GROUNDFISH MANAGEMENT TEAM REPORT ON PROPOSED CHANGES TO THE NEARSHORE AND NON-NEARSHORE MODELS FOR USE IN THE 2019-2020 BIENNIAL HARVEST SPECIFICATIONS AND MANAGEMENT MEASURES ANALYSIS

As described in September, the Groundfish Management Team (GMT) has identified the nearshore and non-nearshore models as priorities for updating over the winter and for review by the Scientific and Statistical Committee (SSC) in the spring (Agenda Item F.2.a, Supplemental GMT Report). Since these models are updated by the West Coast Groundfish Observer Program (WCGOP) annually, the GMT met with Dr. Jason Jannot, Dr. Kayleigh Somers, and Dr. Yong-Woo Lee of WCGOP in October to discuss potential improvements to both models. Below, the GMT provides more detail on the proposed changes for Council consideration and prioritization.

Nearshore Model

To improve the science used to inform management of the nearshore fishery, the GMT and WCGOP discussed potential solutions for improving the nearshore model, and the methods used to apply discard mortality rates.

Overview

The nearshore model is used to project discard mortality of overfished and target stocks based on landings projections from the GMT. Total projected mortality is a sum of the GMT projected landings and the model projected discard mortality.

The model very closely mirrors the approach used by WCGOP to estimate total mortality:

1. discard ratios (to landings) from observed trips by area are calculated for three depth bins since each depth bin has a different mortality rate;
2. total landings are apportioned to each of the three depth bins (by area) based on observed percentages (both based on multiple years of pooled data)
3. discards are determined for each of the three depth bins by multiplying the discard ratios to apportioned catch; and
4. discard mortality is determined by applying discard mortality rates to discards in each bin, and then summed for total.
5. The main difference is the years for inputs (i.e., landings and discard ratios); WCGOP's are annual whereas the model are multi-year grand means.

Since discard mortality of overfished rockfish limits access to target species in the nearshore fishery, it is important that the model projections be as accurate as possible and incorporate measures of uncertainty (e.g., prediction intervals). Furthermore, it is important that the model have the functionality for fishery managers to investigate new regulatory alternatives to maximize opportunity within their overfished species and other potential confines.

The GMT notes that modifications to management measures may provide greater access to target species than improvements to model projections. For example, if there are consistent areas of yelloweye rockfish bycatch, implementing area closures (or other management measures) could provide greater access to target species. Further, if the closures (or other management measure) reduce yelloweye catch it may reduce the need to adjust management measures inseason that

occurs when the inseason estimate is higher than the preseason. However, the exploration of new management measures to improve performance in the nearshore fishery is outside of the scope of the model improvements described in Council Operating Procedure 25 (COP 25). The appropriate time to raise such considerations would be in September 2017 when the range of new management measures is considered for the 2019-2020 cycle.

Improved accuracy
The GMT and WCGOP determined that the nearshore model has had limited ability to accurately project actual mortality when compared to the Groundfish Total Mortality (GM) reports produced by WCGOP annually (Figure 1). While the projections have been relatively close in some years, there have been other years where projections have been off by two, three, or even tenfold (i.e., yelloweye rockfish in 2010 and canary rockfish in 2011).

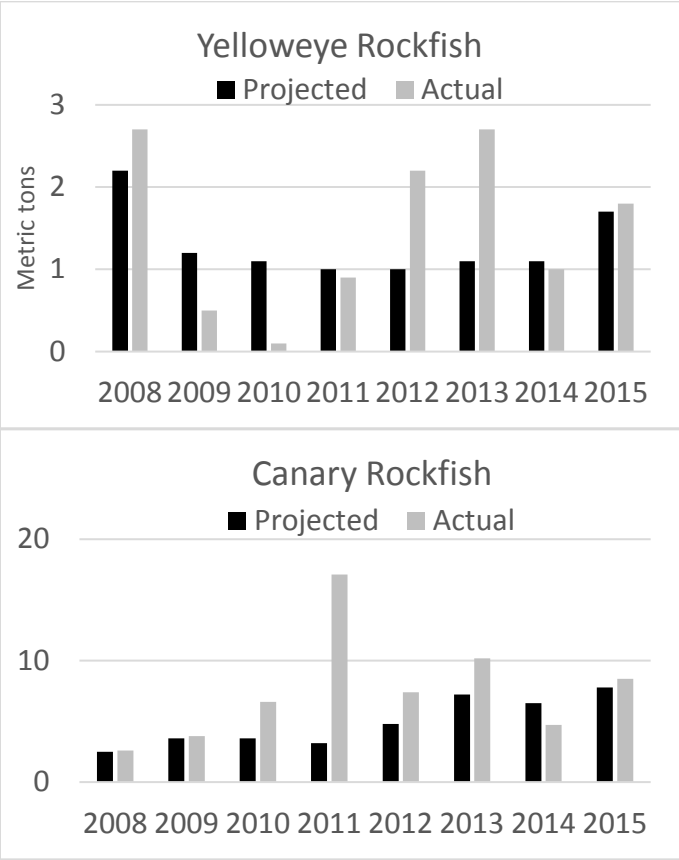

Figure 1. Performance of nearshore model, 2008-2015. Projected vs. actual catch (mt) for yelloweye and canary rockfish.

To improve the predictive ability of the nearshore model, the group first compared how closely the model structure mirrors the estimation procedures used by WCGOP to estimate total mortality; any mismatches could be responsible for the differences. Since the model uses the same structure and formulas used by WCGOP to estimate total mortality, the limited predictive capability can likely be attributed to the following discrepancies:

1. landings - the GMT uses projected landings; WCGOP uses actual ticket landings;
2. discard ratios - the GMT uses a multi-year grand mean; WCGOP uses annual rates;

3. area strata - the model has three area strata whereas WCGOP has two
4. denominator stocks - there are slight mismatches in the target stocks used to determine discard ratios, and to set landings inputs.

In general, the limited predictiveness is probably not due to the model itself since it mirrors WCGOP estimation methods, but rather to model inputs that could be better refined (e.g., landings and discard ratios). **As a focus for 2017, the GMT recommends that model inputs should be better refined within the current model structure since they are a primary driver to model performance. Dissimilarities between the structure of the model and WCGOP estimation procedures that also affect performance should be resolved (i.e., same denominator stocks and area strata).**

Nearshore model: measures of uncertainty

The group also noted that it may be unreasonable for the model to produce exact predictions of actual mortality, especially when considering that rarely encountered stocks such as yelloweye rockfish are difficult to accurately project in all fisheries. As such, being able to produce measures of uncertainty that better reflect potential variability in catch would be useful for improving management of the commercial nearshore fishery. For instance, sector-specific shares could be set at levels based on the risk tolerance of the Council (e.g., how much bycatch would be needed to have X percent chance of attaining target species catch targets).

As a means to incorporate uncertainty, the group first discussed using measures of precision such as coefficients of variation (CVs) to generate prediction intervals surrounding the point projections. It was determined that CVs surrounding discard ratios that were previously endorsed by the Scientific and Statistical Committee (SSC) would have limited usefulness for the model since they are based on the variation from observed trips within a year, whereas the model uses discard ratios across many years. As such, developing CV's based on the variation in WCGOP's annual discard ratios (i.e., across years and not within a year) would have more usefulness for framing model uncertainty.

Therefore, the GMT believes the best approach for framing uncertainty for the final model projections would be to consider, and link, the variation for each of the main model inputs (i.e., discard ratios, landings, depth distribution). As described above, variation would be considered at the multi-year level to match how model inputs are derived, and could be addressed via CV's for prediction intervals, or possibly by bootstrap simulations, if assumptions are met (e.g., no trends). The bootstrap approach would involve thousands of pairings of random draws of annual discard ratios and landings to generate simulations of yearly discards. In addition, WCGOP staff suggested that there may be new Bayesian likelihood techniques that could be used to bracket uncertainty that could be jointly explored.

As a focus for 2017, the GMT recommends that measures of model uncertainty be developed with a yet to be defined approach (e.g., prediction intervals based on CVs, bootstrap distributions, or Bayesian likelihood profiles).

Additional desired attributes

As mentioned above, a focus of the group was to improve the predictive ability of the nearshore model via better point projections and brackets for uncertainty. In addition, the group discussed

the potential for adding new features to the model that would provide modelers "more dials" to better fine-tune regulations or behaviors to meet management goals.

Additional area stratification in the model and/or WCGOP estimates would better group areas with similar discard patterns, and could be beneficial for increasing overall opportunity by shifting focus toward lower bycatch areas. This is consistent with the rationale for additional area strata as requested in public comment for the October GMT/WCGOP meeting, which is similar to comment provided at past Council meetings (Agenda Item G.7.c, Public Comment, September 2013, Agenda Item B.1.b, Supplemental Public Comment 8, June 2016 and Agenda Item H.5.b, September 2015). WCGOP indicated that additional area strata would be problematic since it would result in low sample sizes and could compromise their ability to estimate total mortality. Further, it would result in more confidential depth/area strata for the GM reports (e.g., discard ratios would not be able to be shown for deeper depths); and that transparency of the components used to estimate total mortality is important for WCGOP and constituents. WCGOP indicated that new area strata could be added without compromise if depth strata were reduced (keeping the total number of strata the same); however, depth strata are necessary for the application of Council adopted depth-dependent discard mortality rates, which have a high degree of influence to estimates of mortality and model results.

The GMT accordingly does not recommend that new area strata be added for the model. However, as discussed above, the GMT recommends that WCGOP estimation procedures use the same area strata as used in the model (i.e., split the current area north of 40° 10' N. latitude into Oregon and California specific areas). Resolving the discrepancy would improve model predictiveness and allow the GMT and state fishery managers to monitor actual mortality relative to their state-specific harvest specifications (e.g., ACL for black rockfish; harvest guideline for the nearshore rockfish north complex).

Another desired model attribute is to better predict discards associated with individual species, species groups or strategies. This may allow managers to increase overall yield by shifting focus to species, seasons, or gears that have lesser discard rates. For example, the Groundfish Advisory Subpanel (GAP) has indicated that targeting lingcod in the winter has lower associated discards than in the summer. However, the model is currently limited to projecting discards based on the total landings of all species combined regardless of how and when they are caught. At first glance, the GMT believed that affects/relationships of season, species, gear, etc. to discards could be rather simply modeled and predicted using general linear models (GLMs) or other multivariate modeling techniques. However, a GLM projection model could result in a potential mismatch with the estimation procedures of WCGOP, which are based on the same discard ratio estimator techniques as used with the current model.

In short, GLM projections may not be relatable to the estimates in the GM Reports. While multivariate modeling may hold management value, there would be many challenges to overcome. **While alternative model techniques should be considered in the future (e.g., GLMs), more immediate gains could be realized by working within the current model structure that matches WCGOP estimation procedures (i.e., both ratio estimators) in order to improve accuracy and provide uncertainty.**

Nearshore discard mortality rates

Overview:
While improvements to the nearshore model would be helpful for framing future management actions, updating the discard mortality rates used in both the nearshore model and WCGOP estimates to better reflect actual mortality based on new scientific information is also important for future management and stock assessments (i.e., removals).

Background
A three-part process has been used to develop discard mortality rates for the commercial nearshore fishery: (1) the SSC adopted gear-specific discard mortality rates by species and depth bin; (2) for each species and depth, the GMT created aggregate discard mortality rates based on the proportion of gear use in the fishery; (3) these aggregate discard mortality rates that account for multiple gear use are supplied to WCGOP who then apply them to their respective species and depth bin to estimate total discard mortality. The GMT and WCGOP discussed potential improvements to all three aspects of how discard mortality rates are applied to the commercial nearshore fishery.

As part of the omnibus prioritization exercise earlier in 2016, the Council approved the re-consideration of the discard mortality rates that are currently used, including those in the nearshore model, with the flexibility that the GMT bring pertinent information back to the Council for consideration as time allows. The GMT has identified the exploration of the basis for the discard mortality rates and updates for the nearshore fishery as a priority during the 2017 model review process. Potential timelines for consideration, development, and review of discard mortality rates are discussed below.

2017 Priority: Revise the discard mortality rates applicable to "sport-like" jig and pole gears
During the 2009-2010 biennial harvest specification and management measures analysis, the SSC adopted depth-dependent discard mortality rates for fish released at the surface and stated that these rates should be applied to both the recreational fishery and commercial nearshore "sport-like" jig and pole gears. However, instead of using the recreational rates in the 20-30 fathom depth bin that vary from 40-60 percent by species, the GMT recommended, and the Council approved, that 100 percent mortality was to be applied to the nearshore jig and pole gears beyond 20 fathoms. The rationale for this buffer is not well-documented; however, we understand it was a precautionary adjustment.

During the GMT and WCGOP discussions, there were no recommendations for revising "sport-like" rates for jig and pole gears. **The GMT recommends discussing revisions to "sport-like" rates for jig and pole gears at our January 2017 meeting and scheduling them for a 2017 SSC review as their schedule permits.** The main question is whether or not the precautionary approach (i.e., 100 percent mortality for 20-30 fm) should continue to be applied to the original surface mortality rates adopted by the SSC for nearshore jig and pole gears. No revisions to the current surface rates are expected, rather whether or not existing rates be "activated."

Adoption of descending device mortality rates for the nearshore fishery
Similarly, since descending device mortality rates have already been reviewed and adopted by the SSC, but only for the recreational fishery, **the GMT recommends discussing the applicability of using descending devices mortality rates in the nearshore fishery at our**

January 2017 meeting and scheduling them for a 2017 SSC review as their schedule permits.
Since potential adoption of descending device discard mortality rates for the commercial nearshore fishery would also be an SSC and Council decision, the group had little feedback other than noting that WCGOP has begun acquiring data on descending device use in the commercial nearshore fishery. Accordingly, if the descending devices mortality rates were adopted, then the necessary data may exist to incorporate descending device use into estimates of discard mortality.

Development of new rates for longline and pot gears
New research surveys have indicated that mortality rates for rockfish caught with longline and pots gears may be lower than the current assumption of 100 percent mortality, which was established by the GMT due to lack of information at the time regarding additional mortality that could occur from longer soak times (i.e., due to predation or parasitism).

However, adoption of new rates of longline and pot gears would be a longer-term proposition since these rates have not yet been developed and adopted by the SSC (unlike surface and descending device rates). Over the winter, the GMT will explore if there is sufficient information for development of new rates for the longer term.

Application of gear-specific discard mortality rates
As previously mentioned, the GMT creates aggregated discard mortality rates for each species in three distinct depth bins (0-10 fathoms, 10-20 fathoms, >20 fathoms) based on the proportion of gear (e.g., jig or other gear) use. As outlined in the 2009-2010 biennial harvest specifications and management measures analysis, the following formula is used to determine the aggregate mortality rate for each species by depth bin:

= (proportion jig gear x rec. discard mortality rate) + (proportion other gear x 100 percent mortality)

The proportion of gear use was based on 2004-2006 Oregon fixed gear logbooks (Table 1) but has not been updated. Oregon was used as a proxy for California since there was insufficient data on gear use by depth in the fisheries at the time because California did not have logbooks and there was very limited observer data.

Table 1. Proportion of gears used by the GMT to determine aggregate mortality rates for each species by depth bin (using formula above). Reproduced from Table 4-35 in the 2009-2010 Final Environmental Impact Statement.

Gear Type	Depth Bin (fm)			Total
	0-10	11-20	> 21	
Recreational-like gear (jig)	86.6%	72.3%	60.7%	80.2%
Other gear	13.4%	27.7%	39.3%	19.8%
Total	100.0%	100.0%	100.0%	100.0%

The GMT recommends that if the same formula is to be used, then the proportion of gears should be updated to use more recent data for Oregon. In addition, since there is now 13 years of observer coverage in California, WCGOP gear and depth distributions from California should be used instead of using the Oregon rates as a proxy.

The GMT and WCGOP staff also discussed that there may be bias in observer coverage in regards to gear use and depth of fishing, since many of the small boats that predominately use jig gear are too small to carry observers. A better estimate of gear and depth could potentially be better reflected via a hybrid approach that: (1) uses fish tickets (census of landings) to determine the overall gear usage by fleet; and (2) the WCGOP depth distributions by gear to partition ticket landings by gear to depth bins. An alternative approach to detect bias would be to compare WCGOP observed distributions by depth and gear to those of logbooks, but that would only be possible for Oregon since California does not require fixed gear logbooks.

Additionally, a new method to apply discard mortality rates that is based on the distribution of how and where fish are encountered instead of where effort occurs was discussed. Discard mortality rates for each species are specific to the depth fish are caught, and species may be encountered disproportionately to where effort occurs. For example, estimates may be biased if 50 percent of effort occurs in intermediate depths, but only 10 percent of yelloweye rockfish encounters occur in those same depths.

The group discussed two potential avenues for moving forward. The first approach would be to use the same formula as above, but to base aggregate mortality rates on the proportion of fish caught by depth and gear. While this could improve the rates, there may be issues in which previous encounters are not reflective of what is caught in future years, or that aggregate proportions may not adequately represent the weights of WCGOP (i.e., that the mortality of observed fish represents the contribution of that fish to estimates of discards).

To ensure more proper weighting, WCGOP could apply the gear-specific mortality rates to the subsample of observed fish, based on where and how they are caught. If this approach were taken, it could result in a change to how WCGOP's discard ratios are computed. WCGOP has concerns that this new approach would essentially add new strata, and possibly hinder their ability to display discard ratios since smaller sample sizes could limit what can be shown with current data confidentiality standards. For example, currently discard ratios are provided for three depth bins irrespective of gear use, and if WCGOP were to apply mortality rates to discards in each depth bin based on encounters by gear type, then it could result in six strata (i.e., three for each depth for jig/pole and three for longline/pot), some of which may not meet the confidentiality standards. **The GMT plans to work with WCGOP to determine if applying discard mortality based on species encounters (e.g., depth and gear) instead of effort could be done (e.g., if stratification were reduced).**

Non-Nearshore Model

Overview

The non-nearshore model was previously reviewed and endorsed by the SSC in 2013 for use in the 2015-2016 biennium and beyond. The purpose of the model is to project bycatch impacts for limited entry (LE), both primary and daily trip limit (DTL), and open access (OA) fixed gear vessels seaward of the non-trawl RCA, with the primary focus being yelloweye rockfish.

Proposed Changes

In September, the GMT proposed examining "model performance by exploring changes to the CV estimation methodology with WCGOP and considering expanding the model to estimate catches south of 36° N. latitude." (Agenda Item F.2.a, Supplemental GMT Report). After further discussion with WCGOP, the GMT recommends that the following changes described below be considered for review by the SSC in 2017. Figures below are provided for context using yelloweye rockfish as an example.

Bycatch Rate Calculation

Currently, the species-specific bycatch rates by gear and area is based on a grand mean of the observer data (2002-2015). Due to changes in encounter rate (Figure 2), yearly variation in bycatch rates (Figure 3), and management, the GMT recommends recalculating the bycatch rates for a smaller subset of years. As shown in Figure 2, 2002 and 2003 showed a higher proportion of positive yelloweye rockfish hauls than later years. While it is impossible to characterize the exact cause of the variation in the encounter rate, the implementation of the non-trawl RCA in 2003, observer effect (i.e. vessels may fish deeper when an observer is onboard, lowering the probability of bycatch), management actions (e.g. avoiding rougheye rockfish in 2014), and other uncertainties result in the proportion of positive hauls generally decreasing over time. Therefore, the first few years of WCGOP data may not be representative of the current fishery. Furthermore, the grand mean approach would be appropriate if the yearly bycatch rate followed a trend. However, as shown in Figure 3, the yearly bycatch rate was initially linear in the first few years, but has since been much more variable, extending outside of the 95 percent confidence intervals (shown in grey).

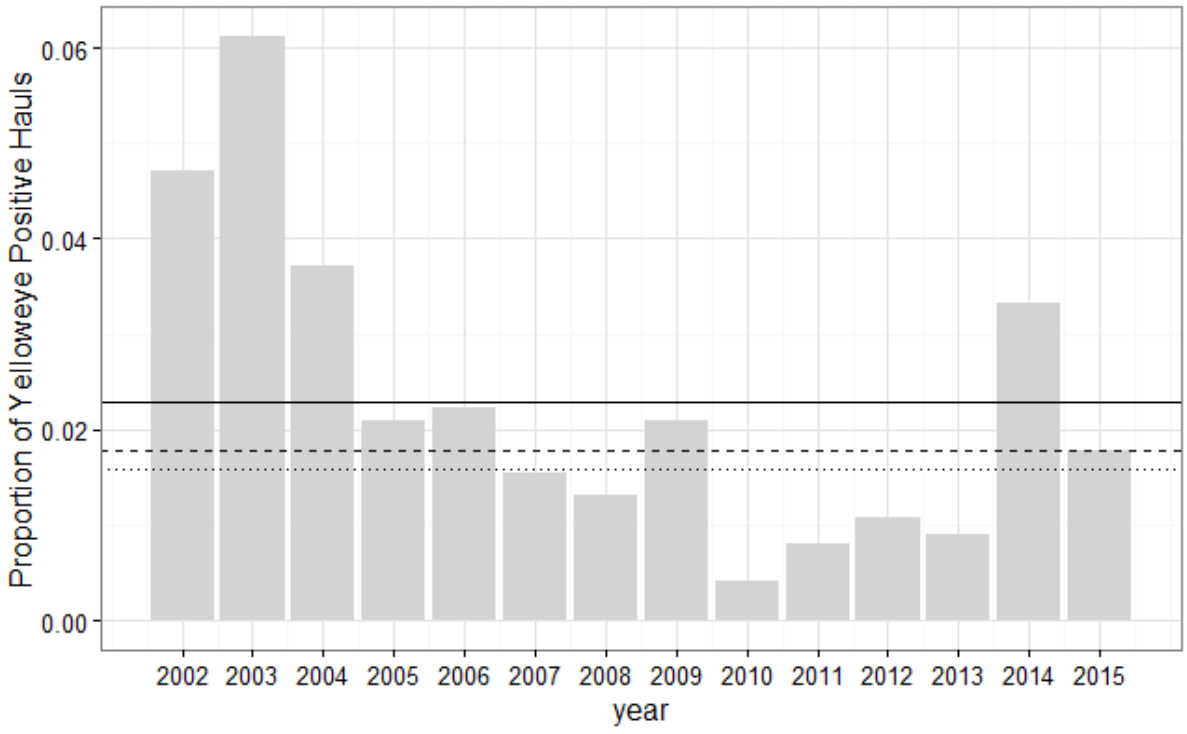

Figure 2: Proportion of positive yelloweye hauls by year in the sablefish fishery north of 36° N. lat. The following averages are shown by the horizontal lines: Solid=2002-2015; Dashed= 2004-2015; and Dotted=2011-2015.

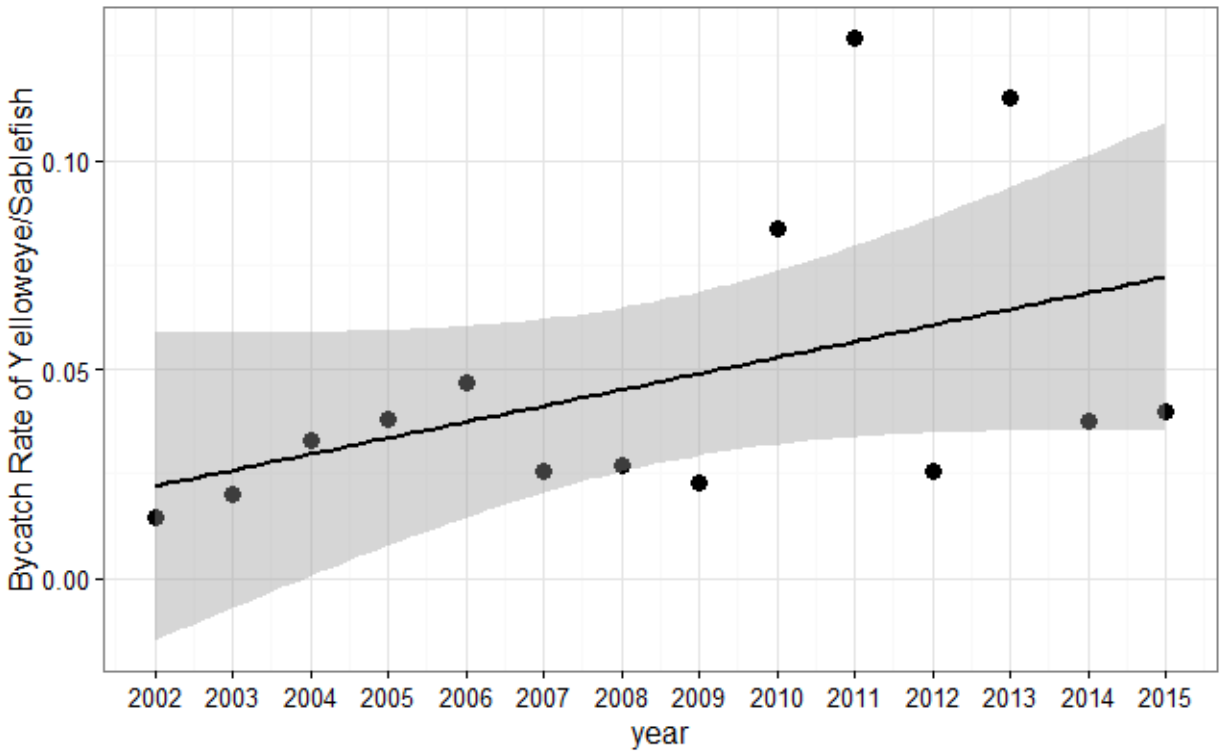

Figure 3: Bycatch rates (total mortality of yelloweye/retained sablefish) by year, 2002-2015. Solid black line represents linear regression with 95 percent confidence interval in grey. Due to confidentiality issues, all gear types and sectors are combined.

Removal of RCA strata

The only management response to limit bycatch in the sablefish fishery is to move the RCA to deeper depths, either 125 or 150 fathoms. However, it has been several biennia since the Council has moved the non-trawl RCA to reduce catch of yelloweye or canary rockfish. **In order to simplify the model, the GMT recommends removing the strata from the model. If an issue were to arise, the GMT would be able to perform an independent analysis using the haul level WCGOP observer data to inform an inseason response.**

Removal of sub-areas for North of 40° 10' N. lat.

Four subareas (40° 10' N. lat. to 43° N. lat., 43° N. lat. to Cascade Head, Cascade Head to Pt. Chehalis, and North of Pt. Chehalis) were established within the model specifically to provide contrast between high and low areas of yelloweye rockfish bycatch. However, as described below, the GMT is exploring an ad-hoc model to estimate the yelloweye rockfish bycatch. With either projection method, an independent analysis could be done if a situation were to arise with yelloweye rockfish (or any other species) to support movement of the RCA. **The GMT therefore proposes removal of sub-areas north of 40° 10' N. lat.**

Sector specific bycatch rates

In the GM report, there is specific reporting of bycatch by strata (LE primary, LE DTL, OA), while in the non-nearshore projection model there is only one bycatch rate for all sectors for each species by model area and gear type. **Therefore, the GMT recommends exploring stratifying the projection model by sector.**

Removal of CVs

Currently, the SSC-endorsed CVs produced in the model are not used by the GMT in managing the non-nearshore fishery. CVs are produced around the bycatch ratio over the entire time series and therefore represent inter-vessel, inter-sector and inter-annual variation. As such, these CVs are representative of what has happened historically, not what will happen in the future. **Therefore, the GMT recommends that prediction intervals around the projected point estimates of bycatch be explored.** By understanding the level of uncertainty around the estimate, the Council can use the information in setting management measures (e.g. moving the RCA) based on their risk tolerance.

The GMT believes that there may be a better way to express the risk around bycatch of yelloweye rockfish (described below), which is the main concern. In the future, the GMT may explore new calculations of the CVs to produce intervals of uncertainty around the point estimate, or expanding the methodology proposed for yelloweye rockfish below to all species.

Yelloweye Rockfish Bycatch Projection Model

As stated above, the primary focus of the non-nearshore model is the bycatch of yelloweye rockfish. Currently, the total projected amount of yelloweye rockfish is based on the bycatch rate by gear and area north of 36° N. lat multiplied by the landing share (allocation minus dead discards) for both LE and OA. However, actual observed yelloweye rockfish encounters are variable and relatively few and only occur north of 40° 10' N. lat. The GMT therefore is exploring an ad-hoc yelloweye rockfish bycatch projection model in the non-nearshore fishery.

Total bycatch of yelloweye rockfish is a function of frequency of encounters and the magnitude of the catch during a positive, or "non-zero," encounter. Looking at the WCGOP haul level observer data from 2002-2015, there are three main factors that may influence yelloweye rockfish bycatch: depth, area, and gear.

Initially, the GMT explored the possibility of a two-step "hurdle" model, with one step to model positive catch events (i.e. a haul would encounter yelloweye rockfish) and a second to predict the magnitude on a positive haul. However, every method that we have looked as thus far when classifying a positive yelloweye rockfish haul has shown poor predictive ability. With this poor predictive ability, the model would offer little added information over the standard binomial distribution. However, a binomial GLM or other statistical classification method shows promise for producing uncertainty intervals around the number of annual catch events. The GMT will continue to explore methodology for predicting the occurrence of yelloweye bycatch on hauls.

With a method for simulating a distribution of annual positive catch events, random sampling from a lognormal or gamma distribution or GLM would be used to produce the estimate of annual total catch. Figure 4 displays a probability plot of the theoretical lognormal distribution with lognormal mean of 2.37 and standard deviation of 0.99 (x-axis) versus the empirical cumulative distribution of yelloweye rockfish catch on positive haul (y-axis). If the actual data were perfectly lognormally distributed, then the data would match the solid grey 1:1 line seen in Figure 4. An R^2 value of 0.9648 was evaluated from the linear regression of the theoretical vs empirical data, showing a tight match. However, there does appear to be a systematic pattern in how the data deviates from the theoretical distribution (i.e. the middle values are larger than predicted by the theoretical distribution).

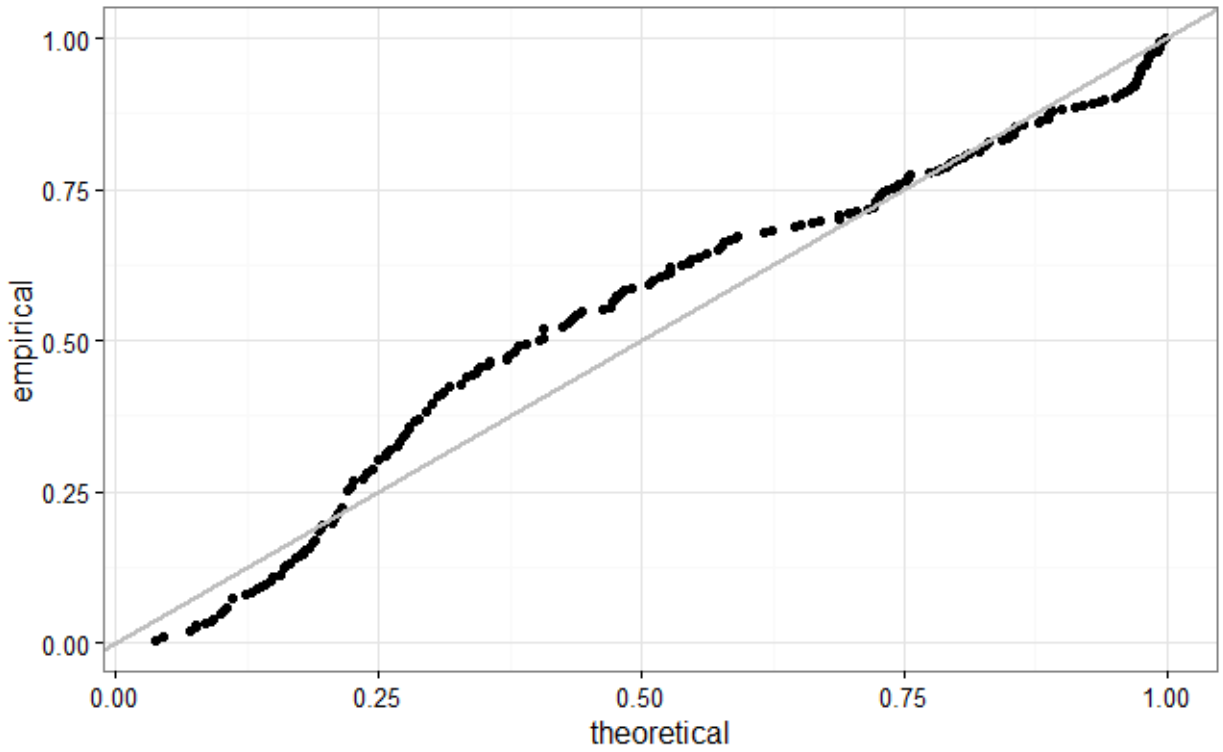

Figure 4: Probability plot of theoretical vs empirical distribution of yelloweye rockfish bycatch on positive hauls, 2002-2015. The 1:1 line is shown in grey.

Therefore, the GMT recommends exploring use of a bootstrap methodology similar to that used for predicting bycatch in the at-sea fleets (Agenda Item I.4., Supplemental Attachment 9).

Estimation of bycatch south of 36° N. lat. or south of 40° 10' N. lat.
In September, the GMT expressed interest in exploring the extension of the current non-nearshore model south of 36° N. lat. (based on sablefish targeted trips) or developing a separate model based on shelf or slope targeted trips (i.e. non-sablefish) for south of 40° 10' N. lat., as there is currently no projection model for estimating bycatch in this area. Furthermore, in 2017, the non-trawl RCA will be liberalized to move from seaward of 150 fathoms to 125 fathoms between 40° 10' N. lat. and 34° 27' N. lat., while the shoreward RCA south of 34° 27' N. lat. will be modified from 60 fathoms to 75 fathoms, which may provide for additional opportunities in the non-nearshore fisheries.

During discussions with WCGOP, the GMT discovered that unlike the area north of 36° N. lat, the GM Report produces estimates of bycatch south of 36° N. lat. in the LE and OA fixed gear sectors based on total landings of Fishery Management Plan (FMP) groundfish, not just sablefish. Therefore, simply extending the current model south based on projected retained sablefish would not align with estimates from the GM report. In addition, by lumping all FMP species together in the denominator for both LE and OA fixed gear fisheries south of 36° N. lat., the actual targets of the fisheries within the non-nearshore sector are not correctly summed. As described below, there are distinct differences between the DTL, shelf, and slope fisheries that need to be considered when developing a bycatch projection model.

While the non-nearshore is comprised mostly of sablefish targeted trips north of 36° N. lat., there are multiple components to the non-nearshore sector in the south. Along with the DTL fishery south of 36° N. lat., there is also a directed shelf and directed slope fishery off the coast of California, which primarily operate south of 40° 10' N. lat. Primary targets are vermilion rockfish and lingcod in the targeted shelf fishery and blackgill rockfish in the targeted slope fishery. Landings of other shelf species, such as yellowtail rockfish, are likely to increase as the RCAs are modified to provide more access. The majority of these fisheries operate in the southern portion of the state, where encounters with yelloweye rockfish are less frequent, given the range of the stock. Currently, trip limit models are used to project mortality of target stocks, but no bycatch projections are available.

Given that these shelf/slope specific target strategies are unique to the area south of 40° 10' N. lat., the GMT recommends that bycatch in these three fisheries be modeled independently. However, given that these fisheries occur on the southern boundary of the yelloweye rockfish stock, the Cowcod Conservation Areas (CCAs) protect prime habitat for cowcod, and that additional data may be available in the future with the liberalization of the non-trawl RCA in 2017, **the GMT recommends that development of these models be considered at a future time**. At that time, the current non-nearshore model may need to be re-evaluated to ensure that bycatch is being accurately captured between 36° N. lat. and 40° 10' N. lat. as the estimate for that area is currently based on sablefish targeted trips, not any shelf or slope targeted trips.

Even if the GMT were to consider creating three separate models for estimating bycatch in the non-nearshore, there is very little observer data for these fisheries as shown in Table 2, with most years having less than ten percent of groundfish landings observed combined in the LE or OA fisheries. While the primary fishery provides additional coverage for north of 36° N. lat., there is very little coverage for the LE and OA fixed gear fisheries. While a majority of these observed trips are thought to be DTL trips, given the current reporting fields within the haul level data in WCGOP, the percentage of observed trips which targeted shelf or slope specifically is unavailable. Therefore, given the current available observer data, it is likely not feasible to develop such models (e.g. sablefish south of 36° N. lat., shelf south of 40° 10' N. lat., or slope south of 40° 10' N. lat.), at this time.

Table 2: Percentage of Groundfish Landings Observed in the Non-Nearshore for LE and OA. Blank cells represent years in which there were no observations. * denotes where confidentiality rules are not met.

Year	36° N. lat. to 40° 10' N. lat.			S of 36° N. lat.	
	Primary	LE	OA	LE	OA
2002	6%	*		*	
2003	*	*	*	*	*
2004	23%	*	*	*	*
2005	23%	*	*	*	*
2006	*	5%	*	8%	*
2007	36%	*	3%	*	2%
2008	*	10%	4%	*	3%
2009	18%	8%	3%	*	2%
2010	12%	7%	5%	11%	2%
2011	*	9%	9%	8%	1%
2012	17%	5%	*	4%	*
2013	36%	9%	6%	7%	1%
2014	37%	11%	5%	5%	2%
2015	32%	*	6%	*	4%

Summary of Recommendations

Nearshore Model

- **Use the same model structure since it mirrors the procedures used by WCGOP to estimate total mortality.**
- **Model inputs should be better refined since they are a primary driver to model performance.**
- **Dissimilarities between the structure of the model and WCGOP estimation procedures that also affect performance should be resolved (i.e., same denominator stocks and area strata).**
- **Measures of model uncertainty should be developed and could be explored via alternative approaches.**
- **Alternative model approaches should be considered in the future (e.g., GLMs), more immediate gains could be realized by working within the current model structure that matches WCGOP estimation procedures (i.e., both ratio estimators).**
- **No new area strata be added for the model.**
- **WCGOP to consider using the same area strata as used in the model (i.e., split the current area north of 40° 10' N. latitude into Oregon and California specific areas**).

Nearshore Mortality Rates:

- **Discuss revisions to "sport-like" rates for jig and pole gears and possible adoption of descending devices rates at the January 2017 GMT meeting and scheduling them for a 2017 SSC review as their schedule permits.**
- **Update data on the proportion of gears used in the nearshore fishery, as it is used in the formula to apply gear-specific discard mortality rates.**
- **California proportion of gears used should no longer be based on Oregon data as a proxy, and should be based on WCGOP gear and depth distributions from California.**
- **Consider longer-term approaches based on the distributions of species encountered instead of the proportion of gear use.**

Non-Nearshore Model

- **Remove RCA strata from the model for simplification. If an issue arises, the GMT would be able to perform an independent analysis using the haul level WCGOP observer data to inform an inseason response.**
- **Removal of sub-areas north of 40° 10' N. latitude**
- **Explore stratifying the projection model to match the same sectors as estimated for by WCGOP (i.e., LE primary, LE DTL, OA).**
- **Prediction intervals around the projected point estimates of bycatch should be explored.**
- **Exploring use of a bootstrap methodology similar to that used for predicting bycatch in the at-sea fleets.**
- **Development of models to estimate bycatch south of 36° N. lat. or south of 40° 10' N. lat. be investigated in the future.**

PFMC
10/25/16