California Halibut

Stock Assessment Review Panel Report

Review conducted at
NMFS-FED Laboratory
Santa Cruz, CA
April 4-6, 2011

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1) Overview

The California halibut assessment Review Panel met at the NMFS/SWFSC Fishery Ecology Division Laboratory in Santa Cruz, CA, on April 4 and 5, 2011. April 6 was an informal work day. The three-person panel reviewed two draft assessments of halibut stock segments in California waters north and south of Pt. Conception, respectively. Mark Maunder conducted, documented and presented the assessments under contract from the California Ocean Protection Council and the California Department of Fish and Game (CDFG). The panel sincerely appreciates Dr. Maunder's dedication and responsiveness, which allowed the review to be completed in the unreasonably (but unavoidably) short period of two days. The assessment contract was loosely patterned on Pacific Fishery Management Council (PFMC) terms of reference for groundfish assessments. The terms of reference for this review are given in Appendix A, and the meeting agenda in Appendix B.

California halibut have been fished actively from before the beginning of California landings records in 1916, and halibut support one of the largest and most valuable groundfish fisheries that is under state-only (i.e., not federal) management. This is the first comprehensive attempt to assess the fishery and resource. Available data from California fisheries north and south of Pt. Conception suggested independence of the two population and fishery segments, and the review panel agreed with Dr. Maunder that separate assessments were appropriate for the two regions. The presumably large portion of the population in Mexican waters remains unassessed. The remainder of this report will be divided into separate discussions of the southern California (Pt. Conception to the Mexican border) and central California (Pt. Conception to approximately Bodega Bay) assessment models.

Unlike stock assessments conducted for the PFMC, the Panel did not require production of a final management-ready assessment for California halibut by the end of the Panel meeting. The California management system has a more flexible timeline, and there were a number of issues (especially updating the assessment to 2010) that should be done before the assessments are considered final as the basis for management. Because the update will use the same assessment models that were reviewed and endorsed by the Review Panel, the updated assessment will not require further review (this is the same standard that is applied to "update" assessments by the Pacific Fishery Management Council).

1a) Southern California

Initial assessment summary: The southern California assessment modeled years 1971 through 2008. The beginning year coincided with adoption of a 22-inch minimum size limit in recreational fisheries, and also benefited from an extensive on-board survey of partyboat (aka CPFV) catches during 1975-78. The primary abundance index was based on monthly aggregate partyboat catch and effort reported in logbooks. The logbook reports were subsetted to include coastal and island reporting blocks (10x10-minute Lat-Lon blocks). Individual trip log are not available before 1980, so species-based subsetting is not possible for the first decade. A variety of other abundance indexes was examined, but these were rejected for assessment use due to various reasons including low sample size, general imprecision, and uncertain selectivity. Length compositions were available for various fishing and gears, including both whole and retained catch for some years in the recreational fishery. A small amount of fishery age data exists, but were not used because of difficulties assigning the samples to individual fishing gears (which vary in selectivity). Halibut are sexually dimorphic, and relative lack of sex-specific data was a major handicap.

The draft (pre-review) assessment of southern California halibut indicated that the stock was already heavily exploited at the start of the model time period. After sustaining an intense fishery (possibly "sustainable overfishing") for about three more decades, recruitment declined sharply beginning with the 1999 year class, and the southern California stock appears to be severely depleted as of the end of 2008. The assessment review focused on determining how reliable these inferences were.

1b) Central California

Draft assessment summary: The draft central California model also began in 1971, but lacked supporting data for the first decade. The model also used a CPUE index based on partyboat logbooks, but in this case used trip-specific data beginning in 1980 so that relevant trips could be filtered by presence of species which should not be located with California halibut. The CPUE index increases over the period 1980-2008. The model also used a trawl logbook index and catch rates of young fish from a San Francisco Bay trawl survey, which shows three major recruitment events in recent years. Compositional data from the commercial and recreational fisheries are sparse, so selectivity patterns were fixed according to those estimated in the southern California model. The model for central California showed a robust pattern of increasing abundance, but was unable to estimate the magnitude of the resource unless it was provided with an absolute population size estimated by a swept-area trawl survey conducted by CDFG in 1993.

2) List of analyses requested by the Panel, and related discussion

2a) Southern California

A. Examine sensitivity to alternative CPFV indices (inshore and islands, northern and southern blocks)

Rationale: The Panel was concerned about the construction of the most important data source included in the assessment, especially since a plot of inshore and islands catch rates appear to differ. Break the inshore area into north and south at Palos Verdes, then create a composite index based on the three indices weighted by the number of blocks.

Response: There are differences among the three regions in terms of CPUE trend. There is some evidence for a shift in relative abundance from south to north. The composite index differed somewhat from the CPUE index used in the draft assessment. The composite index was included in the revised base model (Figure 1).

B. Update the catch series

Rationale: The hook & line and gillnet catches are mislabeled in the SS data file. Also, the unknown catch should be assumed to be gillnet catches and not hook & line. This is part of the 'revised base case'.

Response: This was completed.

C. Update the length composition data for the two recreational fleets

Rationale: The early length-frequency data for the "Other recreational" and "CPFV" fleets may be weights converted to lengths and should be omitted from the data set on which the assessment is based. Any discarded animals should be dropped from the length-frequency data and any discard length-frequency data included in the assessment as a separate data set. The CPFV and "Other recreational" data are assumed to be "combined" data but should be "retained" data (change partition 3 to partition 2 in the SS data file). This is part of the 'revised base case'.

Response: All of the RECFIN length-frequency data for the two recreational fleets prior to 1993 were in weight and were excluded from the model.

D. Update the mortality rates for gillnet (30%) and H&L catches (10%)

Rationale: Discard mortality for hook-and-line catches is likely to be lower than the assumed value of 0.3 while the discard mortality gillnet catches is likely lower than the assumed 100% (Aseltine 1990). This is part of the 'revised base case'.

Response: This was completed.

E. Create a revised base-case model based on A - D

Rationale: The changes listed above may or may not improve the fit to the data. Moreover, the additional requests are relative to a revised base-case analysis. The "dogleg offsets" (see SS3 documentation for technical explanation of this term) for the selectivity patterns need to be updated based on the results of the revised base-case model.

Response: The B/B_0 value for the revised base case was 0.02. The model misses the increase in catch rate during 1985-90. The fits to the length-frequency data were all satisfactory and the effective sample sizes were linearly related to the input sample sizes.

F. Plot the effective vs. actual sample sizes

Rationale: Plot the effective vs. actual sample sizes and determine what type of functional form represents the relationship (e.g. a Michaelis-Menton hyperbolic curve) and use this curve to predict sample size for weighting the length-frequency data (a maximum of 200 if this does not work). Conduct a sensitivity test in which iterative re-weighting (one iteration) is applied. The current weighting scheme is giving too much weight to the gillnet and bottom trawl catch length-compositions compared to other data sources.

Response: All curves converged adequately. Figure 2 shows the relationships. For BT, GN and CPFV, the curve is asymptotic, but the curve is linear for Other recreational. This reduces the weight on the BT and GN particularly.

G. Show the standard deviations of recruitment

Rationale: The standard deviations of the recruitment deviations determine the extent of the ramp-in for the recruitment penalty (Taylor plot). Adjust the specification related to the ramp-in if needed.

*Response***:** This plot was provided.

H. List all of the parameters, which are fixed and which hit bounds

Rationale: This information is needed to interpret the performance and parameterization of the model.
Response: There was no evidence of estimated parameters hitting bounds.

I. Construct likelihood profiles for key parameters
Rationale: The behaviour of the model may be impacted by the value assumed for M for males (assuming the ratio of $M_{\text{male}}/M_{\text{female}}$ is fixed), for steepness, σ_R, and for initial depletion. The latter can be implemented by fixing the initial F and the initial rec_devs and profiling on the recruitment multiplier. Order of importance: 1) M, 2) initial conditions, 3) σ_R.
*Response***:**

(1) For a range from 0.08 to 0.60 in initial depletion, the current depletion ranges from 0.02 to 0.1.
(2) Profile on M. Depletion is very sensitive to the value of M, with improved fits for higher values for M. A tentative interpretation is that, the model does not provide longevity for fish to grow as large with extremely high M --while this is not consistent with observed maximum lengths, it allows a better fit to the truncated length compositions. However, the fit to the survey gets poorer as the fit to the length composition data improves.
(3) Profile on Steepness. 0.8-1.0 all equal in terms of likelihoods.
(4) Profile on σ_R. Not sensitive over 0.6 – 1.2

J. Conduct an analysis in which selectivity for males and females is the same
Rationale: The model pre-specifies the relative selectivity for males and females. However, there is no *apriori* reason for sex-specific differences in selectivity.
Response: The estimated depletion is 0.03. The negative log-likelihood was 100+ units wore than the base-case for six fewer parameters. The fit to the CPFV index was poor, but the fit to the length frequency data was much worse. Estimating M with equal male and female selectivity leads to a better fit to the data with four fewer parameters. However, the fit to the CPFV data was poorer than for the revised base-case. Estimating M with sex-specific selectivity leads to better fits overall, but to much poorer fits to the CPFV index during 1990-2000. This suggests a conflict between the survey index and the length-frequency data; the CPFV data suggest a recruitment event in the late 1980s and 1990s, but the model does not confirm this.

K. Delete the length-compositions for CPFV and "Other recreational" below 55cm
Rationale: There are a few scattered measurements of small fish. Deleting the length composition observations will reduce their impact and also improve the plots of observed and predicted values.
Response: Eliminating length-composition data for animals smaller than 55cm from the retained length-frequencies led to a markedly lower likelihood value. The fits were all reasonable although the match between effective and input sample sizes was poorer. This became the revised base model.

L. Consider a sensitivity test in which the sex-ratio at birth differs from 1:1
Rationale: This may be a way to fit the sex-ratio data without imposing a dogleg on the selectivity patterns. Profile over the sex ratio at birth with length-based selectivity the same for

males and females.
Response: The results confirmed that the sex ratios in the catches could be fitted using sex-specific selectivity, sex-ratio at birth or sex-specific natural mortality. However, all runs lead to a current depletion of < 0.05.

M. Plot the whole length frequency CPFV
Rationale: Whole frequency distributions for CPFV fleet are available for two time periods (1975-8 and 1986-9). The Panel wished to determine if there were changes
Response: The proportion of sub-legal animals (small than 56cm) was substantially higher during the 1986-89 period than during the 1975-78 period. This is a source of uncertainty in how the retention curve is estimated.

N. Conduct a series of sensitivity tests in which SSB is increased from the current value to 50 times the current SSB
Rationale: To examine which data sources are forcing the model to estimate a very low depletion.
Response:
(1) Increasing the current mature biomass 50-fold resulted in a current depletion of 0.78 but a major [and of course unrealistic] increase in biomass in the most recent years and poorer fits to all data sets.
(2) Increasing the current mature biomass 5-fold resulted in a current depletion of 0.21 and an objective function which was 25 points larger than the MLE.
(3) Increasing the current mature biomass 2.5-fold resulted in a current depletion of 0.11 and an objective function which was 11 point larger than the MLE.
(4) Increasing the current mature biomass 2.5-fold and ignoring the discard data resulted in a current depletion of 0.11. The fit to the gillnet and survey length composition data are worse than for the base-case model.

O. Conduct a sensitivity test in which the CPFV index is omitted from the assessment
Rationale: To further examine which data sources are forcing the model to estimate a very low depletion.
Response: The stock was estimated to be more depleted than for the base-case analysis.

P. Conduct a sensitivity test in which the weight on CPFV index is multiplied by 100
Rationale: To further examine which data sources are forcing the model to estimate a very low depletion.
Response: The fit to the CPFV index was improved while the fit the length-composition data deteriorated. In particular, the fit to the gillnet and CPFV length-composition data became markedly poorer.

Q. Conduct a sensitivity test in which gillnet selectivity is dome-shaped
Rationale: An initial sensitivity test indicated an improved fit with dome-shaped selectivity.
Response: The depletion was essentially unaffected because selectivity converged to asymptotic selectivity.

R. Conduct a sensitivity test in which discard data are omitted
Rationale: The discard data appear to be in conflict with some of the other data sources.
Response: The depletion was unaffected. The fit to the survey data was improved and fits to the length-composition data except that for gillnet was improved.

S. Estimate the growth curve (*k*, L_2 and CVs) for females including the age data in the likelihood
Rationale: The impact of fixing growth on a size-based model can be substantial.
Response: The depletion increased from 0.02 to 0.08, but the predicted female growth curve is lower than the observed data. The fit to the CPFV index is slightly poorer.

T. Estimate the growth curve for females ignoring the age data
Rationale: The impact of fixing growth on a size-based model can be substantial. This run is an extreme version of a test in which growth is estimated.
Response: The depletion increased from 0.02 to 0.07, but the predicted female growth curve is lower than the observed data. The objective function dropped from 1980 to 1861 units. Apart from estimating natural mortality, estimating growth has the largest impact on current depletion.

U. Repeat request S in which *M* for females is estimated
Rationale: This allows the question whether growth becomes more plausible if natural mortality is estimated than in the base case
Response: The fit were little different from that in which *M* was fixed.

V. Repeat request U except that all growth parameters (except L_2) are estimated
Rationale: This further allows the question whether growth becomes more plausible if natural mortality is estimated than in the base case
Response: The fits were little different from that in which *M* was fixed.

W. Plot the observed and model-predicted catch sex-ratios
Rationale: The model makes predictions of changes over time in the sex-ratio. However, it is hard to determine how well the model fits the data on sex-ratio from the fits to the length-compositions.
*Response***:** Sex ratio appears to be poorly fit by the model, which is common in length-based Synthesis models with sexual dimorphism, e.g., bocaccio.

X. Plot the CALOFI data for Mexico
Rationale: The stock assessment is based from the US-Mexico border to Point Conception, but CA halibut is found south of the border.
Response: The Panel was provided with an informative figure from CalCOFI Atlas 31 (Figure 3). The larval distribution suggests that the center of the California halibut range extends from Pta. Eugenia to Pt. Conception, with substantial fringes north to San Francisco Bay and south to Magdalena Bay. Spawning is year-round, with a winter peak in southern California, and a spring-summer peak in Bahia Sebastian Vizcaino. The largest portion of the population appears to be in Mexican waters, but this may also reflect a light fishing pressure relative to southern California.

Y. Conduct a retrospective analysis
Rationale: A retrospective analysis will allow the behavior of the model-data interaction to be examined in more detail.
Response: This was not done for lack of time, and awaits update of the assessment to 2010 data.

Z. Plot the proportion of the total catch which is from unknown or non-specific gears
Rationale: This will help the Panel understand the magnitude of this problem and the importance of resolving uncertainties regarding gear type.
Response: This was not done, for lack of time.

Immediate post review
AA. Estimate the time series of depletions using "dynamic Bo"
Rationale: If an abundance decline is driven by recruitment fluctuations, it can be useful to know how abundance would have fluctuated in an unfished resource.
Response: Depletion looks similar, relative to conventional and dynamic Bo.

AB. Re-examine partyboat logbook CPUE using filtered trip data.
Rationale: Aggregate CPUE may reflect hidden changes in targeting that can be recognized by trip-specific catch species compositions.
Response: The trip-specific CPUE, whether raw or species-filtered (Figure 4) are much less variable than the aggregate CPUE, and leads to a more precise as well as less pessimistic view of recent abundances. The relative scaling of filtered CPUE is five times greater than for aggregate CPUE, suggesting that the majority (perhaps 80%) of the aggregate effort is in habitat inappropriate for calculating halibut CPUE.

AC. Analysis of the trip-detailed database since 1980 to obtain a series from 1980-2010
Rationale: Assess if the abundance trajectory has changed since 2008 (and if there is any indication of a recovery), and if the trajectory based on aggregated data is influenced by trips not targeting halibut
Response: Unlike aggregated CPUE, filtered trip-based CPUE (post 1980) is less variable, and does not show a strong recent decline. This suggests there is a problem with aggregate CPUE. Also the three regional areas (north, south, islands) show different trajectories: The north shows some recent decline, the south shows an increase in the most recent years, following a decline in the early 2000s, and the islands show little evidence of a decline. These patterns cannot be interpreted by themselves, and will have to be balanced against other information such as size compositions inside the updated assessment model.

2b) Central California

Revised base case requests

Rationale: Several aspects of the northern model should be revised according to similar changes requested for the southern model.
Response: The following suite of recommended changes was done.

A. Catch modifications

Rationale: Similar to changes requested for the southern model.
Response: Assign catch from unknown gears to the gillnet fishery, based on CDFG's preliminary analysis of unknown catch. Assign correct labels to fleets in the SS files.

B. Apply a regional approach to analysing the central California CPFV logbook index
Rationale: Use an area-weighted approach similar to that recommended for the southern model.
Response: Construct 3 regions with separate indices, weighted by number of blocks with data. Regions defined as:

a. Point Conception to Lopez Point
b. Lopez Point to Pigeon Point
c. Pigeon Point to Point Arena

The estimate for the first year (1980) is very large, and may be overly influential. The first year of index was removed and then the GLM was fit to the entire data set. The Panel suggests removing data prior to GLM estimation to avoid sharing information from 1980 (month, block main effects). Approximately 95% of the data are in Region c, indicating that the index mainly reflects CPUE in the Gulf of the Farallons. The trajectory of CPUE in Region a (Morro Bay) does not resemble that in Region c.

C. Remove 2007 and 2008 (last two years) from the trawl logbook index
Rationale: Index may be influenced by recent area closures in Monterey Bay.
Response: This was completed.

D. Change observed proportions in sub-legal length bins to zero for length comps associated with retained catch.
Rationale: The model is sensitive to small proportions of observed (illegally retained or possibly mis-identified?) catch in smaller length bins.
Response: This was completed.

E. Start the model in 1980 and other changes
Rationale: 1980 is the first year with CPFV logbook data (a) profile over initial depletion in 1980; (b) revise the time-series of bias corrections given the change in start year; initial recruitment deviates start in 1969; (c) updated reweighting procedure; cap effective N for OtherRec at 400.
Response: This was completed.

F. Update the discard mortality rates
Rationale: Use discard mortality rates (10% HKL, 30% GN) that match revisions to the southern model.
Response: This was completed.

G. Change lambdas on survey age comps to 0.5

Rationale: This prevents double-weighting. The age compositions for the CPFV index are currently entered both as conditional age-at-length and unconditional ages.

Response: This was completed.

Immediate post review

H. Estimate the time series of depletions using "dynamic Bo"

Rationale: If an abundance decline is driven by recruitment fluctuations, it can be useful to know how abundance would have fluctuated in an unfished resource.

Response: Depletion relative to conventional Bo is quite variable (ending near unfished biomass, which is logically questionable), but is remarkably constant at about 70% of dynamic Bo. This is a good example of the utility of dynamic Bo.

3) Technical merits and/or deficiencies in the assessment

It is unfortunate that both models end with data from 2008, and are consequently two years out-of-date. Both models suffer from a lack of sex- and age-based information, which is a serious deficiency in view of sexually dimorphic growth. Time series of partyboat CPUE abundance indexes are sensitive to alternative treatments of the data (Figure 2), and different subregions do not show strongly similar trajectories, suggesting population heterogeneity that is not addressed by the model (this issue is not easily resolved).

3a) Southern California

The southern California assessment is at the weak end of acceptability, but importantly, it tends to give remarkably similar results despite a wide range of alternative model specifications. The initial depletion estimated for 1971 is strongly influenced by the length compositions collected from partyboats during 1975 to 1978, which could have been influenced by inter-annual recruitment patterns. The severe final depletion (approximately 2% of unfished abundance in 2008) estimated by the model appears to be supported by multiple data sources including both surveys and compositions, but the magnitude of depletion is imprecise. Use of steepness h=1 in the model results in a tendency to *overestimate* final abundance, which is additional reason for caution. In view of the low estimated abundance in 2008, the model is urgently in need of updating. Use of the aggregate partyboat CPUE from 1971-2008 should be replaced with species filtered trip-based CPUE for 1980-2010, possibly overlapping a downweighted aggregate CPUE series for 1971-mid 1980s.

Immediate post-review analysis of southern California filtered trip-based partyboat CPUE for 1980-2010 indicates that aggregate CPUE shows a high amount of serially correlated but unexplained variability, and that trip-based CPUE is much more precise than the aggregate CPUE used in the draft assessment. Also, the recent decline in aggregate halibut CPUE is not shown clearly by trip-based CPUE, and the patterns vary substantially among areas (north, south, islands). However it should not be anticipated that estimated final depletion will change markedly with revisions to the CPUE index, because the final depletion estimate was not sensitive to downweighting the original CPUE index.

The panel cannot anticipate the outcome of subsequent model revision. However, there are multiple influences in the model that favor a substantial recent decline in estimated halibut abundance as of 2008, so the issue is unlikely to disappear with changes in a single model input. Quantifying the extent of the recent decline and detection of any recovery will require inclusion of post-2008 data and further modeling that the panel did not see.

3b) Central California

The central California model required a number of ad-hoc assumptions (including a swept-area survey q=1, which was rejected for the southern California model) to achieve convergence. The Panel accepts the central California model qualitatively, and concludes that the stock in this region is relatively healthy and no management intervention is needed. The model for central California could not determine absolute biomass precisely. Consideration of the data sources indicates that the model is appropriate only to the Gulf of the Farallons and Monterey Bay areas. The status of California halibut in the Avila-Morro Bay area remains unknown. Pending further improvement, the central California model can serve as the basis of a “Point of Concern” approach for management in the near future, but does not support use of a quantitative (e.g., 60-20) decision rule.

4) Areas of disagreement

No areas of disagreement were identified.

5) Unresolved problems and major uncertainties

Both models suffer from inadequate sampling of gender-specific age compositions, which is vitally important to a largely length-based assessment of a sexually dimorphic species such as halibut. Lack of post-2008 data is also a major source of uncertainty.

5a) Southern California

Sex ratios and male selectivities are not well estimated, and will require more extensive gender-specific data on age compositions.

5b) Central California

The model is unable to estimate the magnitude of the resource, and relies on the accuracy of a single swept-area survey for that information. The model is unable to address central California population segments other than the Gulf of the Farallons area; specifically, the Morro Bay area is unassessed.

6) Recommendations for future assessment and research

These recommendations are not prioritized.

A. Update the assessment document to further justify which selectivity and retention parameters are estimated and which are pre-specified.

B. Update the assessment to include all 2009 and 2010 data, including the best available (trip-specific) partyboat CPUE index.

C. Include the 1980s RecFIN weight composition data as a data source in future assessments.

D. Use trip-based partyboat CPUE (post-1980), and improve algorithms for filtering partyboat trips (e.g., consider method of Stephens and MacCall, 2004). When combining the indices for different regions to compute a composite index, weight each index by habitat area rather than by number of blocks.

E. Include the previously collected gillnet observer data (Aseltine, 1990)

F. Consider starting the model much earlier. The fishery was already active in 1916, so the approach of estimating initial exploitation status makes implicit assumptions about the nature of fisheries prior to the start date (e.g. selectivity, relative harvest levels). Starting the model in an earlier year using reconstructed historical catch data would also require strong assumptions (i.e. historical selectivity, relative catch by gear).

G. Increase gender-specific age sampling of fishery catches and discards.

H. Evaluate potential link between Southern California and central California by examining CalCOFI larval abundance. Relative larval abundances should be indicative of relative spawning biomasses; look at April CalCOFI cruise.

I. Conduct studies on age validation and aging error in each geographic region.

J. Evaluate potential methods to reduce discard of small fish.

6a) Southern California

A. Examine the value of allowing for time-blocking of the gillnet selectivity to reflect changes in management practices

B. Consider a sensitivity test in which the assessment starts in 1980.

6b) Central California

A. Consider a run in which absolute abundance in final year is fixed at 25% of unfished biomass. This is the PFMC's B_{MSY} proxy for flatfish. Given uncertainty in current status, this run provides an estimate of yield that would result if past exploitation had reduced the stock to the PFMC's flatfish proxy for target biomass.

B. Consider a higher *M* for juveniles. The fit to the Bay Survey doesn't hit peaks and this may be resolved by allowing higher mortality.

C. Consider linking male and female selectivity. The current selectivity curve is not well based in data. This may benefit from increased gender-specific age sampling.

D. The Morro Bay area fishery will need a separate assessment model. Necessary data do not presently exist. Data needed to conduct an assessment include gender-specific age compositions and an abundance calibration such as from a swept-area survey or possibly from comparison of CalCOFI larval abundances

E. Consider combining trawl gears into single gear.

F. Try to replace age-based selectivity with length-based selectivity for Swept-Area Survey with parameters from revised Southern model. The original base case model used age-based selectivity to overcome problems with convergence.

G. Set length-based selectivities for males and females equal to each other. The biological basis for having sex-specific selectivity at length is unclear. Also, the southern trawl vessels use different-sized mesh, a good reason to compile information about northern selectivity curves and avoid linking them to the southern model.

H. Incorporate 350 additional age samples for 2007-2009; consider for future runs.

I. Look for SF Bay influence in adult fish; parasite loads are unique to fresh water. This would help determine the existence and extent of a likely San Francisco Bay stock.

J. Repeat the swept-area abundance survey to provide an additional estimate of absolute abundance. This will provide an estimate of precision. An alternative is to treat repeated swept-area estimates as relative abundance indexes.

7) References

Aseltine, D.A. 1990. The California halibut catch by the southern California halibut gill net fleet, 1984-1986. CDFG Fish Bull 174: 243-63.

Miller, K. E. 1990. A comparison of California halibut catches by 8- and 8.5-inch mesh gill and trammel nets off Southern California. CDFG Fish Bull 174: 281-301.

Stephens, A., and A. MacCall. 2004. A multispecies approach to subsetting logbook data for purposes of estimating CPUE. Fisheries Research 70:299-310.

8) Figures

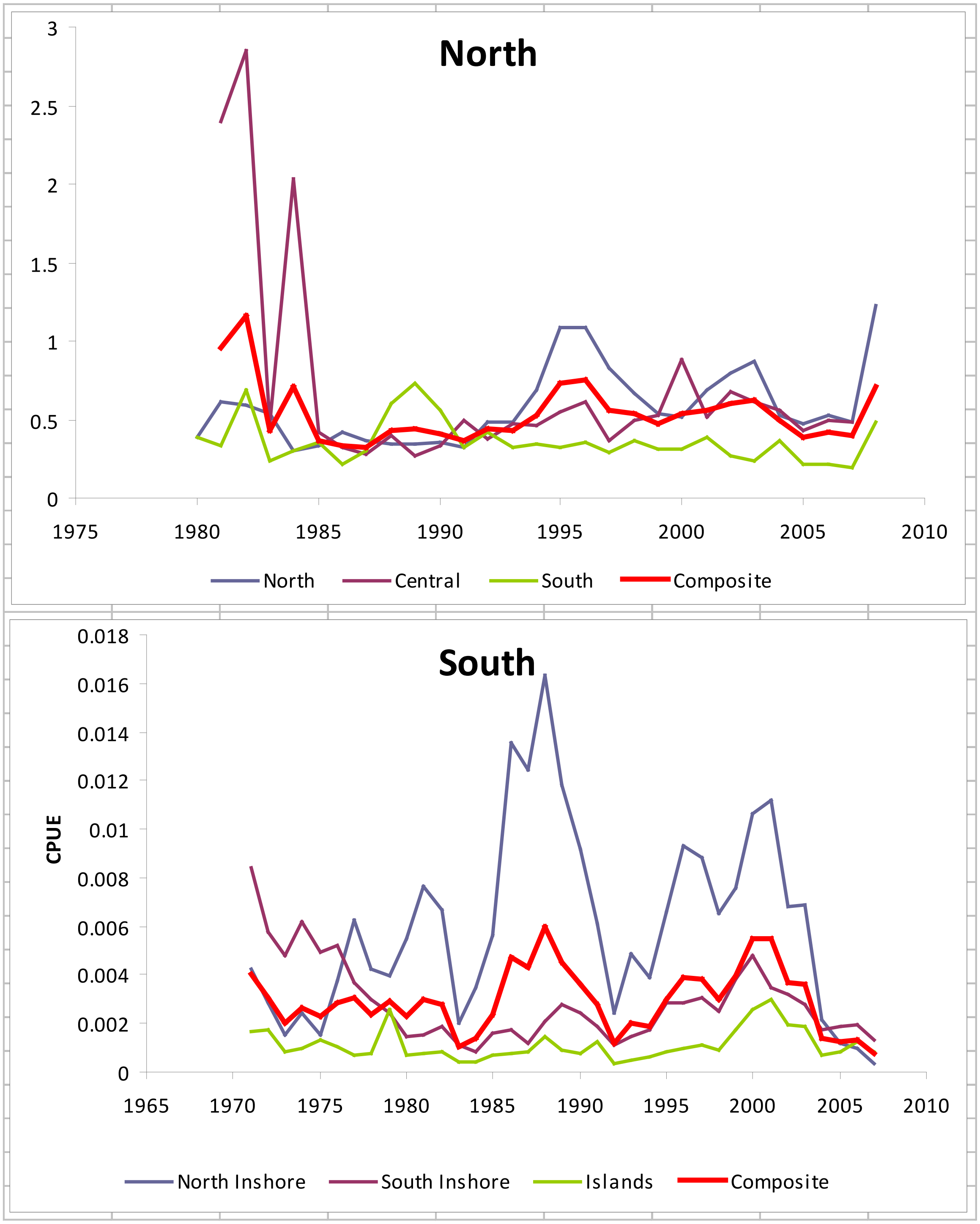

Figure 1. Regionally stratified halibut CPUE abundance indexes.

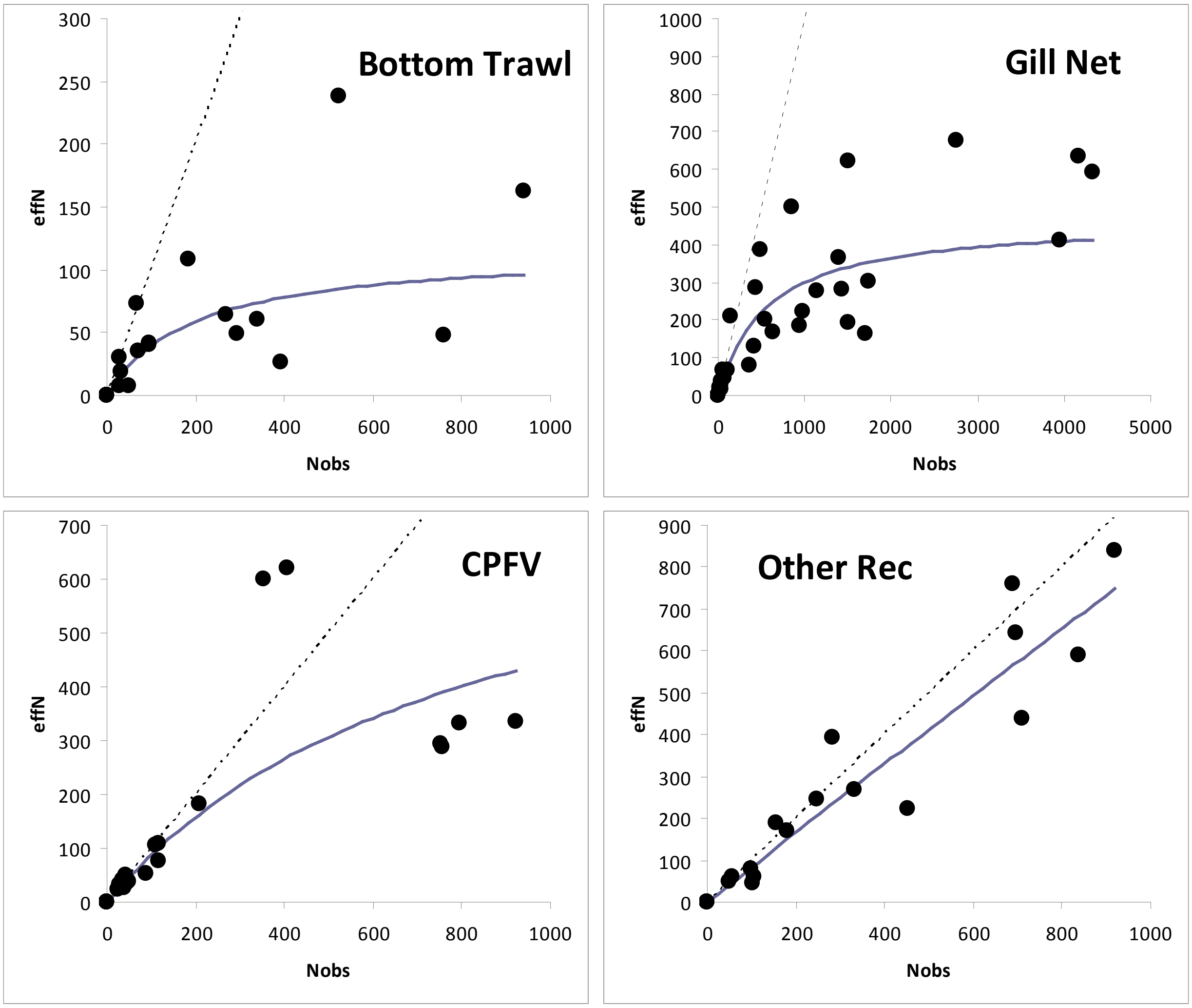

Figure 2. Relationship of effective sample size to observed sample size. Solid line is hyperbolic fit. Broken line is equality.

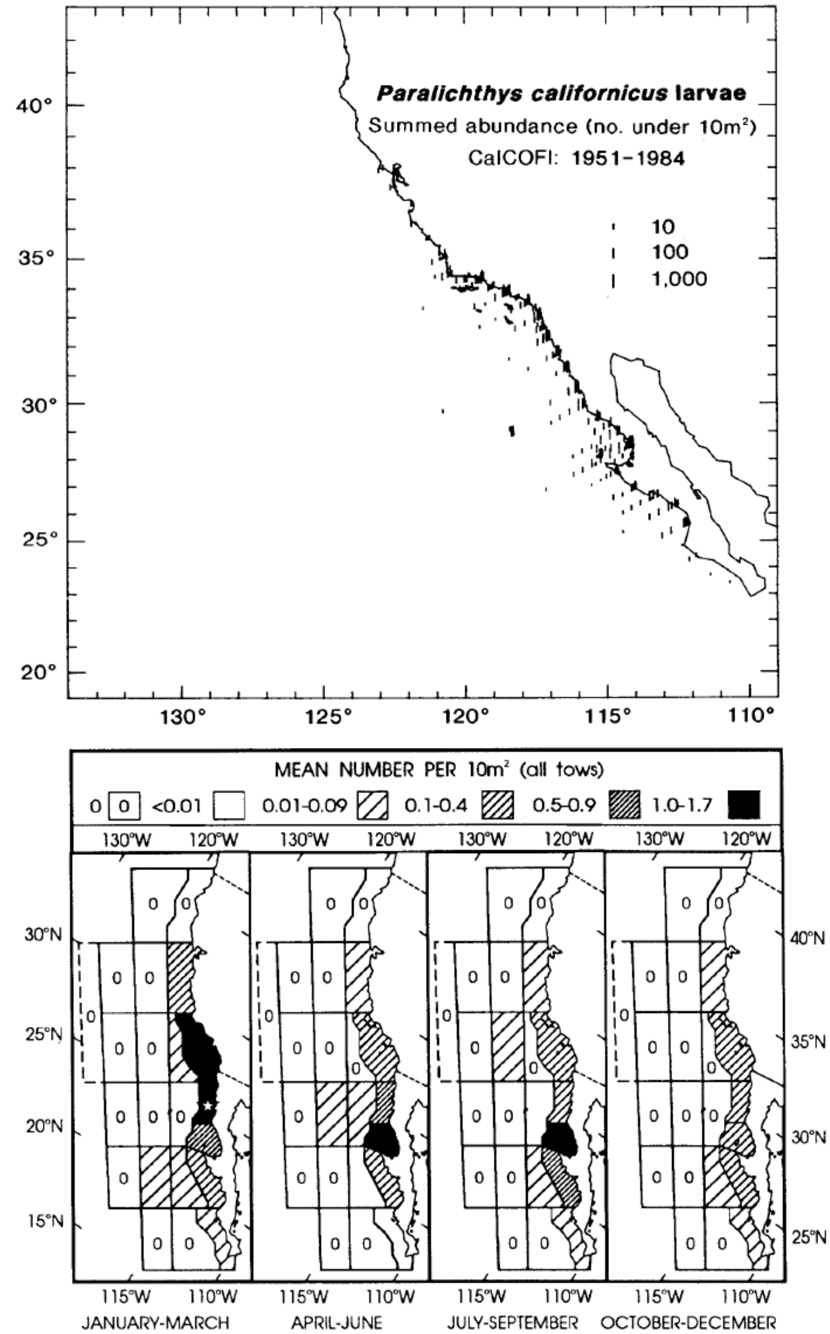

Figure 3. Distribution of larvae sampled by CalCOFI Surveys (from CalCOFI Atlas 31).

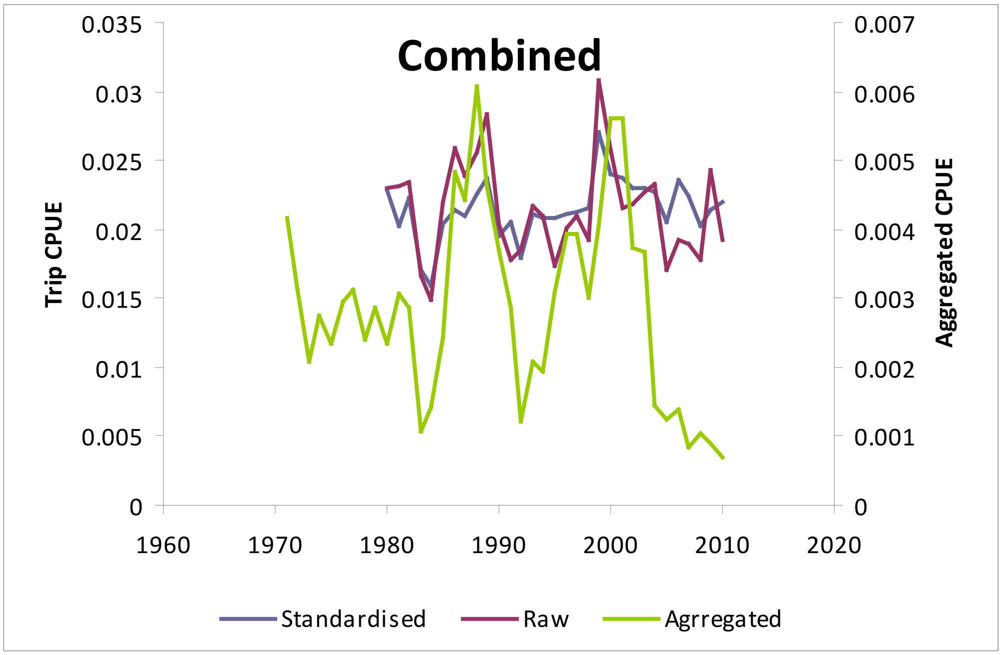

Figure 4. Comparison of southern California partyboat CPUE indexes, post-review.

Appendix A

Terms of Reference for the California Halibut Review Panel Meeting

National Marine Fisheries Service
Southwest Fisheries Science Center
Fisheries Ecology Division (Santa Cruz Lab)
110 Shaffer Rd., Santa Cruz CA 95060

April 4-5, 2011

The Panel's terms of reference concerns technical aspects of stock assessment work. The Panel should strive for a risk neutral approach in its deliberations and written report.

It is the Panel's responsibility to examine draft stock assessment documents and other pertinent information to: determine whether the stock assessment is sufficiently complete for the review process; or identify any reasons why it can not be completed. If the panel decides that the stock assessment is insufficient for review or can not be completed, then the reasons for such a decision must be provided in the Panel's report. The Panel's decision should be made by consensus; if a Panel cannot reach agreement, then the nature of the disagreement also must be described in the Panel's report.

During the review process, the Panel will work with the Stock Assessment Team (STAT) to ensure that the assessment is sufficiently reviewed. This will likely include requests to the STAT for additional analyses. In addition, the Panel will review the summaries of stock status (prepared by the STAT for use by the CDFG and the Fish and Game Commission in developing management measures) and provide recommendations for any changes.

Recommendations and requests to the STAT for additional or revised analyses must be clear, explicit and in writing. These analyses should be completed during the Panel meeting. However, if follow-up work by the STAT is required after the review meeting, then it is the Panel's responsibility to track STAT progress. In particular, the chair is responsible for communicating with all Panel members (by phone, email, or any convenient means) to determine if the revised stock assessment and documents are complete and ready to be used by managers. This follow-up work must be completed within 2-3 weeks in order to conclude the work of the Panel.

The Panel may request additional analysis based on alternative approaches. It is expected that the STAT will make a good faith effort to complete these analyses.

The Panel, STAT, and all interested parties are legitimate meeting participants that must be accommodated in discussions. It is the Panel chair's responsibility to manage discussions and public comment so that work can be completed.

A written summary of discussion on significant technical points and lists of all Panel recommendations and requests to the STAT are appropriate for inclusion in the Panel's report. This should be completed (at least in draft form) prior to the end of the meeting. It is the chair and Panel's responsibility to carry out any follow-up review work that is required.

The STAT and the Panel may disagree on technical issues. If the Panel and STAT disagree, the Panel must document the areas of disagreement in its report. Estimates and projections representing all sides of the disagreement need to be presented in the assessment document.

Confidence intervals of indices and model outputs, as well as other measures of uncertainty that could affect management decisions, should be provided in the completed stock assessment and the report prepared by the Panel. The Panel should identify model scenarios that are unlikely or have a flawed technical basis. The Panel also should include example fishing levels based on conventional control rule levels (e.g. 40:10; 60:20).

The chair is responsible for providing CDFG with the final version of the Panel's report.

Suggested Items for Panel Report

- Minutes of the Panel meeting, including name and affiliation of Panel members.
- Summary of model scenarios reviewed (best scenario; alternative scenarios; unlikely or flawed scenarios).
- List of analyses requested by the Panel and the outcome, relating to model stability.
- Comments on the technical merits and/or deficiencies in the assessment and recommendations for remedies.
- Unresolved problems and major uncertainties (e.g., any special issues that complicate scientific assessment; questions about the best model scenario).
- Explanation of areas of disagreement regarding Panel recommendations:
    - among Panel members (majority and minority reports), and
    - between the Panel and STAT.
- Recommendations for changes to stock status summary
- Table of example fishing levels based on conventional control rule levels
- Prioritized recommendations for future research and data collection.

Appendix B

California Department of Fish and Game, Marine Region
California Halibut Stock Assessment Review Panel

Monday, April 4 to April 5, 2011
Southwest Fisheries Science Center, Santa Cruz, CA

Review Panel (Panel) Objectives:

- Review and discuss the California halibut stock assessment
- Determine if the stock assessment can be successfully completed given available data
- Provide recommendations to stock assessment team for any changes to the assessment
- Provide written panel report to the Department of Fish and Game

Meeting Agenda Monday, April 4, 2011

9:00 am – 9:15 am	Introductions, Roles, and Review of Agenda and Panel Objectives
9:15 am - Lunch Break	Panel-STAT Working Session • Stock Assessment Team (STAT) introduction of stock assessment • Discussion between STAT and Panel of stock assessment
Lunch Break	Time to be determined by Panel and STAT Team
Afternoon Session	Continuation of discussion between STAT and Panel
Recess	Panel will recess until Tuesday AM to allow STAT to run additional analyses • Opportunity for Public Comment will be provided before recess

Meeting Agenda Tuesday, April 5, 2011

9:00 am - Lunch Break	Continuation of discussion between STAT and Panel
Lunch Break	Time to be determined by Panel and STAT Team
Afternoon Session	Continuation of discussion between STAT and Panel
Recess	Panel may recess for specified time to allow STAT to run additional analyses • Opportunity for Public Comment will be provided before recess
Adjournment	Panel will adjourn