Review for manuscript #10-41-1
"Comprehensive Incentives for Reducing Chinook Salmon Bycatch in the Bering Sea Pollock Fleet: Individual Tradable Encounter Credits"

Comments to the Authors

The paper suggests an interesting market-based mechanism to control for bycatch of Chinook salmon in the pollock fishery, such that it helps reducing the salmon bycatch (for conservation purpose) while limiting the financial risk from pollock fishery being closed immaturely. Its conceptual framework is an application of tradable pollution permit, where "dirtier" producers must incur additional cost while "cleaner" ones are rewarded by not having to purchase the permit and by selling or leasing the excess permits. Individual tradable encounter credit (ITEC) proposed by this paper can potentially be applied to other fisheries, most notably the New England groundfish fisheries that recently adopted the catch share system with much controversy over the so-called choke species.

The main concern I have with the current manuscript is that much of its analyses and claims are conjectures without formal models of its own or citation to the models it is building the argument upon. Given that the idea of this system comes from the tradable pollution permit system, which is studied extensively, developing a model for ITEC seems perfectly doable. The lack of a model and conceptual analysis makes a reader difficult to be convinced of some of the outcomes under proposed rules, especially those associated with buy side transfer limits and dynamic salmon savings system (details below). The merit of modeling exercise is to rigorously analyze the impact of the legacy system, and more importantly, transfer rules proposed in the paper.

Comments on buy side transfer limits:

1. I am not convinced that this will solve the potential abuse of ITEC system towards the end of a season when the salmon abundance is low. This rule can avoid such abuse only to the extent that low performing vessels were restricted in purchasing the credit in previous year(s) when the salmon was relatively abundant (because otherwise they have no incentive to purchase extra credits), and then found out that the current season's salmon abundance was low. In another word, when the salmon abundance is low then the overall demand for credit is low (as authors themselves acknowledge in page 20, para. 3), making such purchasing restriction potentially unbinding. I simply do not see why any vessel owners would want to purchase more credits when the salmon abundance is low and then abuse them. What incentive do they have to do such thing?

   I am also skeptical of the possibility of such abuse actually taking place. Should not the legacy system proposed deter such behavior? This is particularly so since the initial allocation of ITECs at the beginning of each season A is free (note: this is how I

understood; the paper was not explicit about how the initial allocation takes place). Thus, any left-over ITEC at the end of season B adds no cost, ceteris paribus (i.e., pollack harvest was not constrained), while abusing it will be costly via fewer initial allocation in the following year.

One might argue that lower ITEC price (due to low salmon abundance and hence excess supply of ITEC) will increase the pollack fishing because part of the marginal cost of harvesting pollack—namely the salmon bycatch—is lower, and hence the overall bycatch of salmon will increase. This is correct, but this is what the market mechanism is intended for. If one sets a high TAC for salmon relative to its abundance, then the market will translate that signal as lower marginal cost of salmon bycatch, and harvesters will respond accordingly. This should not be viewed as an abuse of the system; rather, it is part of what the system is designed to do. If this is a problem, then the TAC should be lowered in accordance with the salmon abundance, not through imposing the purchasing limit on selected vessels.

The real impact of such purchasing limit, as I see it, is that it adds additional penalty to low performing vessels: not just the direct cost of having to purchase credits, but not allowing them to purchase as much as they want to, thereby restricting their ability to catch more pollack. This might sound fine since it is penalizing dirtier vessels (as indicated in p.21 item (iv) and (vi)), but I do not see the necessity when such vessels are already paying the price via purchasing of ITECs *and* the legacy system is already in place so that dirtier (cleaner) vessels receive fewer (more) initial allocations of ITECs.

2. On p.21 para. 1 the authors claim that "[transfer limit] should not affect the profitability of the sector…" A minor clarification is, did authors actually mean the profitability of the *sector*, and not *individual vessel*?

   Major concern with this claim is that I am not convinced that the profitability is unaffected (whether at a sector or individual vessel level) when a constraint on tradability of ITEC is imposed. Generally speaking, if a constraint is imposed on what you can do then there must be a consequence on the outcome, and it is generally worse than the unconstrained optimum. I think this is where a formal modeling exercise can be of help to check and (if true) support such claim.

3. On p.21 item (iii): what is a "historical simulation"?

Comments on the dynamic salmon savings

1. The potential abuse of ITEC during the low abundance of salmon (and excess supply of ITEC) is the key motivation behind the dynamic salmon savings (e.g., p.23 para.1; p.23 para. 5; and p.24 para.3). However, as I have commented above, I am not convinced that such behavior will actually take place because I do not see the incentive of doing so. If

the price of ITEC being too low is the problem, then this should be addressed via adjusting the TAC for salmon.

2. I am also puzzled about the counteracting incentive that dynamic salmon savings system generates against the legacy allocation rule. On p.11 para.2, the authors explain that the legacy allocation rule creates an incentive, among others, where "having extra credits as insurance against future moderate to high salmon abundance years." On the other hand, if a vessel operates "cleanly" in aim to acquire larger allocation of ITEC (through legacy system), but because it is operating cleanly the chances are this vessel will not use all of its ITEC (and be rewarded by selling some of those credits), such cleaner vessel will the one who will be taken its shares away by the dynamic salmon savings system.

   It seems to me that there must be some parameter conditions such that the incentive of fishing clean via legacy allocation rule overweighs the incentive to fish dirty so as not to leave any credits unused. Again, a formal modeling exercise will help clear up this puzzle.

3. Lastly, authors explain briefly about the alternative to dynamic salmon savings, namely setting lower TAC for salmon. Their argument against this alternative is that "[h]owever, historical data show that salmon encounter rates vary over a wide range. A low hard cap can pose significant financial risk for the pollock fishery during years of high salmon encounter" (p.24, para.3). But if salmon abundance is so varying and unpredictable such that adjusting TAC accordingly is not programmatic, why would dynamic salmon savings be capable of doing just that? In another word, to what extent this year's salmon encounter can predict the next year's encounter? If this year experience low encounters, then DSS will lower next year's TAC. But if next year happened to be a high salmon encounter year, how would DSS avoid the "significant financial risk for the pollock fishery"? If, on the other hand, salmon abundance does not change abruptly so that DSS can adjust appropriately over time, would not adjusting TAC for salmon directly also possible, but the latter will not have incentive issues pointed out above and also much simpler mechanism? (In lieu of "[DSS] is more complicated to implement…", p.22 para.4).

Other comments:

- P.8, last para. "… intercooperative agreement enacted within co-ops…": This is a clarification question: is it an *inter*cooperative agreement *among* multiple co-ops, or an *intra*cooperative agreement *within* a co-op?
- P.8, last para. "Within each sector, the ITEC is distributed… under intercooperative agreement enacted within co-ops according to…": Is there a difference between a "sector" and a "cooperative"? If not, I suggest authors keep the terminology consistent in the paper.

- P.16, last para. “Unfortunately, [false legacy] formula for credit allocation lacks the desirable property of asymptotic bounds…”: I am not convinced why such asymptotic bounds are “desirable.” I am also not convinced with the explanation in the following paragraph (on p.17). Some numerical examples could help the readers understand the claims made here.

  But at conceptual level, why is it desirable to constrain the bounds of potential allocations based on the very first initial allocation? The lower bound is somewhat easier to understand, at least from political point of view (but not necessarily in terms of economic incentives). Setting an upper bound seems more difficult to justify: why limit how much one can be rewarded from an improvement—in this case, reducing salmon bycatch? Would not there be an adverse impact on individual vessels’ incentive to improve?

- P.18, para 1: I would like to see more supporting evidence that smaller vessels experience higher variance in salmon bycatch rates. Currently, this claim is supported by Figure 4, which is actually plotting the variance against the percentage of sector pollack share allocation. To what extent is this appropriate proxy for vessel size? Also, the way such difference in variation is adjusted using the pollack share, not the vessel size. As such, the formula is not adjusting for the vessel size per se, and if the authors want to claim that this is effectively adjusting for the vessel size then some evidence relating the pollack share and vessel size seems to be in order.

  Furthermore, is it the vessel size or the location of their operation—inshore or offshore—more important for adjustment? Again, is it appropriate to claim inshore operators = small vessels?

- P.19, Legacy Incentives with this parameterization: I do not think this subsection is adding any new information. It probably does not hurt to delete it.