

Science, Service, Stewardship



SSC Evaluation of the Salmon Bycatch ICA

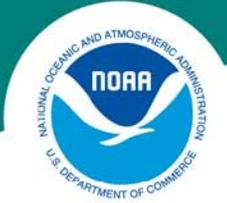
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March 30, 2009

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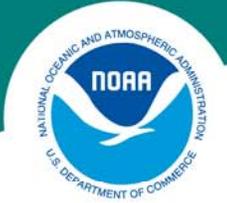
Outline of Presentation

- **Council Request of the SSC**
- Overview and discussion of incentive mechanisms to reduce salmon bycatch
- Salmon Savings Incentive Plan (SSIP)
- Financial Incentive Plan (FIP)
- Trades and vessel movement between plans
- Rolling Hotspot (RHS) Program
- Data collection requirements for monitoring



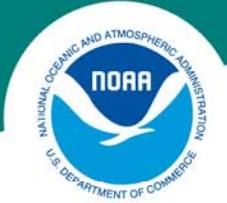
“This final documentation provided by industry must include the following:

- Description of the structure of the ICA agreement including information on the rules governing the inter-relationship of the different incentive programs...
- Clear description of each incentive program proposed under the ICA agreement...
- Analysis to demonstrate how well each incentive program will achieve the Council’s goals of bycatch reduction.”



Council SSC Request Summary

1. Do these incentive programs provide incentives for each vessel to avoid salmon bycatch under any condition of pollock and salmon abundance in all years, including at levels below a hard cap?
2. Can these programs be expected to promote reductions in actual individual vessel bycatch rates *relative to what would have occurred in absence of the incentive program.*



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Will incentive systems be effective?

- Are incentives sufficient to “change behavior”?
- Hard cap will change behavior – vessels will make the least expensive choices available to them to reduce bycatch.
 - A hard cap alone without individual allocation would recreate a race for bycatch and eliminate benefits of rationalization.
- Beyond (below) the hard cap, various mechanisms could potentially provide incentives for bycatch reduction
 - Direct payment to vessel/company, or avoidance of a fee
 - Any system which allows savings now to be used in periods of higher avoidance costs.
 - Dynamic means of adjusting available salmon (e.g., dynamic salmon savings provision)



Will incentive systems be effective?

- Can fishers make choices to reduce bycatch?
 - SeaState provides real-time information about high bycatch areas
 - Bycatch has a predictable components seasonally and spatially
 - Choices that vessel operators can make to reduce bycatch
 - Choices about where to fish
 - When to start and end the season
 - Excluders



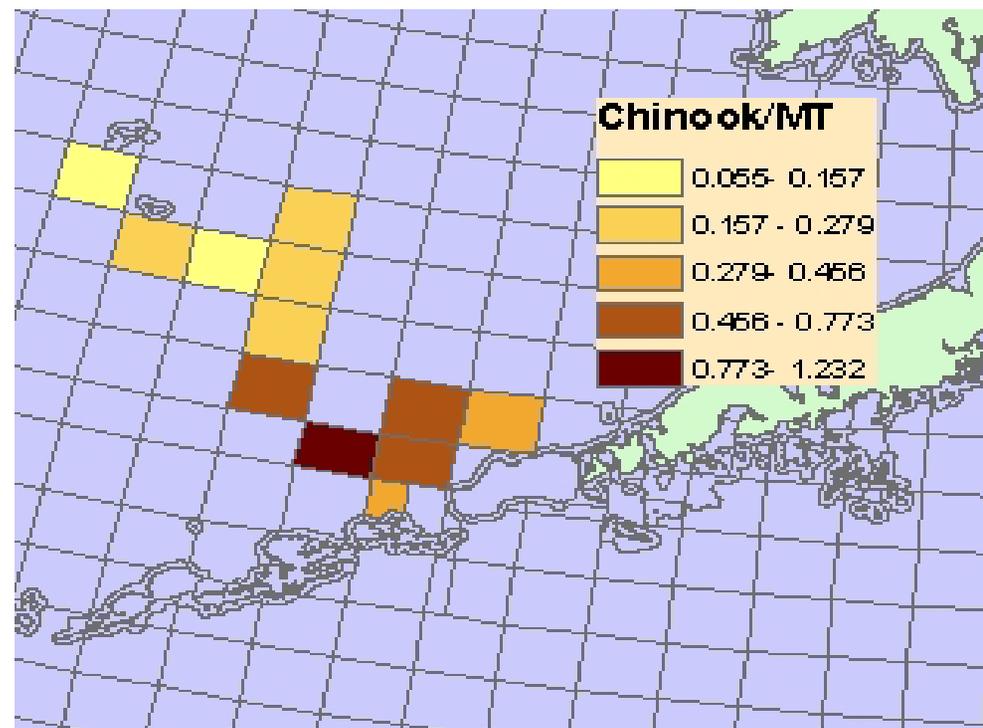
Different vessels are clean and dirty in part because of vessel characteristics

- Some vessels use more fuel/hour so it's more expensive for them to travel further to avoid salmon
- Because many CPs can profitably fish in areas with lower pollock CPUE because of greater horsepower, they can economically fish in a larger number of clean areas.
- CPs and Motherships can travel further north, which can be cleaner.
- The value of roe is higher to the offshore sector, so they are potentially more willing to pay for salmon rights during roe season than the inshore sector.



October 2007 inshore average bycatch rates by ADFG Area

- For areas with >10 hauls per area, considerable variation exists among areas, with cleaner areas being more distant
- Important question remains: can this bycatch be predicted and avoided?





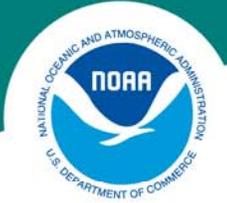
While bycatch may be random, that doesn't mean that it's not predictable!

- For example, in October 2007, large correlation in CV ln(bycatch rates) in ADF&G statistical areas
 - From Week 2 to Week 3 in areas with > than 1 haul per week, the correlation is 0.91.
 - From the first half of the month to the second, the correlation is 0.61.
- For CPs, 2001-2007, the correlation is 0.47 from one day to the next in any given area.
- This gives some evidence of predictability, but further analysis can much better define these relationships to develop an efficient predictive model of expected bycatch across space.



Standard environmental externality problem

- Action of a person or company produces a negative impact (i.e., externality) on the environment.
 - Negative effect may be pollution (e.g., smog, noise, etc.) or bycatch
- Damage from action not borne solely by actor generating the pollution but by society or other groups
- Limited or no benefit from “good behavior” of reducing pollution or bycatch
 - Costs of any “good behavior” solely borne by actor, while benefits are experienced by society or others.



Standard approach to “internalizing the externality”

- Require polluting actors to bear the full social costs of their actions, which will create the efficient level of resource consumption
- Decisions are made at the margin
- Reduce pollution until Marginal Abatement Cost (MAC) = Marginal Damage (MD)
 - This is the socially efficient level of pollution.



Fees and Quotas can both be used to internalize environmental externalities

- If an additional unit of pollution will be very harmful (e.g., mercury), quotas provide more certainty on how much pollution (or bycatch) occurs because we know that the 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). Don't know what level of pollution will occur, however.
 - If fee is too low, pollution will be too high ($MD > MAC$)
 - If fee is too high, pollution too low ($MD < MAC$)



Bycatch is an environmental externality but...

it can't be accurately internalized with a standard quota or fee system.

- Not with a fixed quota because the optimal level of bycatch is variable – the right cap is not the same each year
- Not with a standard fee system because the Council's PPA implies that there is a level (i.e., hard cap) over which bycatch is excessive, regardless of what the pollock industry is willing to pay for it.
 - Because MAC and MD vary with abundance fee will be *both* too high and too low at different times.



Socially efficient level of bycatch

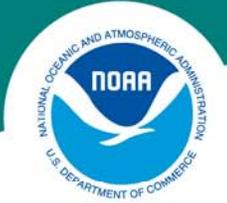
- Socially efficient level of bycatch is where marginal abatement cost (MAC) = marginal damage (MD)
 - i.e., the cost of pollock fishery avoiding that salmon (MAC) = impact of the salmon loss on its other uses/users (MD)
 - We don't know exactly how many salmon this is
 - The Council approximates this point with the hard cap, but PPA recognizes that the point where this is the case is not fixed though time.
- Social efficiency can only be achieved through a hybrid system, such as both of the programs evaluated here.



Socially optimal bycatch level (2)

An optimal system will adjust with changes in 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



Two reasons why salmon bycatch may increase

- Salmon abundance increases
 - If this is case, the marginal damage from additional bycatch is lower at any given amount of bycatch
- Salmon abundance is constant, but those 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
- Because high 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

- Actors must be able to respond to incentives
- Response to the incentives meets the intent of the rule-makers
- System allows salmon savings to occur where and when it is least expensive
 - Allowing flexibility across time when there is not a biological reason to restrict one period vs. another.
 - Actions which restrict *how* an actor reduces bycatch add cost to the system.



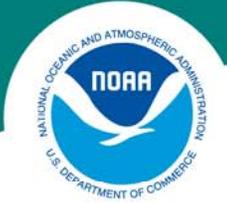
Why is tradability important?

- 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 different abilities to avoid bycatch. A trading system provides incentives for vessels that can cost-effectively reduce bycatch so that they can trade allocations to others.
- The option to trade 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 given haul).



What are restrictions to trade?

- Prohibiting vessels that reach an individual cap from purchasing additional salmon.
- Restricting the trade of salmon bycatch allocations between co-ops or sectors.
- Restricting the transfer of “saved” salmon in the SSIP is one example.



What are the impacts of restrictions on trade?

- Reduction in incentive for clean vessels to save because sales to vessels that reach their limit will be restricted and salmon prices lower.
 - Pollock can be transferred from dirty to clean vessels, which may mitigate the loss in incentive if the clean vessels are able to increase effort but it creates a loss from the inefficiency in the pollock fishery that it creates.
- Inefficient, high-bycatch vessels are likely to be distributional winners from trade restrictions (because prices will be lower for them), not clean vessels.

Reducing trade restrictions would increase salmon quota prices, which will encourage innovation in bycatch reduction.



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Council Q1: Are individual incentives in place under all conditions?

Description of SSIP

- After first year of the program, vessels can only exceed their share of the 47K “performance standard” by
 - Using savings that was achieved over the previous 3 years (at a significant discount rate – 1 unit of salmon savings requires 2.29 salmon avoided below 47K)
 - Transferring salmon from another vessel that is saving below 47K for the year, in which case the transferee will be forced to conserve or transfer in that amount the following year
- The first year of the program allows vessels to go up to their share of 68K, but if they do they must conserve over the next two years so that the 3-year average bycatch will be under 47K.



Council Q1: Are individual incentives in place under all conditions?

Important features of the SSIP

- Provides incentives for all vessels to reduce bycatch
 - Insurance incentive present in the system that will encourage bycatch savings in low-bycatch years.
- No vessel can catch more than its share of 68K in any year
 - i.e., There can be no really “bad” actors under this system
- System is arguably less competitive in nature than the FIP or the Legacy Plan
 - This encourages sharing of bycatch information and avoidance strategies
 - Trade-off is reduced competition among vessels, which is most important at low bycatch levels.



Key Control Variables of System

- Discount rate for salmon savings
 - This is the rate at which savings earned today is savings in the future
 - Discount rate is large: must forgo 2.29 salmon this year to earn a saved salmon to use in future years
- Banked salmon expiration or decay
 - Saved salmon expires in 3-years
 - Could have a smoother decay, or allow further discounted sale of the 3rd year savings
- *Vesse/s* may not exceed total cap.
- Trading of savings not permitted.

Council Q2: Is ICA an improvement versus hard cap alone?



Sample Scenario 1: Three years of low bycatch, then 3 years of higher bycatch

- Assume bycatch was 24,000 per year for the first 3 years—roughly half of the performance standard.
- After 3 years of this low bycatch, vessels could fish three years at 57,092. The following year (Year 7) would have to be back to performance standard.
- 6-year average bycatch would be 14 percent below performance standard.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual Bycatch	24,000	24,000	24,000	57,902	57,902	57,902
3-year mean	24,000	24,000	24,000	35,301	46,601	57,902
6-year mean	24,000	24,000	24,000	32,476	37,561	40,951



Council Q2: Is ICA an improvement versus hard cap alone?

Sample Scenario 2: How would we see the highest 3-year rolling average?

- Highest possible 3-year average would follow 3 years of no bycatch.
- After 3 years of no bycatch, vessels could fish three years at 68,392. The following year would have to be back to the performance standard.
- 6-year average bycatch would be 28 percent below 47K average.

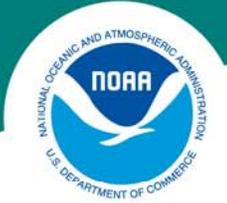
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual Bycatch	0	0	0	68392	68392	68392
3-year mean	0	0	0	22797.333	45594.667	68392
6-year mean	0	0	0	17098	27356.8	34196



**Sample Scenario 3: Upper limit
fishing in all years**

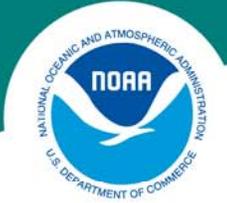
- Startup Loan used in Year 1
—Paid back over next 2 years
- Fishing at performance standard after this
- Unlikely to occur unless salmon extremely abundant on grounds in year 1; extremely financially risky for pollock fleet to have 37K cap for years 2 & 3.
- 3-yr and 6-yr averages are 47K.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Annual Max	68,392	37,191	37,191	47,591	47,591	47,591
3-year mean	68,392	52,791	47,591	40,657	44,124	47,591
6-year mean	68,392	52,791	47,591	47,591	47,591	47,591



Does SSIP Satisfy Provisions of PPA?

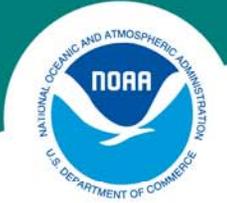
1. Does the SSIP provide incentives for each vessel to avoid salmon bycatch under any condition of pollock and salmon abundance in all years, including at levels below a hard cap?
— Yes.
2. Can the SSIP be expected to promote reductions in actual individual vessel bycatch rates *relative to what would have occurred in absence of the incentive program*.
 - Average of 1st 3 years will be at or below 47K.
 - If average of 1st 3 years is below 47K, 2nd 3 years could be above 47K, but 6-year average will be below 47K. After year 1, any salmon in excess of 47K for any year will be compensated by 2.29 salmon below 47K for another year.



Council Q2: Is ICA an improvement versus hard cap alone?

Possible Improvements

- Third year salmon savings is “use it or lose it” and this could be improved.
 - This would only matter in the case that a vessel exceeds its base cap and has 3-year-old savings that it couldn’t trade
 - Doesn’t eliminate insurance incentive behavior beforehand, but creates an inefficiency in the system and reduces the incentive to save
 - Will occur infrequently & not dramatically affect the system.
- Trade restrictions could be relaxed.
- Discount rate could be made a decreasing function of savings within a year to sharpen incentives to save in low bycatch years.



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Council Q1: Are individual incentives in place under all conditions?

Description of FIP

- Hard cap (68K) enforces upper bound of bycatch
- FIP mechanism provides per-salmon bycatch reduction incentive that increases as total bycatch declines and complements the salmon quota which increases in price as vessels approach the cap
 - Each vessel contributes a \$22.05/ton of pollock “ante” to a pool that is divided according to relative bycatch
 - Pool of contributions is divided based on relative “undercatch” of salmon.
- Ante to pool increases by \$11.03/yr when 3-year average bycatch is above 47K performance standard.



Council Q1: Are individual incentives in place under all conditions?

Key Features of FIP

- Tournament or pool mechanism of FIP uses competition to provide incentives to reduce bycatch.
 - At low levels of salmon bycatch, there are increased incentives for conservation
- Plan provides larger per-salmon marginal values when it is most biologically important, as bycatch goes towards zero (and therefore salmon abundance is low and marginal damage is high)
- Increasing “ante” to the tournament mechanism provides a strong mechanism to bring companies below 47K standard.



Council Q1: Are individual incentives in place under all conditions?

Undercatch calculation

- “Dirty Harry Problem” solved by basing the undercatch on the median vessel
- Undercatch is based on how many salmon are saved relative to bycatch, which is call the ‘performance reference.’ Currently set at 2.5 times the median bycatch.
- Interaction of the performance reference and the ante amount determine the strength of the plan’s incentives.
 - Both the size of the pie and how it’s divided are important.



Council Q1: Are individual incentives in place under all conditions?

Company Adjustment

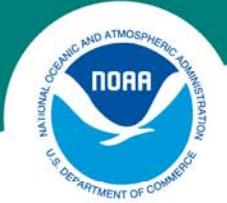
- Adjusts pay-outs so that the marginal value per salmon is similar for each company
 - In previous version large companies faced lower marginal values of salmon & this adjustment corrects for this issue.
- How do the company adjustment and the escalating ante interact?



Council Q1: Are individual incentives in place under all conditions?

Control Variables of the FIP

- Ante and performance reference of under-catch to median interact to determine marginal value of salmon & payout
 - Smaller performance reference leads to a larger incentive for avoidance.
- How steep does the ante increase with a 3-year average above the performance standard?
- # of players is important to functioning of the program
 - Ante could be increased and/or performance reference could be decreased with smaller groups to provide stronger incentives.



Council Q1: Are individual incentives in place under all conditions?

What is the possibility for collusion or gaming in the FIP?

- Formal conspiracy to collude would be very difficult, as described by Kochin et al. (2008)
- Tacit collusion is possible, particularly with very small groups. It would be better for companies to have a higher bycatch, lower avoidance cost strategy if everyone would do that.
- The possibility of collusion in this system is reduced by several factors:
 - The ante increases if vessels are above a 3-year mean of 47K
 - Other vessels can enter this program and get a significant share of the antes if existing vessels are colluding and not attempting to minimize bycatch
 - It's sometimes hard to tell whether vessels are trying to aggressively minimize bycatch or are just lucky, which it makes it more difficult to observe deviation from any possible collusion.



Council Q2: Is ICA an improvement versus hard cap alone?

Scenario 1: What are payouts and marginal values with the current ante and performance reference?

- The relationship between the ante and marginal value of salmon is direct – double the ante leads to double the marginal value for salmon.
- The difference between a performance reference of 2.0 and 2.5 is significant.
 - Marginal value would be approx. 1.5 times higher in 2007 with a 2.0 performance reference – approx. \$360 instead of \$240.
 - Total marginal values much higher than this in low bycatch years.
- While everyone in the FIP faces positive marginal values for salmon, the net payment is positive for those above the median and negative for those below.



Council Q2: Is ICA an improvement versus hard cap alone?

Scenario 2: Can a vessel have a high bycatch year and pay its way out with increasing ante over three years?

- A vessel could choose to go to its share of 68K in Year 1 and then stay at its share of 47K for three years, paying increased antes for 3 years before the ante returns to normal. How much would this cost and would it be worth it?
- The vessel would pay approximately \$4,000 per salmon extra as a result of the increasing ante, plus additional costs in the first year that will depend on other vessels' performance.
 - The large per-salmon cost to this strategy makes it unlikely.



Council Q2: Is ICA an improvement versus hard cap alone?

Scenario 3: What are the incentives for dirty and clean vessels to form their own pools?

- Clean vessels would like to be in an FIP with dirty vessels, but dirty vessels would like to be in their own FIP
- For 2007, compare what happens if the vessels above and below the median both form a separate FIP
 - Approximately \$1.5 million in ante is divided among dirty vessels rather than transferring it to clean vessels.
 - Marginal value of salmon for clean vessels increases from approx \$240 to \$270, while it declines to approx \$190 for the dirty vessels.
- This implies that we would expect dirty vessels to form a separate FIP.



Council Q2: Is ICA an improvement versus hard cap alone?

Possible Improvements

- If additional certainty to model is desired, add escalation of ante until all-time average goes below 47K. The high costs of a vessel accepting the costs of an increasing ante for multiple years makes it unlikely that this is necessary.
- Consider restricting exit or requiring a larger size for the program.
- Ante and/or ratio can be tuned to increase avoidance incentives at lower levels depending on policy preferences or new biological information.



Council Q2: Is ICA an improvement versus hard cap alone?

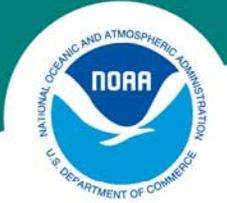
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— Yes.
2. Can the FIP be expected to promote reductions in actual individual vessel bycatch rates *relative to what would have occurred in absence of the incentive program*.
— Yes.



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Comparison of Key Program Features

SSIP

- After 1st year, vessels can only exceed 47K by trading with vessels who catch less than 47K or by using savings.
 - Savings is discounted at rate of 1 unit of savings per 2.29 salmon avoided under performance standard.
- No vessel can exceed its share of 68K cap in any year.
- Discount rate and 3-year savings window could be adjusted to increase incentives for salmon conservation.

FIP

- Competitive structure has increasing incentives at low bycatch levels that works in conjunction with salmon quota that becomes more expensive near the hard cap.
- No restrictions on quota trading
- Increasing ante for vessels above 47K performance standard
- Some potential for tacit collusion in small groups.
- Ante and undercatch ratio can be adjusted to increase incentives.



Interaction of SSIP & FIP

- Plans both contain measures that require vessels to be below 47K to leave incentive plan.
- Trading of salmon between plans permissible.
- No Issues with the SSIP plan being small. One vessel could operate under the plan.
- Possible issues with FIP being small, but it's not possible to say how small is “too small”
 - If there is a sector-level performance standard, then this problem only applies to how well the mechanism will work at low bycatch levels.



Performance standard issues

- Performance standard sets a level (e.g., 47K Chinook) that will not be exceeded under most years or an average of years.
- In different ways, both the SSIP and FIP provide significant salmon savings below the performance standard, but with the trade-off of inter-annual variation.
- Determining how much variation is acceptable is an important part of considering a performance standard.



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Overview of Rolling Hotspot (RHS) Program

- Will include fixed Chinook Conservation Area.
- Closures will apply at the vessel level (rather than coop).
- Weekly “core” closures closed to vessels above 75% of base rate
 - Base rate will use 3-week rolling average.
- “Dirty 20” list will be replaced by a comprehensive report card.



Rolling Hotspot (RHS) Program

- Key value of RHS is the sharing of bycatch information, which is essential for vessels to respond to incentives.
- Several impacts of having an RHS
 - Additional incentive to have low bycatch at the vessel level (to be able to fish inside closures)
 - Additional restriction in periods of low salmon abundance when quota is inexpensive
 - Will prevent people from fishing in high roe areas whether or not they are willing to pay for it with quota purchases
 - If we believe that someone will be able to bid up the value of salmon bycatch, we can restrict this (for distributional reasons).

The RHS is not the most efficient means to reduce bycatch because it doesn't maximize the pollock revenue per salmon caught, but does provide additional salmon reduction incentives & protection. This should be weighted against the costs of the system; it's possible that the same protection could be achieved more efficiently by slightly lowering the hard cap or increasing other program incentives in the future.



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Data collection and reporting requirements for monitoring

- Observing total salmon bycatch tells us whether any performance standard is met.
- Observing all salmon bycatch transactions and incentive payments is vital to assessing the performance of the bycatch incentive systems.
 - Prices, quantities, dates, and parties of transfers
 - Payments made in the FIP
 - Banked salmon in the SSIP.
- Having a fully functioning market with observable prices is one of the most valuable things for the Council to be able to determine the value of salmon bycatch to the pollock fleet for future decision making.
- Annual Report from ICA should be peer-reviewed.



Potential mechanisms to improve price information

- Require true third-party exchange to monitor transactions.
- Mandatory auction of a portion of each vessel or sector's salmon bycatch allocation (e.g., 10%)
 - Makes prices true arms-length transactions
 - Insures market is available (i.e., makes market thick)
 - Prevents vessels/companies from exercising market power on other companies.
- While near real-time bycatch rate information is essential for bycatch reduction, consideration could be given to whether constraining information on vessels' aggregate bycatch would reduce the possibility of in-season collusion.



Information to observe how fishermen take action to reduce bycatch

Possible categories of information that could be recorded in log books:

- When excluders are operating
- Moved to a different statistical area
- Moved to a slightly different location
- Altered fishing depth
- Reduced duration of haul
- Did you return to port early? How early?
- How many people did you consult about bycatch rates before this haul?

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The End

