SSC Review of the Northeast Region Discard Estimation Methods for Groundfish Quota Monitoring and Annual Catch Limits
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General Comments

A response to each of the review's terms of reference is provided below. Provided here are general comments pertinent to all terms of reference.

The overall approach to discard estimation was designed-based as opposed to model-based. The former makes no attempt to explain discarding as a function of influential factors whereas the latter does. Discarding is a function of processes related to the stock (e.g. local concentration, population age/size structure), fishing operations (e.g. gear mesh) and management (e.g. small fish prohibitions). Ideally, it would be useful to develop a discard estimation model which describes the key processes and in doing so provides the capability to project discard rates in sampling strata where data are sparse. During the review meeting, it was noted that the initiation of fleet sector management in 2010 will introduce considerable uncertainty into how discard practices may change. Thus, at least in the short term, a design-based approach is warranted. It may be possible to explore modeling of the discard process as the database under sector management accumulates. Certainly, the results of the current analyses could be used as Bayesian priors in these modeling efforts.

As a number of the papers noted, catch is equal to landings plus discards, the latter composed of observed and unobserved portions. The review primarily addressed how to estimate unobserved discards. Palmer (2010a: table 5) estimates that during 2004 – 2008, total discards for a number of fleets exploiting New England groundfish was generally less than 15% by weight of the catch. Wigley (2010a: Appendix Table1) provides information that indicates that unobserved longline, otter trawl and gillnet trips during 2005 – 2008 were about 16% of the total catch. On the other hand, it was assumed in these analyses that landings are known with certainty. Palmer (2010b) outlines landings allocation method which takes a precautionary approach to overestimate landings when data are missing to ensure that quotas are not exceeded. As updated information on landings becomes available during a year, the kept estimates used in the discard calculations will change, further changing the overall estimates of catch. It will be important to evaluate the relative contribution of variation in landings and discards for each fishery. It is important to keep in perspective the contribution of unobserved discards to the total catch. It would be useful for NMFS to provide monitoring reports that identify how much catch is based upon unobserved discards. Further, there may be some fleets for which unobserved discards represent a high proportion of the catch. As well, there may be some stocks that are in an overfished state that require special attention. In these cases, NMFS should make special efforts to ensure that discard estimates are as accurate and precise as possible. This may require NEFSC to undertake discard analyses focused on these stocks.

For most fisheries, discard mortality is assumed 100%. Discard mortality is taken into account in a few fisheries (e.g. dogfish). It is important that the estimates of discarding developed using the algorithms discussed in the working papers make the same assumptions on discard mortality as used in the stock assessments.

Response to Terms of Reference

Compare and contrast the performance with alternative estimators of total discards with respect to precision and accuracy

The simulation studies described by Nitschke (2010) and Palmer (2010a) explored the performance of six alternative discard estimators. The focus of these comparisons was relative performance under different temporal splits of an annual dataset (moving window of 20, 35 and 50 days, quarterly and annual, the latter two cumulative within time block). These comparisons are understandable given the operational need to monitor discards throughout a fishing year. Nitschke (2010) describes two estimation algorithms to produce discard ratios – combined (average across sampling strata weighted by total number of trips) and separate (average per sampling stratum). In both cases, the discard ratio is multiplied by kept total weight from each stratum to provide a discard estimate for that stratum. Previous work (Wigley et al., 2007) had determined that the combined and separate algorithms perform similarly both with regards to estimation bias and precision. The combined algorithm was included in the Nitschke (2010) analyses as this is the approach used in the Standardized Bycatch Report Methodology (SBRM) and current groundfish assessments. Nitschke (pers. comm.) clarified subsequent to the review meeting that the combined analyses in his analyses in fact stratified the year into quarterly time blocks.

It is recommended that the working papers use consistent terminology to describe discard algorithms, both in how temporal processes are treated as well as how averaging across strata is handled. In the case of Nitschke (2010), given that only one stock and gear was being considered at a time, combined and separate approaches are equivalent. Palmer (pers. comm.) clarified his use of terms at the review meeting.

Overall, the simulators appeared adequate to capture the key uncertainties that may occur in the discard dataset and provide an adequate basis on which to undertake the analyses. There was a concern that the design of the simulator may have biased the results towards certain outcomes e.g. lack of temporal discard pattern in simulated data could cause the annual cumulative estimator would perform better than the stratified quarterly. However, the impacts of temporal trends in discard rates was examined in the simulations (Nitschke, 2010) and generally found not to be a large concern.

Nitschke (2010) and Palmer (2010a) indicate that, overall, discard estimators which apply temporal divisions to an annual data set of observed discard information do not perform as well as the cumulative annual indicator. Moving average window estimators tended to be biased, the latter dependent upon temporal trends in discarding rates. These estimators tended to be biased high unless discard rates are increasing at the end of the year in which case the estimator tended to be biased low. When there was a temporal trend in discarding rates, the combined ratio and quarterly stratified discard estimators had slightly less variability than the annual (cumulative) estimator. However, there was considerable variation in the estimates for all of the estimators with observer coverage rates as high as 40% (+/- 30%). Generally, bias in the discard estimates was reduced as observer coverage increased from 10 to 95%.

Overall, Nitschke (2010) and Palmer (2010a) concurred that the most appropriate discard estimator was the annual (cumulative). This reviewer is in agreement with this conclusion.

Evaluate impacts of trimming observations (e.g. large discard events) on the magnitude of bias and measures of precision

Nitschke (2010) explored the impact of ‘outlier’ discard events (high and low discards) on six discard estimators. These indicated that the elimination of outliers produced large bias in the six estimators considered. Given the sensitivity of the discard estimators to the trimming of outliers, Nitschke (2010) recommended that this not be done. This reviewer concurs with this recommendation. Outliers are a feature of statistical distributions and may be indicative of processes that require further exploration. The mean is generally an unbiased estimator, the variance around which is subject to the presence / absence of outliers. Perhaps the more relevant question is how best to handle the variance implied by outliers. It may be appropriate to consider alternative transformations of the data (e.g delta) which better address the underlying statistical distribution of discard ratios. Such distributions may become evident as the discard database grows. Until such time as these analyses can be undertaken, it is appropriate to assume normality.

Examine the cumulative method and temporally stratified cumulative method (with various time steps and discarding patterns) and recommend a preferred method with consideration of the following: a) within-year pattern of precision and bias, including a review of historical data used to estimate landings and discards (precision/accuracy), b) feasibility/practical aspects, particularly implications of stratum size for small sectors and the ability to derive obtain fine-scale measures of total discard and its uncertainty, and c) estimate the probability of premature closure

The first terms of reference addresses which method is preferred (annual cumulative) to estimate discards using different temporal stratifications. Palmer (2010b) further explored the behavior of the cumulative discard estimator using a range of within-year splits (monthly, quarterly, annual), all employing the separate method of averaging across strata. He considered low, medium and high fleet sizes and low, medium and high discard rates and employed a suite of performance measures not used by Nitschke (2010). While adequate, the display of results of the simulations would benefit from use of star plots. These would better illustrate the performance of the various discard estimators.

Regarding TOR a), at low discard rates, splitting a year into monthly, quarterly or an annual time block produced similar discard estimate behavior across the range of fleet sizes examined. As discarding rates increased, the annual time block was shown to produce superior performance over the other estimators, particularly for small fleets (i.e. small sample sizes). While monthly and quarterly discard estimators had consistent lower coefficients of variation (CVs) than the annual estimator, Palmer (2010b) considers that this may be due to artificially low CVs as a consequence of presence of null variances in small strata. This reviewer concurs with this observation.

Regarding TOR b), given the large number of strata necessitated by a sector approach, there is a tradeoff between temporal resolution and data availability in each stratum - the more data, the greater the sample size per stratum. Splitting the year into time blocks effectively reduces sample size per stratum. Use of an annual time block allows data to accumulate within each stratum throughout the year. This is perhaps why the annual estimator performed better in all the simulations. Use of the annual estimator also somewhat diminishes the influence of assumed discard rates which have to be employed at the start of the time series when observer data are lacking. Using monthly or quarterly time blocks requires assumed discard rates at the start of each time block which would then transition into observer – based discard rates as the fishery progresses.

While concurring that the annual cumulative discard estimator is preferred, Palmer (2010a) points out that if discard patterns are similar in 2010 as in previous years, observer coverage of 40% will likely be insufficient to achieve 30% CV across all strata. Further examination of how best to combine information across strata is warranted if this objective is to be met. Notwithstanding this, the comments made at the beginning of this report are pertinent.

These analyses need to be undertaken in the context of what strata are important to obtain discard information on. If certain strata are deemed critical (potentially high discard rates, sensitive stock, etc), it is appropriate to undertake specific studies to obtain discard information on these strata.

Regarding TOR c), only a general response can be given. The annual estimator will experience substantial variability at the beginning of year but will be buffered against large discard events as observations accumulate throughout the year. The simulations indicated that of all the indicators, the annual estimator performed with the least bias. Thus, to the degree that discards are an important component of the catch, use of the annual discard estimator should avoid issues with premature closures. However, as noted in the general comments above, discards are only a component of the total catch. It is more likely that issues with the landings, which also influence discard estimation, are more pertinent to premature closure. It is recommended that for each sector, the relative importance of unreported discards to the total catch be evaluated. This would identify which sectors may be susceptible to premature closure due to discarding.

Provide guidance of methods to measure uncertainty of the preferred method (e.g., asymptotic vs. bootstrap estimates of variance)

Palmer (2010b) provides an estimate of the variance of separate – method derived discard estimates based upon sampling theory (Cochran, 1963). He compares these variance estimates with those based upon a non-parametric bootstrap of the simulated data. Both provide satisfactory measures of discard uncertainty and for operational reasons, use of the analytic variance may be preferred (computationally more straightforward in routine monitoring).

However, the analysis highlights some issues. In exploring the relationship between the analytic and bootstrap – derived variances, he considers that the analytic variances are slightly biased (low) by 10 – 20% but that the bias is small relative to the scale of the precision. It is not clear which variance estimate is in fact biased. Bias can be present in bootstrap – derived estimators which can be addressed through use of Bias-Corrected Percentile Limits or Accelerated Bias-Corrected Percentile Limits (Manly, 1997). It would be useful to explore this to see whether or not this is a source of bias in the bootstrap variance. Whether or not this is the case, it is worthwhile understanding the source of the difference. However, as noted elsewhere in this report, unobserved discard is only one component of the catch. The landings and observed catch components have associated variances that contribute to the variance of the total catch. Further, it is necessary to understand how these variance estimates might be used in management. They could be relevant to determination of ACE – specific buffer sizes associated with management uncertainty. At the review meeting, it appeared that consideration of discard variance to inform management actions had not yet taken place. Before more work is undertaken on this aspect of discard estimation, it would be useful to understand how variance estimates of landings and discards will be used in management. Until such time, the analytic variances are likely good enough.

Provide guidance on risks of alternative management actions given the uncertainty and/or behavior of the preferred discard estimation method. In particular, consider the costs to industry/sector from premature cessation of fishing and the risk to the resource from excess harvests

The costs to industry/sector from premature cessation of fishing and risks to the stock of excessive harvests relate to the capacity of catch monitoring to provide timely data on catch levels by ACE so that harvesting can be stopped in time to prevent either underages or overages in catch relative to the ACE. Nitschke (2010) compared the maximum cumulative discard estimate on any day of the year to the true modeled discard at the end of the year. There was only a slight shift upwards of the maximum estimate, suggesting that year-end over-estimating of discards using the annual (cumulative) approach is not a major concern. While this is not a rigorous examination in that the behavior of only one estimator was examined, it suggests that precision, rather than bias, will be a year-end issue.

On the other hand, the probability of overages and underages at the end of a fishing year relates to the rate of harvesting, which is in turn a function of stock biomass and fishery catchability. One could envisage a situation in which a highly efficient fleet could overshoot its quota even though fisheries managers have imposed cessation of fishing. Given that catch is equal to landings plus discards, there may be utility in examining the rate of change of catch at the end of a fishing year to project when to close a fishery. This could be based upon an analysis of annual cumulative catch plots as is done in some management jurisdictions. There are a number of possibilities which are beyond the terms of reference of this review. However, the key point is that discards are only a component of the catch and the risks to the industry and the stock should be managed with this in mind.

Consider implications of finer-scale stratification on performance of estimators that might be required for sector-specific discard rates and will be required for multi-stock species

The implications of fine-scale stratification has been raised both in the general comments section and in the responses to the other terms of reference. In essence, the smaller the size of the strata, the greater the need to increase overall sample size (e.g. observer coverage), infer discard rates from other strata or both. In the estimation of assumed discard rates based upon July 2008 – June 2009 observed data, Wigley (2010b) noted that the majority (75%) of the 1360 strata (17 sectors, 4 mesh-gear groups and 20 stocks) that were defined had less than 12 observed trips (number of trips established by the National Working Group on Bycatch), indicating that most discard rates would not be derived at the finest level of stratification (sector, mesh-gear, stock); the majority of assumed discard rates were populated at the gear-mesh, stock level.

Palmer (2010a) states that "Given the small strata sizes likely under Amendment 16, an expectation of discard estimate CVs below…the coefficient of variation in the Standardized Bycatch Reporting Methodology may be unrealistic. If the discard patterns used in these simulations are similar to what will be observed in 2010, observer coverage rates ±40% will likely be insufficient to achieve 0.30 CV across all strata". In addition, there will likely be a need to consider finer divisions of the strata that already exist. For instance, it is acknowledged that Ruhle and haddock separator trawls, which are designed to reduce bycatch, will be in use but there is thus far limited information on discard rates for these gears. Future innovations in the fishery to address bycatch issues will no doubt arise and indeed are to be encouraged. There is a need for a discard estimation approach that can accommodate future such developments. Thus, sample size per stratum will be a continuing issue. While the current design-based approach is adequate in the short-term, greater examination of discarding patterns within the observer database to infer discard rates where data is limited, will likely required to address future contingencies. For example, it may be possible to group strata based upon a multivariate analysis of discard rates. Imputation of discard rates for strata with low sampling could be informed by these analyses until data from targeted observer coverage becomes available. These analyses could be supplemented by model-based approaches which attempt to describe discarding as a function of a suite of resource, fishery and management factors, leading to better understanding of the discarding process.

The need to transition between assumed and observation – based discard rates will be generally greater the finer the degree of stratification. Certainly, observer data in smaller strata can be expected to grow at a slower rate than larger strata. Wigley (2010b) provides a sufficient means in the short-term to estimate assumed discard rates for data-deficient strata while FSO (2010) provides a suitable algorithm that transitions these assumed rates to observed rates as the observer dataset grows. Examination of discard patterns in the observer data base could lead to greater weight in the algorithm being placed on newly collected observer information in strata considered characteristic of the one with few observations, leading to shorter transition periods.

Concluding Remarks

The discard estimation review considered an important but difficult issue. It was evident from the drafted reports and presentations at the review meeting that the Northeast Fisheries Science Centre and Fisheries Statistics Office, Northeast Region have put considerable time and effort into considering way and means to address the significant challenges of in-season discard estimation. These efforts are commended. It is hoped that the comments provided in this report will be of use to the Northeast Region in facilitating its fisheries management efforts.

References

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