COUNCIL STAFF AND GROUNDFISH MANAGEMENT TEAM SUBGROUP REPORT ON CONSIDERING RISK IN THE IFQ TRAWL SECTOR WHEN SETTING ANNUAL CATCH LIMITS FOR CANARY ROCKFISH AND PACIFIC OCEAN PERCH

Summary

In this report, we used risk measures adapted from Holland and Jannot (2012) as a method of comparing bycatch risk among areas of the coast, and among ACL alternatives for canary rockfish and Pacific ocean perch (POP). Their study focused on the design of risk pools yet is also relevant to the question of how different ACLs might affect bycatch risk of fishermen using bottom trawl gear in the IFQ sector, and in turn, affect the "needs of fishing communities."

Bycatch rates used in the paper were from pre-IFQ years, and given the comparatively much lower catch of most rebuilding species in 2011, the risk estimates in this paper likely represent an upper bound where vessels did not actively avoid canary or POP. However, the data from this period is useful for comparing bycatch risk among areas of the coast and among ACL alternatives.

Holland and Jannot (2012) estimate that fishermen in northern CA and southern OR (e.g., Brookings, Crescent City, Eureka area), and northern WA (e.g., Bellingham and Neah Bay) are at higher risk than other areas for exceeding their quota pounds (QP) of canary rockfish, using pre-IFQ trawl bycatch rates, and 2011 IFQ QP amounts, with those at highest risk likely to incur multiple transaction costs, and possibly needing to "tie up" until acquiring the necessary QP. For POP, fishermen in northern Oregon and Washington are estimated to be at highest risk (e.g., Astoria, Westport, Ilwaco, Bellingham and Neah Bay). Risk pools, further developments in QP trading, and the coming trading of QS will provide fishery participants with the means of addressing bycatch risk.

Applying this method to the alternatives under Council consideration yields some apparent differences in estimated bycatch risk among them (e.g., Alternatives 1, 2, 8), for fishermen in certain areas in each alternative, using the metric of 95th percentile TCE to non-zero QP allocation. TCE is a measure of "value at risk" or expected shortfall, expressed here in terms of pounds of catch. Translating that catch into an economic cost would depend on a number of factors.

Introduction

In this report, we used risk measures explored in Holland and Jannot (2012) as an additional method of comparing and contrasting ACL alternatives for canary rockfish and Pacific ocean perch (POP).[1] We consider these two stocks in this analysis because they are the two rebuilding stocks that the Council is most focused on in this cycle.

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[1] Danel S. Holland and Jason E. Jannot, "Bycatch risk pools for the U.S. West Coast Groundfish Fishery." 78 Ecological Economics 132 (2012).

Holland and Jannot's paper focuses on the design of risk pools, yet their data and methods are also relevant to the question of how different ACLs might affect actual and perceived bycatch risk in the bottom trawl IFQ sector. In turn, this risk affects the "needs of fishing communities" by influencing who participates in the fishery, where they choose to fish, and where they deliver their fish.

As we have highlighted over the past couple of meetings, risk is not something that our current models and projections in the DEIS take into account explicitly in projections of catch, effort, and distribution of landings and economic benefits among fishing communities. Evidence and theory suggests that risk and attitudes toward risk are important factors in how the IFQ program operates and on where quota and landings flow in the program. These factors were prominent in the Council's consideration of the IFQ program and were explored qualitatively in the Amendment 20 EIS, in Appendix C and Appendix E in particular.

The TCE Risk Measure

In their analysis, Holland and Jannot used a risk measure used in the insurance and financial industries called the tail conditional expectation (TCE) (a.k.a. expected tail loss or tail value at risk).[2] In general, risk is thought of as the consequences of an event times the probability of that event occurring. For this analysis, the risk and event of concern is the incidental catch ("bycatch") of canary and POP. Instead of focusing on a particular event and its probability of occurring, the TCE risk measure focuses on a broader range. Holland and Jannot use the 95th percentile TCE, which they define as the average of the highest 5-percentile catch events in their data (i.e., those catch events in the upper tail of the distribution, occurring with a probability of 5 percent or less). This TCE measure is not the same as the "worst case" scenario or the largest catch possible. Instead, the TCE averages that worst case scenario against all the possible catches in that upper 5th percentile.

Risk measures like the TCE are only as reliable as the information on probabilities and consequences of events on which they are based. We are fortunate in that Holland and Jannot used tow by tow data from bottom trawl trips observed by the West Coast Groundfish Observer Program over 2002-2009 (for a total of over 26,000 tows). In brief, their methods involved splitting all observed tows into eight areas (Figure 1) corresponding to major groundfish ports and then randomly sampling 100 tows over 1,000 replicates in each area to calculate the frequency of catch by species. Their TCE measure is the average catch across the upper 95th percentile of the distributions produced by this method. They chose 100 tows as roughly equivalent to the 2010 average annual activity level. They also report the median (50th percentile) catches from this method.

The TCE and median catch measures and the ratio between them as calculated by Holland and Jannot for canary and POP are reproduced in Table 1. For comparison, Table 2 reproduces these same measures for the other key groundfish bycatch stocks in the IFQ fishery.

[2] http://en.wikipedia.org/wiki/Tail_value_at_risk.

The GMT views the Holland and Jannot approach as an informative measure of gauging actual and perceived bycatch risk in the bottom trawl sector.[3] During 2002-2009, there was no direct incentive for vessels to avoid canary or POP. Bycatch was instead managed through adjustments to trip limits and RCA boundaries. Therefore, the 2002-2009 data that they use gives some baseline indication of what catch variability is like when most vessels were unconcerned with lowering their catch of canary and POP (although this time period was greatly restricted in some respects compared to the pre-RCA management).

The IFQ program now places strong incentives and direct accountability, and hence financial risk, on fishery participants. Under these circumstances, vessels are expected to mitigate their bycatch risk by changing fishing behaviors. Yet the IFQ program is new and involves learning and chance. Even if risks are controllable to some degree, fishery participants may be uncertain as to how much mitigation is possible. Participants may be acting on perceptions about bycatch rather than on what is actually achievable. The 2002-2009 data may provides some sense of what those perceptions might be. It may be that changed behavior can lower the TCE and median measures from those seen in the 2002-2009 data. Yet a relevant analytical question to the setting of ACLs is what cost or difference such changes entail relative to higher ACLs. Risk can be thought of as one such difference.

Bycatch Variability and Need

The risk measures discussed in Holland and Jannot speak to two characteristics of bycatch. First, they help describe the variability, and in turn, the uncertainty fishery participants have with their quota needs. Second, and more directly related to the Council's ACL decision, the measures they use can help describe the potential gap between what may be needed in high bycatch years and the typical (median) quota holdings under each ACL alternative. In addition, this gap relative to typical allocations can also be relevant to the functioning of quota markets because of the effect of high transaction costs. We discuss these points below.

Comparing TCE and median catch – Evaluating the Degree of variability

As described above, the TCE measure characterizes what a 1-in-20 or less type fishing year (defined as 100 tows) would look like in the bottom trawl fishery, expressed in terms of pounds of catch for the eight areas used in the study. In comparison, catches near the median catch (i.e., the 50th percentile) represent what we would expect most vessels to experience. As shown, both measures show considerable variation between areas and species (Table 1 and Table 2).

The distance between the TCE and median catch levels, expressed here as a ratio, gives a sense of how variable catch is for each species and area with variability proportional to the ratio of TCE. Variability is an important factor in risk and the perception of risk. More variability creates more uncertainty for fishery participants and the possibility of risk-averse behavior, which in turn, can negatively affect quota trading and choices on where to fish or even whether

[3] We did not have time to replicate Holland and Jannot's analysis. If we had, we would have added data from 2010, which was the final year under the trip limit fishery.

to fish at all.[4] Variability can be equal or more important than the amount of catch when predicting fishing behaviors. For example, Pacific halibut bycatch has been a big concern to fishery participants because halibut is frequently encountered in the fishery. Yet as Holland and Jannot point out, the TCE catch for halibut is only twice the median catch (Table 2). The gap between what may be considered most likely to happen and what can happen with a less than 5 percent probability is small, relatively speaking. In contrast, that same gap for widow rockfish is relatively large. For widow, the TCE is over 500 times greater than the median catch in a couple of areas and over 2,500 times the median catch in another (Table 2). Widow bycatch can be very uncertain and fishery participants will be uncertain about how much quota they need to cover their desired fishing activities.

The variability for canary and POP bycatch is shown in Table 2. It is relatively high in some areas, especially in the area between 40°10' and 42°30' N. latitude where the TCE is almost 40 times greater than the median catch for of canary and over 60 times greater than the median catch of POP.

Comparing TCE to allocations

The magnitude of the TCE measure is also important. For example, small ratios between the TCE and the median catch mean that there is less uncertainty expected with quota needs. cAt the same time, the relative certainty about need does little good if quota is scarce relative to that need. Likewise, large ratios between the TCE and the median catch can result from a large TCE, a small median catch, or both. A large ratio may be less worrisome if the TCE level is not large relative to quota holdings. For these reasons, Holland and Jannot suggest the ratio of the TCE to median quota holdings as another informative indicator of risk:

> When TCE is many times median quota holdings, individuals that end up with high catches are not only more likely to have to acquire additional quota, they may have to acquire quota from a number of different individual [sic], thereby increasing transaction costs.

Holland and Jannot point to two things here. One, the bigger the gap between the TCE and the typical allocation, the more quota that will have to be acquired to cover a TCE-type year. Two, the smaller the typical allocation is relative to the TCE, the more people someone needing to cover a TCE event will need to deal with to acquire the quota. As Holland and Jannot discuss, such transaction costs can be an important factor. High transaction costs can work against the benefits expected from the tradability of quota. These costs are not the price that would be paid to acquire a given amount of quota, but rather, the costs necessary to complete the transaction (e.g., from the time spent looking for a buyer to the time it takes to fill out the transaction paperwork with NMFS). The "tie up" provisions of the IFQ program could also be considered a related cost. Longer QP acquisition times could lead to longer time out of the fishery. Low ACLs, relative to higher ACLs, can raise transaction costs by reducing the average quota holding, and in turn, the number of transactions needed to acquire the quota necessary to cover

[4] Daniel S. Holland. Markets, pooling, and insurance for managing bycatch in fisheries. Ecological Economics. 70(1): 121-133 (2010). The Amendment 20 EIS.

expected or actual bycatch (i.e., the average quota holder, and hence the average trading partner, holds less quota).

To explore how the distance between the TCE and quota holdings vary between the canary and ACL alternatives, we calculated the quota pounds (QP) that would be distributed to each quota share (QS) account holder under each alternative. To do so, we multiplied the IFQ sector allocation by the QS in each QS account. For purposes of this analysis, as with the 2013-2014 allocations, the 10 percent adaptive management quota is passed through to QS account holders in proportion to their QS. For ease of analysis, we only analyzed 2013 ACLs. The shifts in ACL from 2013 to 2014 are small enough so that the overall pattern seen in 2013 would hold for 2014. Of note, our analysis is based on QS accounts coastwide. We did not map where QS holders had landed their QP in 2011 or during the pre-IFQ fishery.

Table 3 and Table 4 display the median and average QP allocations for ACL alternatives where the canary ACL and POP ACL differ (i.e., they are constant across some of the integrated alternatives). These tables also display the ratio of the TCE by area to the median coastwide allocations. To be clear, allocations are not split by area, so the ratio is simply the area-specific TCE to the sector wide allocation. Moreover, this measure just captures the median estimates, i.e., the halfway point of the quota distribution. Medians and averages are meant to capture the "central tendency" of a distribution. They do not capture the circumstances of individual quota holder or vessel owners that are well below or above the median. Where the ACL is set affects each individual quota holder differently.

On the patterns seen in Table 3 and Table 4, fishermen in northern CA and southern OR (e.g., Brookings, Crescent City, Eureka area) and northern WA (e.g., Bellingham, Blaine, Neah Bay areas) are at higher risk than other areas for exceeding their quota pounds (QP) of canary rockfish. For POP, fishermen in northern Oregon and Washington are estimated to be at highest risk (e.g., Astoria, Westport, Ilwaco, Bellingham, Blaine, and Neah Bay areas). There are large changes in the ratio of the TCE to median catch within the alternatives under consideration by the Council. At this time, this concept is new enough to us that we cannot draw concrete conclusions about differences in this ratio. That is, we cannot draw conclusions about the difference between, for example, TCE to median allocations of 6.8 and 5.2 and what those differences mean to the "needs of fishing communities" in 2013 and 2014. We do see risk as a relevant factor and recommend further investigation of these measures in coming cycles.

Lastly, Holland and Jannot examined fishery performance in 2011 and include some statements about risk and performance in 2011. Based on these observations, they noted that the fishery showed signs of "highly risk-averse behavior" and speculated that this may "have been due to fears about being able to acquire quota to cover bycatch." They also noted that fishermen appeared to avoid areas of high bycatch risk and focused effort in deeper water where bycatch of key stocks tends to be lower.

We have not had time to examine the 2011 fishery data to evaluate their claims independently. We do agree that bycatch risk, the actual risk and the perceptions about that risk, is a factor influencing dynamics in the IFQ fishery and worthy of close attention in future cycles. The indicators they use do show variation between areas and between ACL alternatives.

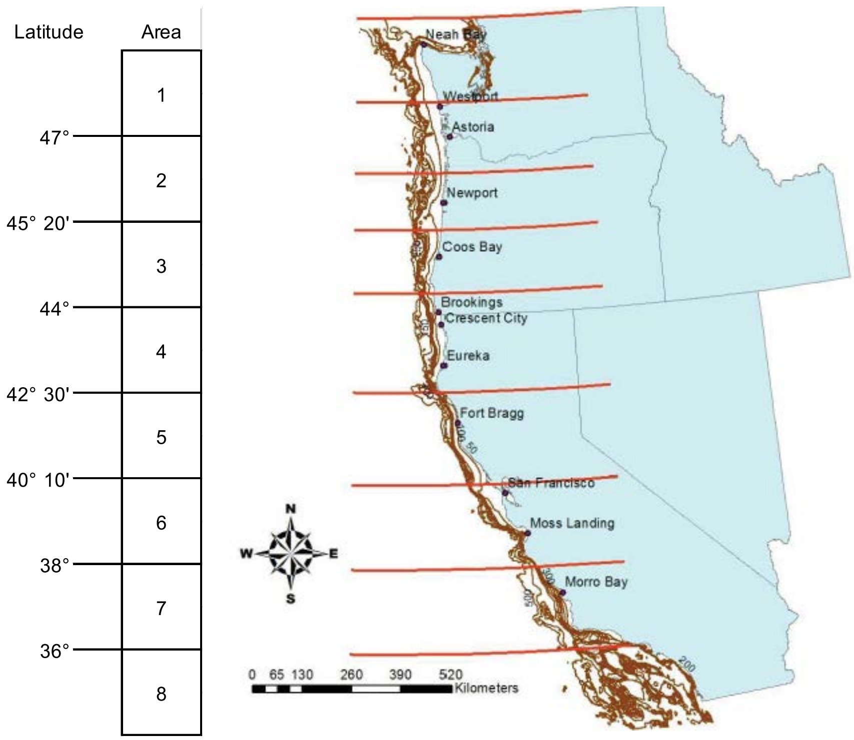

Figure 1. The areas used by Holland and Jannot (2012) and a key to match those areas in the tables below.

Table 1. The 95th percentile TCE catch (lbs), median catch (lbs), and ratio between them for canary and POP as calculated by Holland and Jannot (2012).

	TCE		Median Catch		Ratio: TCE to Median	
Area	*Canary*	*POP*	*Canary*	*POP*	*Canary*	*POP*
1	3,627	24,537	1,101	9,225	3.3	2.7
2	1,148	23,026	150	4,643	7.7	5.0
3	1,413	6,773	576	580	2.5	11.7
4	2,502	2,794	490	502	5.1	5.6
5	7,504	1,056	192	17	39.1	62.1
6	326	NA	73	NA	4.5	NA
7	1,150	NA	79	NA	14.6	NA
8	9	NA	–	NA	NA	NA

Table 2. The 95th percentile TCE catch, median catch, and ratio between the two as calculated by Holland and Jannot (2012).

	TCE catch (lbs)					
Area	*Bocaccio*	*Cowcod*	*Darkblotched*	*Widow*	*Yelloweye*	*Halibut*
1	NA	NA	8,398	11,444	212	22,574
2	NA	NA	7,339	28,279	52	3,575
3	NA	NA	8,133	400	74	14,841
4	NA	NA	16,911	240	91	5,254
5	NA	NA	11,645	19,274	11	3,566
6	4,081	251	7,159	2,138	55	NA
7	8,787	242	2,244	4,386	33	NA
8	763	166	896	15	0	NA

	Median catch (lbs)					
Area	*Bocaccio*	*Cowcod*	*Darkblotched*	*Widow*	*Yelloweye*	*Halibut*
1	NA	NA	1,969	22	18	12,428
2	NA	NA	1,890	48	0	2,052
3	NA	NA	735	24	4	9,278
4	NA	NA	5,243	9	0	2,297
5	NA	NA	1,332	8	0	2,002
6	759	6	1,478	221	0	NA
7	2,026	42	53	26	0	NA
8	204	0	248	4	0	NA

	Ratio of TCE to Median Catch					
Area	*Bocaccio*	*Cowcod*	*Darkblotched*	*Widow*	*Yelloweye*	*Halibut*
1	NA	NA	4.3	520.2	12.1	1.8
2	NA	NA	3.9	585.5	1.0	1.7
3	NA	NA	11.1	16.4	18.6	1.6
4	NA	NA	3.2	26.1	1.0	2.3
5	NA	NA	8.7	2,536.0	1.0	1.8
6	5.4	44.9	4.8	9.7	1.0	NA
7	4.3	5.7	42.7	168.7	1.0	NA
8	3.7	1.0	3.6	3.9	1.0	NA

Table 3. Canary – Median and average allocations and ratio of TCE to median allocations by area and alternative.

	Alt 4	No Action	Alt 2	Alt 1	Alt 8	Alt 5
Median and Average of QP allocations (non-zero) to QS Accounts						
Median	169	346	451	532	698	1,067
Average	220	451	589	694	911	1,393
Ratio of TCE to Median QP Allocation						
Area	***Alt 4***	***No Action***	***Alt 2***	***Alt 1***	***Alt 8***	***Alt 5***
1	21.5	10.5	8.0	6.8	5.2	3.4
2	6.8	3.3	2.5	2.2	1.6	1.1
3	8.4	4.1	3.1	2.7	2.0	1.3
4	14.8	7.2	5.5	4.7	3.6	2.3
5	44.4	21.7	16.6	14.1	10.8	7.0
6	1.9	0.9	0.7	0.6	0.5	0.3
7	6.8	3.3	2.5	2.2	1.6	1.1
8	0.1	0.0	0.0	0.0	0.0	0.0

Table 4. POP – Median and average allocations and ratio of TCE to median allocations by area and alternative. (note: POP is managed as part of the minor slope rockfish in the areas south of 40°10’ N. latitude (i.e., areas 6-8)).

	Alt 3	Alt 1	No Action	Alt 6	Alt 4
Median and Average of QP allocations (non-zero) to QS Accounts					
Median	394	1,086	1,149	1,721	1,923
Average	706	1,946	2,058	3,083	3,445
Ratio of TCE to Median QP Allocation					
Area	***Alt 3***	***Alt 1***	***No Action***	***Alt 6***	***Alt 4***
1	62.2	22.6	21.4	14.3	12.8
2	58.4	21.2	20.0	13.4	12.0
3	17.2	6.2	5.9	3.9	3.5
4	7.1	2.6	2.4	1.6	1.5
5	2.7	1.0	0.9	0.6	0.5