Comments on “Comprehensive Incentives for Reducing Chinook Salmon Bycatch in the Bering Sea Pollock Fleet: Individual Tradable Encounter Credits”

This paper explicates a system for controlling salmon bycatch in the Eastern Bering Sea pollock fishery. This system bears some resemblance to the plans currently entertained in the North Pacific Fishery Management Council, although it differs in a number of details. The intent is to introduce a system that gives vessels *individual* incentives to avoid bycatch and that strengthens this incentive when salmon biomass is at its lowest. The heart of your proposal is a legacy allocation rule (essentially a first-order autoregressive process of past proportional salmon allocation mixed with a penalty/reward for lagged relative bycatch performance). This rule is creative, original, and I suspect that it possesses many of the positive attributes that you attribute to it. That said, I have a number of concerns. I break these into general comments largely related to the presentation of your results and specific comments on the modeling itself.

General comments

As it currently stands, the paper suffers from a number of flaws of presentation and argumentation that distract from what is likely a great launching pad for analysis. In general the paper is not written as a careful analysis of the positive and negative properties of a policy mechanism as is expected of an academic paper in economics; rather, the focus seems to be on advocacy for a particular combination of rules. Most of the professed properties of your policies are established by hand-waving argumentation or assertion rather than any careful behavioral modeling. This is especially true of points in the paper where you are arguing for the pattern of liquidity and price evolution within the season. Without any model of these processes, it is very easy to argue the exact opposite of your claims.

The explication of the legacy allocation component of your model seems far too fragmented and obtuse for what is ultimately a very simple mathematical rule. Many very important properties of the rule are relegated to the appendices, and even then it is difficult to come away with a thorough understanding. The paper would benefit immensely from a reorganization that builds the legacy allocation rule up from first principles in a much more linear and deliberate fashion.

In addition to the legacy allocation component of your proposed policy, there are a number of other aspects that you discuss, including buy and sell-side transfer limits, infrastructure considerations for monitoring and trading ITEC and cross-sector transfers. While some of these issues are important, trying to incorporate them into a single paper makes things excessively long and rambling, and this is amplified by the lack of a common analytical modeling framework to unify why all of the instruments you propose are necessary and complementary.

Finally, the introduction of the paper is weak. There is a lot of superfluous information here in terms of the history of the pollock fleet and essentially no motivation for how this particular application fits within the context of bycatch as a globally relevant problem in many fisheries. The paper would also benefit from an acknowledgement of the literature on bycatch and discards in fisheries (which is actually fairly substantial) and the broader mechanism design literature in economics. For instance, there are key papers by Boyce and Abbott and Wilen (both in the Journal of Environmental Economics and

Management) that examine the question of hard quotas in the absence of individual incentives for bycatch avoidance. As things currently stand, one would be led to think that you are the first to ponder these issues, which is not the case.

Specific Comments

In Figure 2, you demonstrate how individual vessels would have run out of encounter credits under a PPA performance cap of 47,591 salmon (without trading). However, the hard cap you describe is one at the level of the sector and so it is unclear how you are allocating this cap across individual vessels (evenly?)

The properties of equation 2 are not made explicitly clear. For instance, when alpha and gamma are equalized, it is asserted that the upper bounds of the proportional allocation are dependent upon Q alone. This is not immediately obvious (at least to this reviewer) and so a proof (perhaps in an appendix or footnote) is called for (as are proofs of boundedness). Also, it is asserted that if Q>1 then the proportional allocation increases. Again this isn't quite as obvious as it is made to seem. For instance, does this apply relative to the initial allocation (y=0) or the allocation in the preceding period? Again, much more care in demonstrating the properties of these equations is needed. In general, your audience for this paper is not one of time series experts and you need to be mindful of this.

A troubling aspect of the legacy allocation equations is that, because of their linearity, there is nothing to impose an "adding up" restriction of the sector-wide target bycatch level. This is dealt with briefly in Appendix A but seems far more important than this relegation would suggest. You seem content to assert that the allocation rules would be very unlikely to exceed the hard cap. Even so (if this is in fact the case) this would seem to guarantee that the typical cumulative allocation is likely to fall well below the hard cap. This could be quite costly to the fleet, and it is doubtful that all such "takings" could be justified on the grounds of economic efficiency. Indeed, while the rules you propose seem to get the relative incentives right within seasons for a given cumulative allocation of bycatch they do so in a way that manipulates total encounter credits in the sector (and across all sectors in total) in a subtle and difficult to justify manner. Indeed, one would like a mechanism to pull credits out of the system as salmon abundance decreases (as mean encounter rates decrease), but this does not look to be a property of the allocation rules you suggest. It seems like a decoupling of the total allocation of ITEC (perhaps to all sectors if inter-sector trades are allowed) from allocation rules to vessels within sectors is wise. This could be facilitated in you model (I think) by simply restricting the proportional allocation rules to sum to 1 across all vessels.

One concern in the addressing of incentives under the legacy allocation plan you prescribe, is the possibility of strategic (and potentially collusive) behavior undermining the incentives toward bycatch avoidance. While the incentive under noncooperative play is clearly to attempt to improve one's bycatch performance relative to one's competitors (and hence create a "race to the top"), it is also the case that from the perspective of fishermen that they may find it collectively sub-optimal to do so if they could bind themselves to an alternative, credible course of action. Given the relatively small number of companies and close working relationships in this fishery that have been forged under the AFA

cooperatives (not to mention the relative lack of transparency achievable within the cooperative structure), it is heroic to assume that behavior in such a market will conform to the large-N neoclassical assumptions. Given a clear, predetermined rule whereby reallocation occurs on a seasonal basis, there is ample room for collusion and side payments on the part of participants. The potential for such gaming of the system should be considered. Furthermore, given the intertwined nature of the ITEC allocation mechanism with the holdings of pollock quota (which is itself endogenous to fishermen's decision making), the potential for spillovers to the internal "market" for pollock quota within cooperatives must be considered as well.