

Several restrictions of trade were discussed as part of the political process for approving this Council action. The most common restriction was the consideration of prohibiting vessels that reach an individual cap from purchasing additional salmon allocation. Also considered were restrictions on the trade of salmon bycatch allocations between co-ops or sectors. Interestingly, after the hard cap number had been chosen, some groups that had seemed to support tradability turned against it because it they felt that limiting tradability would be likely to further restrict salmon bycatch because not all vessels would catch their entire quota.

It is unlikely that the impacts of restricting trade would have been what these groups expected. What are the likely impacts of restrictions on trade? Restricting trade reduces the incentive for clean vessels to save salmon because sales to vessels that reach their limit will be restricted and salmon allocation prices lower. Further, reducing trade restrictions would increase salmon quota prices, which will encourage innovation in bycatch reduction.

The process of implementing the Chinook bycatch program for the Bering Sea pollock fishery

One institutional feature that made implementing and enforcing a hard cap in the pollock fishery is that more than 80 percent of hauls are currently observed in the fishery. Expanding the North Pacific Observer Program to 100 percent coverage for this fishery was easier and represented a more certain cost than it would for some other fisheries.

An additional special feature of the fishery is its past experience with the implementation of the VRHS system. In creating this mechanism of dynamic salmon hotspot closures, beginning in 2001 industry had to come to consensus and set up legal mechanisms for civil enforcement. This made developing a plan of this sort internally feasible for industry and made the Council willing to entertain the proposals submitted.

After a discussion paper was presented to the Council by NMFS economists in February 2008, the NMFS Region and NMFS General Council concluded that implementing bycatch fees was not legally feasible. Having a rolling bycatch quota was also seen as very difficult to implement. After discussion between industry and the Council, in June 2008 the Council selected a preliminary preferred alternative (PPA) that, as mentioned in the introduction, would allow for a higher cap of 68,392 fish if there was an incentive plan in place that would provide incentives to reduce bycatch at all levels of abundance.[2]

Industry representatives developed several incentive plans. The plans were publicly presented, critiqued, and revised a number of times between June 2008 and the Council's final action in April 2009. The Council's Scientific and Statistical Committee (SSC) and NMFS economists analyzed the final proposals and presented these results at the April 2009 Council meeting. One of the plans, the Financial Incentive Plan (FIP), required vessels to "ante," typically at a rate of $0.01/pound of pollock held by the vessel, and the pool would then be returned to the fleet based on their relative bycatch performance. This provides stronger incentives the lower the level of bycatch, as one fish has a larger marginal value at low bycatch levels than high levels. Another proposal was called the Salmon Savings Incentive Plan (SSIP) which was built in part on an earlier plan called the Legacy Plan. This plan allowed vessels to bank salmon (at a discounted rate) that they saved below their share of the lower limit of 47,591 salmon for use in future years when bycatch was harder to avoid.

Each plan had attractive features. At a Council meeting in February 2009, prior to the April 2009 action, the Council clarified that it expected the incentive plans to perform at levels below the 47,591 level on average. Each plan was adapted to adhere to this additional requirement. The plans evolved as the Council and stakeholders expressed preferences through public and private comments.

One significant concern remained for people skeptical of the motives of industry, however. Because the plans presented were not formally part of the Council's action, they were developed in a draft or sample basis that was not legally binding. Given the long-term importance of the pollock fishery maintaining its credibility with the Council, the likelihood of industry pulling a "bait and switch" did not seem very high, but this lack of certainty made some Council members very uncomfortable as they heard strong

[2] The June 2008 Council motion can be accessed at http://www.fakr.noaa.gov/npfmc/current_issues/bycatch/salmonbycatchmotion608.pdf.

messages from constituents about the importance of imposing significant limits. A number of Native Alaskan and environmental groups were asking that a hard cap be imposed in the range of 30,000 Chinook and in the end the PPA hard cap of 68,392 was apparently too high for the Council to politically accept. The Council passed a hard cap of 47,591, with the provision that the cap would be 60,000 for any 2 of 7 years, so long as an incentive plan agreement (IPA) was in place that provided incentives at all levels of salmon bycatch. The Council's action allowed for tradable salmon bycatch allocations, which ensures that the hard cap will not create a "race or bycatch" that could erode the economic benefits created with the creation of catch shares in the fishery, which occurred in 1999 and 2000.

The "Performance Standard" requirement that the hard cap could be above 47,591 for only two years was an extra check on the system that would give added comfort that the plans would reduce bycatch below the 47,591 level in most years. Unfortunately, the Performance Standard presents significant problems for the inter-annual flexibility and exchange that the IPAs were built upon. If individuals save salmon below the cap and then exceed their share of 47,591 Chinook in subsequent years, the fleet could slightly exceed that level in more than 2 of 7 years and then could not exceed that level again.

Since from the fleet's perspective the purpose of having an IPA is to in some years exceed the lower cap, there are not strong collective economic incentives for industry to develop of an IPA with strong incentives. Because the Council changed the hard cap and implemented the Performance Standard, industry is in no way bound to its previous proposals. Nonetheless, significant political incentives are still in place because the Council may at a later date reduce the hard cap further if it deems that this is necessary. Industry is currently working to develop a new IPA compatible with the performance standard, but NMFS will not see the final IPA until shortly before the implementation of the salmon bycatch program, which is expected to be in January 2011. Future analysis will be directed at determining the effectiveness of the IPA in years when the hard cap is not reached.