

**Report on the
Stock Assessment Review (STAR) Panel for Blackgill and Greenspotted rockfish**

Prepared for:
The Center for Independent Experts

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EXECUTIVE SUMMARY

The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.

The Stock Assessment Review (STAR) Panel for blackgill and greenspotted rockfish was held at the Southwest Fishery Science Center (SWFSC), Santa Cruz, California, from 8th to 12th August 2011. The review was hosted by SWFSC. For both stocks, the Panel reached a point where agreement was reached on what would constitute base case runs and sensitivity tests, and what would go in to decision tables.

The assessment for blackgill rockfish was effectively new with major revisions since the previous assessment in 2005. The two assessments (for northern and southern zones) for greenspotted rockfish were new. All assessments were thoroughly investigated and well communicated, with clear arguments for changes and decisions made. Presentations were well measured with sufficient material for useful discussion but no unnecessary detail.

The assessments of blackgill and greenspotted rockfish were both implemented using Stock Synthesis 3. Stock Synthesis has been extensively used and the main software and extensions have been validated and documented. Tuning of model runs followed standard procedures with multiple passes (iterative re-weighting) to refine index and composition weights. The models for both stocks are complex but both have been developed with care to balance complexity with data availability and to provide credible and robust science inputs to the fishery management process. In this respect, both models are successful. The models and methods used are fairly standard and I see no technical causes for concern. A number of suggestions and recommendations are made.

The blackgill rockfish stock assessment suffers from problems with residual lack of fit but has been thoroughly explored given the data and time available. The agreed base case and accompanying sensitivity tests provide a good basis for depicting uncertainty and informing management. Decision tables have been defined. The greenspotted rockfish assessments are more problematic, with major structural and parameter assumptions driving estimates of derived parameters intended for management purposes. It is debatable whether the assessments, even if the best currently available, are sufficient usefully to inform management.

BACKGROUND

Blackgill rockfish

Blackgill rockfish (*Sebastes melanostonus*) is a slope rockfish distributed from southern British Columbia to Baja California but with greatest densities in the southern California Bight south of Cape Mendocino. The species typically inhabits depths ranging from about 100 to 600 m, with juveniles generally in shallower water found over soft bottom areas and adults associated with high relief bottom areas though caught often in midwater. The lifespan of blackgill rockfish is of the order of 60 years; maturity is uncertain but 50% maturity occurs relatively late, likely at the order of 20 years.

The assessment region for blackgill rockfish considered in this review covers the US west coast ranging from just south of Cape Mendocino (40° 10') to south of Point Conception (Conception and Monterey INPFC areas). Linkages with blackgill rockfish north and south are assumed to be negligible though there is likely a connection. Nearly all historic US catches of blackgill rockfish have come from the assessment area with a small (less than 2%) contribution from north of Cape Mendocino. The distribution and catches of blackgill rockfish from Mexico are unknown, as are stock linkages.

Blackgill rockfish fisheries are relatively recent with reported catches of 20 to 30 tonnes per year during the 1950s, rising steadily from the mid 1960s as Californian longline fisheries moved further offshore in to deeper waters and hook and line fisheries developed. Annual catches peaked at about 1,000 tonnes in the mid 1980s but declined steadily thereafter as various management measures (principally trip limits and then implementation of the Cowcod Conservation Area, CCA) were implemented for rockfish. Catches since 2001 have ranged from a little over 50 tonnes to near 200 tonnes per year.

Blackgill rockfish was last assessed in 2005. At that time, the point estimate for depletion of spawning biomass was above the management target of 40% of virgin biomass and the spawning potential ratio (SPR) was estimated to be above the target reference level corresponding to F50%. The stock was therefore assessed to be neither overfished nor experiencing overfishing.

Greenspotted rockfish

Greenspotted rockfish (*Sebastes chlorostictus*) is a moderately long-lived, slow growing rockfish, distributed from southern Baja California through to Washington, at depths ranging from 35 to over 300 m. Life history is complex with reproduction characterized by internal fertilization and release of live larvae. Maturation timing and size at maturity vary with latitude. Recruitment linkages between areas are unknown. Young fish are typically found in shallow waters on a variety of habitat types whereas adult fish are found in slightly deeper waters, again across a variety of habitat types. Various studies have suggested adults are highly sedentary, showing limited horizontal and almost no vertical movement. The lifespan of greenspotted

rockfish is of the order of 50 years, reaching 50% maturity at around 10-15 years depending on latitude. There is no clear evidence for differences in growth by sex.

The assessment region for greenspotted rockfish considered in this review covers the California entire coast between the borders with Mexico to the south and Oregon to the north. Linkages with greenspotted rockfish beyond these waters are assumed to be negligible for assessment purposes though there is likely connection with fish in Oregon and especially to the south in Mexico. The assessment has been split in to northern and southern at Point Conception (34° 27') based on observed differences in growth and exploitation history but also on general (rather than species-specific) biogeographic considerations.

Greenspotted rockfish catches have been reported or inferred back to 1916 but have always been of low rank (amongst rockfish) in both northern and southern zones and at low overall levels. From the early twentieth century until the mid 1960s, total commercial and recreational landings averaged about 50 tonnes per year from each of the northern and southern zones. Southern zone catches increased from the mid/late 1960, reaching a peak of around 250 tonnes per year in the mid/late 1970s before declining rapidly. Since 2000, southern zone catches have averaged a little over 10 tonnes per year. Northern zone catches started to increase slightly later, in the early 1970s, reaching a peak of about 200 tonnes per year in the late 1980s before declining rapidly. Since 2003, northern zone catches have averaged less than 1 tonne per year.

This is the first full stock assessment for greenspotted rockfish. Previously, a US coastwide OFL has been set for greenspotted rockfish based on estimates using Depletion-Based Stock Reduction Analysis (DB-SRA; see ftp://ftp.pcouncil.org/pub/Data-Limited_Review_April_2011).

REVIEW PROCESS

ToR 7 *Provide a brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations*

The Stock Assessment Review (STAR) Panel for blackgill and greenspotted rockfish took place at the SWFSC, Santa Cruz, California, from 8th to 12th August 2011. The review was hosted by SWFSC.

Participants in the review are listed in Appendix 3. The STAR Panel comprised a PFMC SSC appointed Chair (Gertseva), a PFMC appointed reviewer (Botsford, SSC and UCSC) and two CIE reviewers (Armstrong and Stokes). The rapporteurs for the STAR Panel reports were appointed on the first morning during the opening session. The STAR Panel was tasked with providing separate reports for blackgill rockfish and greenspotted rockfish (considered as two stocks but in one report). Notification of the meeting and dissemination of papers followed closely the schedule laid out in the CIE Statement of Work (see Appendix 2). Materials were

provided in advance *via* a dedicated ftp server (see Appendix 1). Overall, administration of the review was sound and meeting facilities good.

The Terms of Reference (ToR) for the review are given in Appendix 2, Annex 2. Often, reviews including CIE experts focus on a particular phase of the stock assessment process – either the data inputs or the assessment *per se*, and often deal only with a single stock. The ToR set for the STAR 5 review (and other STAR meetings) is very wide, spanning for each of blackgill and greenspotted rockfish, data quality (including collection and analysis) and the stock assessment. In the case of greenspotted rockfish two assessments (for different areas) were reviewed, together with relevant data sources. For STAR 2 it was noted in a separate CIE report that given the scope of the ToR and review meeting, it was not possible to devote as much time as would be desirable to every issue area. This was not a major difficulty during STAR 3, despite substantial difficulties with one stock. In STAR 4, there were no constraints on time and the Panel was well able to review both stock assessments in the time available. In STAR 5, even considering three stock assessments, the Panel reasonably considered all stock assessments but data issues were again not given full consideration. In considering three assessments, however, it was at times confusing and difficult to separate stocks and issues, especially for greenspotted rockfish for which issues related to both northern and southern stock assessments were considered in the same sessions (and were inter-leaved in the pre-STAR documents). Clearer separation of issues and assessments in general is important, but especially when multiple assessments for the same species are considered.

The STAR 5 process was very good. Although only single STAT members were generally available for each stock assessment, the presentations were well prepared, thoughtful, and of appropriate detail to allow thorough discussion and exploration without becoming bogged in unnecessary detail. In the case of blackgill rockfish some additional material on ecosystem matters was presented and it would have been valuable to have considered these if time permitted. Responses to Panel requests were thorough and well communicated.

The meeting followed the general outline of the draft agenda (Appendix 2, Annex 3) but with sufficient flexibility to allow necessary responses from the two STAT. The STAR process involves the STAR Panel working with Advisors and the STAT not just to review data and assessments but also to agree to definitions of final decision tables. For both blackgill and greenspotted rockfish, the Panel reached a point where agreement was reached on what would constitute a base case run and sensitivity tests, and the states of nature (and initial) catch options to go in to decision tables.

The blackgill and greenspotted rockfish STATs comprised staff from the SWFSC. Panel advisors included representatives from the PFMC staff, Groundfish Management team (GMT) and Groundfish Advisory Panel (GAP). Other participants included SWFSC and state staff. There were no fishing industry representatives and no public participation. I am not aware of any problems with notification of the meetings and understand that notification was appropriate. All participants were able to participate throughout the meeting and opportunity was regularly given

for input. Many non-Panel participants contributed usefully to discussion and I believe that all were provided appropriate opportunity for involvement both during the Panel meeting and during extra-mural discussions.

REVIEWER'S ROLE IN THE REVIEW ACTIVITIES

The role of the reviewer is set out in the CIE Statement of Work, Attachment A, attached here in Appendix 2, Attachment A. Both CIE reviewers are tasked with producing an independent report to the CIE. The reviewers are additionally tasked with contributing to Panel Reports for each of blackgill and greenspotted rockfish.

In addition to *becom(ing) familiar with the draft stock assessments(s) and background materials (ToR 1)*, I (Stokes) participated in all discussions and contributed to note-taking for both stocks. After the meeting I further contributed by e-mail to editing of Panel reports which at the time of writing this CIE report are with the Panel Chair for final formatting. Both are very close to completion and are in good order. Note that at the time of writing this (CIE) report, all 2011 STAR Panel Reports are finalized or close to completion.

SUMMARY OF FINDINGS BY STOCK

ToR 2 Comment on the quality of data used in the assessments including data collection and processing.

Blackgill rockfish

Stock structure: Very little is known about stock structure of blackgill rockfish. The limited information available is insufficiently powerful categorically to rule out complex structure but does suggest lack of genetic differentiation within the assessment area. Of course, lack of genetic differentiation does not necessarily imply functional homogeneity. Further work to investigate stock structure to the north appears to be underway but given the lack of catches historically and currently this may not be an obvious priority. Lack of information on catches and stock structure south of US waters is more of a concern. There is good evidence of catches and juveniles as far south as southern Baja California. It is **suggested** that investigating Mexican catches and information sources would be more useful than investigating northern connections. However, unless Mexican catches were substantial, the assumption of a single stock as defined for assessment purposes is a reasonable simplification at this time, recognizing the need to strike a balance in the modeling of complex dynamics with available data and the need to assess for the purposes of informing decision making.

Natural Mortality: There are no direct, data-based estimates of natural mortality. The previous assessment used a constant value of 0.04 based on the assumption of a maximum age of close to

90 years and using standard inference techniques. That assessment identified natural mortality as the major axis of uncertainty and used upper and lower bounds of 0.03 and 0.05 in final advice (based on correspondence to low and high percentiles of estimated depletion). In this assessment, natural mortality is again the major axis of uncertainty (and confounded with estimation of growth, steepness, etc). Natural mortality for males and females used in the stock assessment is based on priors derived from unpublished meta-analyses by Hamel. Extensive discussion took place during STAR 2 and a presentation was made at that meeting by Hamel (see file *Mprior.ppt* on the ftp server for STAR 2), which explained background theory and alternative methods of estimation as well as derivation of the priors used for a number of stock assessments to be reviewed during the 2011 STAR Panels. The proposed priors for blackgill rockfish are shown in the blackgill rockfish presentations (*blackgill.model.ppt*, slide 22; corrected in *blackgill.day3.ppt*, slide 2); the median for males is 0.065 and 0.063 for females. These values are higher than those used in the previous assessment primarily because of a changed perception about maximum age. The use of the medians from the Hamel prior, with appropriate sensitivity testing, is appropriate. Likelihood profiling on natural mortality was carried out and reported in the pre-STAR report (Fig. 86) and in the STAR 5 presentations (request 11). From profiling, it is clear that there is little or no information available to the model to estimate natural mortality, with conflicting signals from age and length data. Use of the fixed values combined with sensitivity testing is appropriate.

Steepness: Steepness is assumed fixed at 0.76 (the median value for rockfish from the updated “Dorn prior”). Likelihood profiling on steepness was carried out and reported in the pre-STAR report (Fig. 87) and in the STAR 5 presentations (request 10). From profiling, it is clear that there is little or no information available to the model to estimate steepness. Use of the fixed value combined with sensitivity testing is appropriate.

Length/Age/Growth: Growth is estimated in the stock assessment separately for males and females. Data on length and age-at-length are available variously from commercial fisheries and surveys. Ageing of blackgill rockfish is not straightforward and in preparation for the assessment, extensive ageing work was undertaken to explore alternative techniques, reduce bias, improve sample sizes, etc. The work to date has led to a new preferred method of preparing otoliths (break or saw and bake (not burn)) and to reasonable consistency between reads by one reader, but has not included inter-laboratory work or categorical validation. Given the noted difficulties in age reading, and potential importance for growth estimation (which confounds with estimation of natural mortality), ageing remains a potentially important area for future work. However, it is only worth solving ageing issues and undertaking additional reading if age samples representative of the population are available historically and in the future. blackgill rockfish has not been a major target species and there are relatively few age samples available. Those that are derive primarily from the NWFSC survey and WGCOP, both of which cover only the period during which the CCA have been in place, displacing fishing and survey effort from a major area of distribution. While it is **suggested** that further work on age validation and additional reading would be useful, it is **recommended** that this only be prioritized following

careful consideration of the samples available and whether they might be sufficiently representative/informative.

Maturity/fecundity: Maturity and fecundity appear to be complex issues in blackgill rockfish. Considerable effort has been expended trying to understand both issues. In the case of both maturity and fecundity it is unfortunate that many historical data used in analyses are now unavailable. Recent sampling efforts have, however, led to collection of many maturity samples/data from commercial fisheries and surveys. It is problematic that the sampling has not covered the southern California Bight and CCA zones as these represent a high proportion of historical catches. It is also reasonably clear that there is a latitudinal gradient in size/age at maturity with the southern fish maturing earlier/smaller. The approach taken to fit maturity at length using a restricted GLM seems reasonable at this time. However, ongoing histological work which should provide greater certainty as to maturity staging and include coverage of more southerly fish is reported in the pre-STAR (Appendix A) and was discussed briefly during the review meeting. That work is important and it will be interesting to see if estimates of maturity at length change. As for maturity, it is unfortunate that historical data from fecundity analyses are no longer available. There appears to be a strong linear relationship between fecundity and length in rockfish generally and for blackgill rockfish specifically. Recent sampling from a variety of sources has provided confirmation of this relationship which is appropriately used in the assessment. It is **recommended** that continued sampling of maturity and fecundity be carried out and used to update estimates used in assessments.

Surveys: Three series of fishery independent indices are available: triennial trawl surveys conducted between 1995 and 2004; and annual trawl surveys conducted by the NWFSC between 1999 and 2008 but split in 2002 as the survey coverage extended from slope-only to cover both the shelf and slope. Survey age and length data were expanded by tow (as opposed to trip for fishery composition data). This could lead to over-weighting of survey composition data in the assessment if there are correlations between tows; the issue was not considered in the limited time available. From the limited presentations during STAR 5, the indices appear to be sound. The pre-STAR document provides useful background on the index estimation, including an appendix (B) showing annual coverage and CPUE by area. The methods used to derive indices using GLMMs are standardized using common code. However, as with all standardized/common approaches, choices are available to the analysts. It is notable that in the Triennial survey series, though covering a period prior to the previous assessment, the 2004 index point is higher than previously estimated. The explanation is likely due to the choice of a different error structure but this is unclear. In this case, the indices have little weight/impact on the assessment results but in general, changes in indices might be important and technical decisions need to be justified. There are limited length or age-at-length composition data available from the surveys, with only the later shelf-slope NWFC effectively providing age-at-length data for the period 2003-2010.

Removals: Total removals (landings and discards) are important, especially when virgin biomass based reference point are used. The blackgill rockfish assessment is fairly standard in that productivity parameters are estimated using a complex model and fitting procedure for a period

relatively late in the fishing history (and possibly unrepresentative of the population) and then those parameters are applied in a simple accounting exercise, taking account of removals (withdrawals) over a prolonged period to estimate initial capital (virgin biomass). Any uncertainty in removals can therefore be a major source of uncertainty in estimates of depletion (as a ratio of current to virgin biomass). Reconstructions of historic catch for California have been undertaken and form a useful point of departure for assessment. As noted in many 2011 STAR Panel reports, however, there is a need to review those reconstructions. For Blackgill rockfish, the pre-STAR document carefully explains the basis for reconstruction and notes possible problems with the reconstruction due to the way in which the reconstruction uses composition sampling starting in the late 1970s but applied to a prior period during which time fisheries were expanding further offshore. It is **recommended** that a general review of the California catch reconstruction should be carried out but that for Blackgill specifically consideration be given to the use of late period composition data to back-calculate earlier catches. Of most utility, would be a concerted effort to define not just single catch histories but plausible alternative histories to allow sensitivity testing. Those histories should not be simple multipliers on series as often used in assessments but should rather reflect alternative possibilities dependent on altered reconstruction assumptions.

Greenspotted rockfish

Stock structure: There is no information on stock structure. The defined assessment areas are pragmatically chosen to reflect differences in growth and exploitation history in northern and southern California and ignoring the small catches northward to Oregon as well as south to Mexico. Ignoring the northward stock component(s) appears trivial given the very low catches. If there is stock connection to the north then ignoring that component would necessarily be precautionary. Treating the northern stock as a single entity is generally precautionary (compared to linking it with the southern zone) so long as catch limits are set on the same basis. Linkages to the south are of most concern. Greenspotted rockfish is known to be distributed in Mexican waters and there were reports by the GAP during STAR 5 of landings of 30 to 50 tonnes *per* week from Ensenada, far exceeding current and historic catches from the defined southern (and northern) zone. Results for the southern (and northern) zone could be highly misleading if there is connection to Mexican waters. Adults are apparently highly sedentary but larval dynamics are unknown. It is **recommended** that at a minimum, if the greenspotted rockfish assessment is to be used for management advisory purposes, there is a need quickly to appraise Mexican historic and current catches (quantum and distribution) to provide a context for interpreting the new assessments. If the Mexican catches are and have been substantial relative to the Californian catches then the credibility of the southern zone assessment at least, and possibly the northern zone assessment as well, for management purposes, must be in doubt. It is **suggested** that in addition to formal requests for information on catches in Mexican waters, it could be useful to explore widely possible sources of information on greenspotted rockfish (and other species) ecology, biology, fisheries, etc from Mexico. Sources could include, for example, research

studies conducted through universities or direct observation and discussion with fishers, recreational charter companies, and markets.

Natural Mortality: a value of 0.065 was used (sexes combined) for northern and southern zones, based on application of a number of standard techniques (Gunderson, Beverton, Hoenig). The value derived is not unreasonable (similar to blackgill rockfish) and there is little option but to use the simple value and to explore sensitivity to it (below). As for blackgill rockfish, it would have been useful to use the prior for rockfish natural mortality derived from unpublished meta-analyses by Hamel (see above). However, this was not done pre-STAR and attempts to get advice during STAR 5 were unsuccessful. It is **suggested** that this be done for completeness for northern and southern zones. Because the prior depends on maximum age and temperature, there will be a difference between northern and southern zone medians which in principle, given the basis for stock separation, should be taken in to account. However, it is unlikely that the differences would be so great as not to be encompassed within the low and high values used (see below, ToR 5) and the general paucity of information to inform stock assessment (by zone or jointly) suggests it is not agonizing over this issue.

Steepness: Steepness is assumed fixed at 0.76 (the median value for rockfish from the updated “Dorn prior”). Likelihood profiling on steepness was carried out and reported in the pre-STAR report and in the STAR 5 presentations. From profiling, it is clear that there is little or no information available to the model to estimate steepness. Use of the fixed value combined with profiling and sensitivity testing is appropriate for both southern and northern zone assessments. In general, however, it is worth noting that the recruitment dynamics of greenspotted rockfish are unclear and use of strongly assumed Beverton-Holt dynamics may not be appropriate, especially if the defined stocks for assessment purposes are linked or associated also with stocks to the south.

Length/Age/Growth: Growth is estimated in the northern and southern stock assessments assuming no sex differentiation. For both northern and southern zones, data on length are available from commercial and recreational fisheries and surveys. Very limited age data are available for the northern zone only from recreational sampling. Age-at-length data are limited, especially from the southern zone where some are available from NWFSC trawl and hook and line surveys in recent years (though these do not enter the historical centre of catch gravity which is now closed by the CCA). Northern zone age-at-length data are available for recent years from the NWFSC trawl surveys as well as from recreational sampling *circa* 1980. Ageing of greenspotted rockfish is not well validated though appears consistent with other species for which validation has been successful. Within-reader studies to estimate precision and bias have limited and no between-reader studies are reported. Given the potential importance for growth estimation (which confounds with estimation of natural mortality, selectivity, etc), ageing remains a potentially important area for future work if analytical stock assessments are to be pursued. However, it is only worth refining ageing techniques and undertaking additional reading of historic and future samples if age samples are representative of the population. Greenspotted rockfish has not been a major target species and there are relatively few age samples available,

though alternate years for the two NWFSC surveys have not yet been read. Those that are derive primarily from the NWFSC surveys, both of which cover only the period during which the CCA have been in place, displacing fishing and survey effort from a major area of distribution. As for blackgill rockfish, while it is **suggested** that further work on age validation and additional reading would be useful, it is **recommended** that this only be prioritized following careful consideration of the samples available and whether they might be sufficiently representative/informative. In the case of greenspotted rockfish, this would involve consideration not just of sampling protocols *per se* but also of stock structure and linkages, access to closed areas, etc.

Maturity/fecundity: Greenspotted rockfish life history is complex with maturity and fecundity related to size. With latitudinal differences in growth, there should be an expectation of differences in maturity and fecundity in the defined northern and southern zones. Maturity is fit assuming a logistic form for northern zone data but there are no such data available for the southern zone. The approach of using the same logistic curve shifted to account for a reported difference in length at 50% maturity seems a reasonable simplification. Use of the fecundity relationship using meta-analysis, developed by the lead STAT member, similarly seems reasonable. Improving estimates of maturity and fecundity (and perhaps fertility given the unusual life history) might be interesting but is not likely to make a substantial improvement to the assessment given other major uncertainties. Nevertheless, it is **suggested** that continued sampling of maturity and fecundity be carried out as possible and used to update estimates used in future greenspotted rockfish assessments.

Surveys: Two NWFSC surveys have been used to derive indices, two for the southern zone and one for the northern. These are all well described in the pre-STAR document and associated appendices. For the northern zone, NWFSC trawl survey indices from 2003-2010 have been derived using standard methods. Age and length composition data are also available though reading has only been of alternate year samples. Over the restricted period of the survey there is little if any obvious signal and CVs are large. Given the major reductions in catch the northern zone, an upward trend in survey indices would have been expected if the stock were a distinct biological unit. For the southern zone, NWFSC trawl and hook and line (from charter vessels) indices are available. Both have been derived using standard methods. As for the northern area, for both surveys, age and length composition data are also available though reading has only been of alternate year samples. The hook and line series is flat. The trawl series potentially indicates an increasing trend though there appears to be a large reduction in 2007 (unfortunately a year for which no age data are available) which overall leads again to a flat series. Generally, given the lack of survey access to large closed areas and the sedentary nature of greenspotted rockfish, it is likely that the indices and associated composition data are unrepresentative of the defined stock. For the southern zone in particular, *a priori*, there should be little expectation that the model will be able to fit credible population level estimates of growth.

CPUE: Two recreational fishery surveys have been used to derive CPUE series, one for the southern zone and two for the northern. These are all well described in the pre-STAR document,

associated appendices and additional file provided. For the northern zone indices have been derived using standard techniques from CDFG onboard observer data on catch rates (1987-1998) as well as from dockside sampling (1980 – 2001). Both series show no apparent trend despite spanning a prolonged period in which catches were consistently at the highest historic level. Superficially, neither series suggest stock decline. For the southern zone indices have been derived using standard techniques from dockside sampling data only (1980 – 1986 and 1996, 1998-2001). The series shows no apparent trend overall or within the separated periods despite spanning a prolonged period in which catches were consistently at the highest historic level and subsequently declined markedly. Generally, given that the recreational indices cover periods of highest catches and subsequent decline, and are the only indices available for those periods, the lack of trends is indicative either that the indices are not representative of population level changes in abundance or, if they are, that population level changes as assessed may be overemphasized.

Removals: Total removals (landings and discards) are important, especially when virgin biomass based reference point are used. The blackgill rockfish assessment is fairly standard in that productivity parameters are estimated using a complex model and fitting procedure for a period relatively late in the fishing history (and possibly unrepresentative of the population) and then those parameters are applied in a simple accounting exercise, taking account of removals (withdrawals) over a prolonged period to estimate initial capital (virgin biomass). Any uncertainty in removals can therefore be a major source of uncertainty in estimates of depletion (as a ratio of current to virgin biomass). Reconstructions of historic catch for California have been undertaken and form a useful point of departure for assessment. As noted in many 2011 STAR Panel reports and for blackgill rockfish, however, there is a need to review those reconstructions. For greenspotted rockfish, the pre-STAR document explains the basis for reconstruction and notes possible problems with the reconstruction (e.g. underestimation due to ignoring landings for animal food). The pre-STAR document also outlines issues related to discarding in commercial and recreational fisheries. As stated elsewhere, it is **recommended** that a general review of the California catch reconstruction should be carried out. Of most utility, would be a concerted effort to define not just single catch histories but plausible alternative histories to allow sensitivity testing. Those histories should not be simple multipliers on series as often used in assessments but should rather reflect alternative possibilities dependent on altered reconstruction assumptions.

ToR 3 *Evaluate and comment on analytic methodologies.*

Blackgill rockfish

The assessment model assumes a distinct stock of blackgill rockfish with no linkages to the north within US waters or south to Mexico, and uses catch data from 1950 to 2010, separated by sex to reflect dimorphic growth. Catches and composition data are provided for three fisheries (south and central Californian fixed gears and central Californian trawl) and observer data and

compositions are provided from 2002 onwards. Discards are included explicitly for recent years (at a low level) and are assumed negligible prior to 2002. Three survey indices are provided with associated length compositions plus conditional age-at-length composition data, notably for the most recent NWFSC shelf-slope survey. Maturity- and fecundity-at-length ogives are estimated externally and are assumed constant through time. Steepness (assuming Beverton-Holt stock-recruitment dynamics) is fixed at 0.76 and recruitment assumed to be deterministic. Natural mortality is fixed as constant at 0.065 for males and 0.063 for females. The model estimates separate length-based selectivity for three commercial fleets, assuming a double normal selectivity pattern but asymptotic after full selection. Survey selectivity is fit for each survey separately assuming a logistic function. The choice of selectivity functions was determined followed extensive pre-STAR evaluation of alternative domed selectivity assumptions and exploration of alternative forms for surveys during STAR 5 (also using new, expanded, age class binning). Growth, by sex, is estimated in the model using the Schnute parameterization of the Von Bertalanffy growth function. Extensive exploration of alternative constants for Amin and Amax, and plus group definition, was undertaken. Although steepness and natural mortality are not estimated in the model, pre-STAR attempts to estimate parameters and profiling were undertaken; these illustrated clearly the lack of information in the available data to allow credible estimation and the decision to use best available fixed values from meta-analyses and sensitivity testing/profiling to portray uncertainty and illustrate sensitivity.

The assessment of blackgill rockfish was implemented using Stock Synthesis 3 (SS3 v3.21f). Stock Synthesis has been extensively used and the main software and extensions have been validated and documented. The implementation in SS3 was new in 2011. The new implementation was tested with settings and data as closely as possible mimicking the previous assessment, run in 2005 using SS2. Results of the analysis suggest that there are some differences in estimates of spawning biomass and depletion but especially in the interpretation of recruitment signals. It is unclear why the differences occur but the pre-STAR work, while extensive, was insufficient to explain these. Differences are likely due to multiple changes in the way SS3 works compared to SS2. It is notable that many new assessments cannot be fully reconciled with earlier assessments run in versions of SS3; trying to explain fully discrepancies when moving from SS2 to SS3 for a specific stock assessment is therefore not seen as overly critical. The differences in estimates of derived parameters of interest to management are small compared to the differences caused by gross changes in perception due to changes in overt model assumptions. Overall, the link/continuity analysis provides reasonable confidence in the new model as a starting place for exploration. Nevertheless, as mentioned in other reports on 2011 STAR assessments, there is an overall need to understand better how technical changes in SS3 (may) lead to consequential changes in estimation, especially of key derived parameters. It is **suggested** (see ToR 6) that it may be useful to consider a simple comparison across SS3 versions using standard data and assumptions for selected stocks.

During STAR 5 the model was explored extensively using SS3. Tuning of model runs followed standard procedures with multiple passes to refine index and composition weights. Alternative age binning, plus group definition, growth fitting, selectivity blocking and form, recruitment

estimation, etc were explored, together with extensive likelihood profiling and sensitivity testing. The final model definition was accepted as the best available in full recognition of data shortcomings and model simplifications and assumptions. Although a simplification of the biological and fishery dynamics, the model is nevertheless complex, fitting a wide range of parameters. Pre-STAR and STAR 5 exploration of the model was thorough and uncertainty (see below) seems to be well depicted around the base case with the major axis of uncertainty, natural mortality, well investigated. The model and methods used are fairly standard and I see no cause for concern.

Greenspotted rockfish

Separate assessments have been conducted for northern and southern zone fisheries.

The northern zone assessment model assumes a distinct stock of greenspotted rockfish with no linkages to the north beyond Cape Mendocino and none to the south below Point Conception, and uses catch data from 1916 to 2010. The assessment models the population as a single sex. Catches and composition data are provided for four fisheries (commercial trawl, hook and line, and net, and recreational) with various (and intermittent) length composition data from the mid/late 1970s onwards. Survey indices (trawl) are provided with associated length compositions plus conditional age-at-length composition data for just three recent years (2005, 07, 09). CPUE are provided derived from two recreational data sets with very limited age and age-at-length composition data from one series only from the late 1970s. Maturity- and fecundity-at-length ogives are estimated externally and are assumed constant through time. Steepness (assuming Beverton-Holt stock-recruitment dynamics) is fixed at 0.76 and recruitment assumed to be deterministic. Natural mortality is fixed as constant at 0.065. The model estimates separate length-based selectivity for three commercial and the recreational fleets, with time blocking of the commercial trawl and hook and line fisheries to reflect both changes in length compositions and implementation of management measures. The choice of selectivity functions was determined followed extensive pre-STAR evaluation of alternative assumptions and exploration of alternative forms for surveys during STAR 5. Growth is estimated in the model using the Schnute parameterization of the Von Bertalanffy growth function. Extensive exploration of alternative constants for A_{min} and A_{max} was undertaken. Although steepness and natural mortality are not estimated in the model, pre-STAR attempts to estimate parameters and profiling were undertaken; these illustrated clearly the lack of information in the available data to allow credible estimation and the decision to use best available fixed values from meta-analyses and sensitivity testing/profiling to portray uncertainty and illustrate sensitivity.

The southern zone assessment model assumes a distinct stock of greenspotted rockfish with no linkages to the north beyond Point Conception and none to the south below the US-Mexico border, and uses catch data from 1916 to 2010. The assessment models the population as a single sex. Catches and composition data are provided for five fisheries (commercial trawl, hook and line, and net, and recreational charter, and private) with various (and intermittent) length

composition data from the mid/late 1970s onwards. Two survey indices (trawl, and hook and line) are provided with associated length and age-at-length compositions ((limited to occasional, recent years). CPUE are provided derived from one recreational data set with length composition data from two recreational fisheries available from the mid 1970s to 2010. Maturity- and fecundity-at-length ogives are estimated externally and are assumed constant through time. Steepness (assuming Beverton-Holt stock-recruitment dynamics) is fixed at 0.76 and recruitment assumed to be deterministic. Natural mortality is fixed as constant at 0.065. The model estimates separate length-based selectivity for all commercial and recreational fleets, with time blocking of the commercial trawl and hook and line fisheries to reflect implementation of management measures. The choice of selectivity functions was determined followed extensive pre-STAR evaluation of alternative assumptions and exploration of alternative forms for surveys during STAR 5. Growth is estimated in the model using the Schnute parameterization of the Von Bertalanffy growth function. Extensive exploration of alternative constants for Amin and Amax was undertaken. Although steepness and natural mortality are not estimated in the model, pre-STAR attempts to estimate parameters and profiling were undertaken; these illustrated clearly the lack of information in the available data to allow credible estimation and the decision to use best available fixed values from meta-analyses and sensitivity testing/profiling to portray uncertainty and illustrate sensitivity.

The assessment of greenspotted rockfish (northern and southern zones) was implemented using Stock Synthesis 3 (SS3 v3.21f). Stock Synthesis has been extensively used and the main software and extensions have been validated and documented. The implementation in SS3 was new in 2011. During STAR 5 the models were explored extensively using SS3. Tuning of model runs followed standard procedures with multiple passes to refine index and composition weights. Alternative growth fitting, selectivity blocking and form, etc were explored, together with extensive likelihood profiling and sensitivity testing. The final model definitions were accepted as the best available in full recognition of data shortcomings and model simplifications and assumptions. Although a simplification of the biological and fishery dynamics, the models are nevertheless complex, fitting a wide range of parameters. Pre-STAR and STAR 5 exploration of the model was thorough and uncertainty (see below) seems to be reasonably well depicted around the base case with the major axis of uncertainty, natural mortality, well investigated. The model and methods used are fairly standard and I see no cause for concern (though note general reservations about model structure, data representativeness, etc).

ToR 4 *Evaluate model assumptions, estimates, and major sources of uncertainty and provide constructive suggestions for improvements if technical deficiencies or additional major sources of uncertainty are identified.*

Blackgill rockfish

The model assumes a single stock with no linkage to the north or beyond US waters to the south. As noted in previous reports, there is a need to strike a balance in stock assessment modeling for

management advisory purposes. The need is not to model all complexities but rather to model sufficiently to provide reliable, robust and credible advice given knowledge, reasonable assumptions and data availability. The new blackgill rockfish assessment is structurally similar to the 2005 assessment and fits to data are far from perfect though adequate as a basis for providing advice. The assessment is thoughtful, and careful explorations and redefinitions of fleet structure, ageing, maturity, etc are well described and justified. The characterization of overall uncertainty cannot fully integrate the many real sources of uncertainty but the major axes have been captured.

As noted under ToR 2 further work to understand the details of blackgill rockfish distribution and fisheries is encouraged. If further investigation were to suggest alternative model structures and if data were available for fitting such models, then it might be appropriate to consider more detailed assessment modeling. My expectation is that such work would be interesting but not necessarily of great utility from a strict management perspective.

Steepness is fixed at 0.76 in the assessment. Likelihood profiling as part of the pre-STAR work and during STAR 5 clearly demonstrated the lack of information on the parameter and the tension between data sources (especially length and age compositions). Sensitivity testing demonstrated the lack of dependency of the scale of spawning biomass on steepness, and of depletion. Given the lack of information in data, the use of fixed steepness derived from meta-analysis is appropriate. Given the low current exploitation and lack of data acquisition in key areas of distribution it is unlikely that improved blackgill rockfish-specific estimates of steepness will be available.

Natural mortality is the major point of interest in the assessment. Exploration during STAR 5 revealed tensions in age and length data from various sources and a general inability to estimate natural mortality. As for steepness, given the low current exploitation and lack of data acquisition in key areas of distribution it is unlikely that improved estimates of natural mortality for blackgill rockfish will be available. Therefore, given the lack of information in data, the use of fixed natural mortality values derived from meta-analysis seems appropriate. What is less clear is the need for sex-specific estimation of growth and separate definition of natural mortality. Given the lack of information overall it is **suggested** that single sex modeling might be warranted.

The model uses substantial data sources, fitting to survey indices and length and age composition data, with externally calculated parameters, to estimate a range of parameters and derived parameters of interest to management. The fits to composition data are acceptable though there are clear compromises given model structure and tensions between data, for instance as exposed by profiling on steepness and natural mortality, and in interactions between growth modeling and selectivity estimation. Fits to indices are acceptable though they show little variation and have large CVs. Despite the complexity of fitting productivity parameters using composition data, the major uncertainty in the assessment remains most notably in the definition of natural mortality.

The STAR 5 Panel decision was to accept a slightly modified pre-STAR base case, estimating growth and selectivity, but with fixed steepness and natural mortality, and to characterize uncertainty by choosing male/female natural mortality combinations as the median plus and minus 1 SD on the adopted Hamel prior (0.065, 0.089, 0.048 for males and correspondingly 0.63, 0.086 and 0.046 for females). This captures the range of uncertainty within the model as structured. This range of natural mortality possibly over-emphasizes the real uncertainty in derived parameters for due to natural mortality but neglects uncertainty due to stock definition, within stock variation in life-history, catch history definition, difficulties in ageing, estimation of maturity and fecundity, etc. Overall, while the stock assessment is sufficient reasonably to inform management in a gross sense, in detail care is needed not to over interpret specific numbers. Various suggestions and recommendations are made above, notably under ToR 2. Unless improvements are made to understanding and data in a number of areas, it is **suggested** that the next blackgill rockfish assessment should only be an update. Note that better external estimation of maturity and fecundity, or of alternative catch histories, could all be accommodated within an update assessment. If understanding of stock structure and dynamics were to lead to possible assessment structure changes, or if improved composition data were available following further or refined ageing, then a full assessment might be warranted.

Greenspotted rockfish

Separate assessments have been conducted for northern and southern zone fisheries.

As noted in previous reports, there is a need to strike a balance in stock assessment modeling for management advisory purposes. The need is not to model all complexities but rather to model sufficiently to provide reliable, robust and credible advice given knowledge, reasonable assumptions and data availability. Both greenspotted rockfish assessment models assume single stocks with no linkage between each other or to the north or south. The assumption is based on inference from very limited information and the credibility of the assessments as a basis for informing decision making is therefore debatable. In particular, the utility of the southern model is questionable. There are possibly strong linkages with stock(s) in Mexican waters and Mexican fisheries (commercial and recreational) may be sizeable. It is essential that if analytical assessments are to be pursued for greenspotted rockfish then fuller consideration of linkages with Mexican stocks/fisheries needs to be undertaken. It is **suggested** that absent such consideration, it is difficult currently to commend the southern zone stock assessment for management use. The northern zone assessment is little better with very limited data available realistically to estimate growth internally or to fit selectivity patterns. Both models are driven largely by assumptions.

Steepness is fixed at 0.76 in the assessment. Likelihood profiling as part of the pre-STAR work and during STAR 5 clearly demonstrated the lack of information on the parameter and the tension between data sources (especially length and age-at-length compositions). Sensitivity testing demonstrated the relative lack of dependency (compared to that for natural mortality) of the scale of spawning biomass on steepness, and of depletion. Given the lack of information in

data, the use of fixed steepness derived from meta-analysis is appropriate. Given the very low current exploitation (extremely so in the case of the southern zone) and lack of data acquisition in key areas of distribution (again, notably in the southern zone) it is unlikely that improved stock-specific estimates of steepness will be available.

Natural mortality is the major point of interest in both assessments. Exploration during STAR 5 revealed tensions in age and length data from various sources and a general inability to estimate natural mortality. As for steepness, given the very low current exploitation and lack of data acquisition in key areas of distribution it is unlikely that improved estimates of natural mortality for greenspotted rockfish will be available. Therefore, given the lack of information in data, the use of fixed natural mortality values derived from meta-analysis seems appropriate. For completeness, as noted above, it is **suggested** that natural mortality priors be produced using the Hamel approach for both southern and northern zones to compare with the constant assumed value (and defined high and low states of nature) used in the assessment.

The models use substantial data sources, fitting to survey indices and length and age composition data, with externally calculated parameters, to estimate a range of parameters and derived parameters of interest to management. The fits to composition data for both zones are superficially acceptable though there are clear compromises given model structure and tensions between data, for instance as exposed by profiling on steepness and natural mortality, in interactions between growth modeling and selectivity estimation, and in residual fits. Fits to indices in both zones are also superficially acceptable though they show little variation and have large CVs. Of concern is that the model fits do not fully make intuitive sense.

The northern model, for example, indicates a substantial decrease in spawning biomass between 1940 and 1970 and a serious decline thereafter until the late 1990s. The indices of abundance for recreational fisheries span the periods 1980 to 2000 and 1987 to 1998. During the period 1980 to 2000 the assessment suggests a change in depletion from above 40%, down to 10% in the late 1990s. In the period 1987 to 1998 the depletion estimates decline from over 25% to 10%. Despite these indicated strong declines, neither index shows any obvious trend. The depletion estimate are driven entirely by the assumed productivity (steepness and natural mortality) as modified slightly by fits to growth and selectivity using information-poor data. The southern zone model estimates a change in depletion from about 80% in 1970 to 15% in the mid 1980s. The single index available for (the latter part of) this period indicates no clear trend. As for the northern assessment, the depletion estimates are driven entirely by the assumed productivity (steepness and natural mortality) as modified slightly by fits to growth and selectivity using information-poor data. Despite the complexity of fitting productivity parameters using composition data, the major uncertainty in both assessments remains most notably in the definition of natural mortality and, secondarily, steepness.

The STAR 5 Panel decision for both zones was to accept slightly modified pre-STAR base case models, estimating growth and selectivity, but with fixed steepness and natural mortality, and to characterize uncertainty by choosing natural mortality combinations as the median plus and

minus 1 SD inferred from the range of estimated natural mortality rates using alternative techniques and interpreting the range as a 90% confidence interval. This captures most of the range of uncertainty within the models - as structured. This range of natural mortality possibly over-emphasizes the real uncertainty in derived parameters due solely to natural mortality but neglects uncertainty due to stock structure/linkage, steepness/stock-recruit assumptions, catch history definition, ageing, representativeness of sampling, estimation of maturity and fecundity, etc. Overall, while the stock assessments are sufficient reasonably to inform management in a gross sense, in detail great care is needed not to over interpret specific numbers. Various suggestions and recommendations are made above, notably under ToR 2.

ToR 5 Determine whether the science reviewed is considered to be the best scientific information available.

Blackgill and Greenspotted rockfish

In my opinion, the STAT initially, and in conjunction with the STAR Panel and advisors, has comprehensively reviewed the available information on blackgill and greenspotted rockfish and has conducted thorough analyses to provide best available estimates of management-related quantities. Uncertainties in inputs and estimates of interest have been adequately explored and overall I am confident that the resulting assessments and decision tables represent the best scientific information available.

For greenspotted rockfish, however, while recognizing the assessments represent the best available information, it is not clear that the best available is in fact sufficient usefully to inform management. The assessments are driven primarily by structural and parameter assumptions.

ToR 6 Provide specific suggestions for future improvement in any relevant aspects of data collection and treatment, modeling approaches and technical issues.

Specific recommendations and suggestions are highlighted in **bold, red** in the preceding sections. I distinguish between recommendations as necessary activities and suggestions as desirable ones, recognizing that research planning and prioritization requires consideration of multiple factors and applies to many stocks, fisheries and other factors.

As noted in the report on STAR 3, given differences in bridging (aka “link”, “crossover” or “continuity”) runs for POP during STAR 2 and widow rockfish during STAR 3, and now for blackgill rockfish in STAR 5, it is **suggested** that it may be useful to consider a simple comparison across SS3 versions using standard data and assumptions for selected stocks. The various examples suggest cause for at least a simple analysis to explore if there is an issue requiring further analysis and, if so, possibly to identify likely technical SS3 implementation

explanations and/or data/model-implementation interactions. I have only quickly gone through the change-log for SS3 and cannot immediately see any obvious places to concentrate.

It is notable for both blackgill and greenspotted rockfish that many of the major issues are data-rather than assessment-related. The STAR 5 meeting touched on many of these issues but overall did not have sufficient time to consider in detail the many data-related matters. It is recognized that a short pre-STAR workshop was held between the STAT, GMT and GAP, but there could be value in considering separate data workshops for some species to help define assumptions, parameter inputs, datasets, etc for assessment purposes. Alternatively, for species where data issues may outweigh assessment modeling issues, it might be better to focus reviews on data. There are numerous ways of approaching the matter but the current, rigid STAR format seems to place more emphasis on assessment *per se*, possibly to the detriment of more fundamental issues. It is **suggested** that consideration be given to more flexible ToR for STAR panels and/or additional or separate processes to consider data issues.

CONCLUSIONS AND RECOMMENDATIONS

Because of the wide scope (two stocks, consideration of both data collection and analysis, and three stock assessments), it is highly likely that misinterpretation of some materials, presentations or discussions has been made. This is the fault of the reviewer, not of the many excellent STAT scientists who gave good presentations and made the review an enjoyable experience – to them, many thanks.

The STAR Panel system is well established and I am reluctant to criticize or comment on the basis of a few meetings. My initial view, after STAR 2, was that reviewing two entire stock assessments and all data inputs in one week, using the same Panel, is too frenetic. That view was based on the conclusion at the time that the time available was insufficient to do justice to the substantial efforts of the STAT and to review in detail all necessary aspects of the work. After STAR 3 through 5 the view is clearly not generally applicable. Each meeting has had its own flavor, driven by the nature of the data and assessments but also, substantially, by the specific composition of the STAT, Panelists, Advisors, public involvement, etc. Overall, while it is clearly possible to review (not redo) assessments *per se* within the time available, I am unconvinced that it is possible reasonably to review all data inputs or to consider appropriate assessment structure. Some themes have recurred, notably assignment of historic removals for base case and sensitivity testing, and the use of priors from meta-analyses. Some issues have generally been only lightly considered, for example survey index estimation and commercial CPUE modeling options. There would be value in considering alternative means of reviewing such issues and of dealing with data-related issues as opposed to stock assessment modeling for each species/stock. It may be useful to consider more flexibility (less rigidity) in STAR ToR.

The assessments for blackgill and greenspotted rockfish are effectively new assessments, developed after thorough and careful examination of data and considered modeling. Both

assessments necessarily simplify complex biological and fishery issues and therefore make compromises when fitting to limited data. The blackgill rockfish assessment has resulted in credible base cases and has reasonably explored uncertainty. The emergent management advice for the species represents the best scientific information available at this time. For greenspotted rockfish the two assessments should perhaps be treated as more exploratory until the major stock structure/linkage uncertainties are explored and unless more representative data are available, especially for the southern zone. It is not clear that the assessments, though arguably the best currently available, are sufficient usefully to inform management.

APPENDIX 1

BIBLIOGRAPHY

Prior to the Workshop, extensive materials were provided *via* a dedicated, anonymous ftp server (ftp.pccouncil.org/pub/GF_STAR_5_2011_GreenspottedRF_BlackgillRF_Aug_8-12). The materials were extensive and relevant to all terms of reference in varying degrees.

During the workshop multiple presentations were given, and additional materials were provided on request, including further background documents and presentations as well as responses to Panel requests. All files were made available using the dedicated server which was accessed using hotel guest Wi-Fi throughout the meeting. The access was generally adequate. Directory listings are not provided here as the server is anonymous (and therefore publicly available).

APPENDIX 2

Attachment A: Statement of Work for Dr. Kevin Stokes

External Independent Peer Review by the Center for Independent Experts

Stock Assessment Review (STAR) Panel for greenspotted rockfish and blackgill rockfish

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: A benchmark assessment is proposed for Blackgill rockfish, another highly vulnerable species, and a major component in the Southern Slope Rockfish complex. It has not been assessed since the first effort in 2005. A new assessment is planned for proposed for greenspotted rockfish because it is at the high end of the PFMC's precautionary range developed by the GMT, and the SWFSC has already expended considerable effort in organizing and analyzing data for this species. Assessments for these two stocks will provide the basis for the management of the groundfish fisheries off the West Coast of the U.S. including providing scientific basis for setting OFLs and ABCs as mandated by the Magnuson-Stevens Act. The technical review will take place during a formal, public, multiple-day meeting of fishery stock assessment experts. Participation of external, independent reviewer is an essential part of the review process. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements for CIE Reviewers: Two CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. CIE reviewers shall have working knowledge and recent experience in fish population dynamics, with experience in the integrated analysis modeling approach, using age-and size-structured models, use of MCMC to develop confidence intervals, and use of Generalized Linear Models in stock assessment models. Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled in Santa Cruz, California during 8-12 August 2011.

Statement of Tasks: Each CIE reviewers shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: <http://deemedexports.noaa.gov/sponsor.html>).

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Other Tasks – Contribution to Summary Report: Each CIE reviewer may assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. Each CIE reviewer is not required to reach a consensus, and should provide a brief summary of the reviewer's views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

- 1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
- 2) Participate during the panel review meeting in Santa Cruz, California during 8-12 August 2011.
- 3) In Santa Cruz, California during 8-12 August 2011 as specified herein, conduct an independent peer review in accordance with the ToRs (**Annex 2**).
- 4) No later than 26 August 2011, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net and to Dr. David Die, CIE Regional Coordinator, via email to ddie@rsmas.miami.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

5 July 2011	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
25 July 2011	NMFS Project Contact sends the CIE Reviewers the pre-review documents
8-12 August 2011	Each reviewer participates and conducts an independent peer review during the panel review meeting
26 August 2011	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
9 September 2011	CIE submits CIE independent peer review reports to the COTR
16 September 2011	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:

- (1) each CIE report shall be completed with the format and content in accordance with **Annex 1**,
- (2) each CIE report shall address each ToR as specified in **Annex 2**,
- (3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

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Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.
2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.
 - a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a brief summary of findings, of the science, conclusions, and recommendations.
 - b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.
 - c. Reviewers should elaborate on any points raised in the Summary Report that they feel might require further clarification.
 - d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.
 - e. The CIE independent report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.
3. The reviewer report shall include the following appendices:
 - Appendix 1: Bibliography of materials provided for review
 - Appendix 2: A copy of the CIE Statement of Work
 - Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference for the Peer Review

Stock Assessment Review (STAR) Panel for greenspotted rockfish and blackgill rockfish

1. Become familiar with the draft stock assessment and background materials.
2. Comment on the quality of data used in the assessments including data collection and processing.
3. Evaluate and comment on analytic methodologies.
4. Evaluate model assumptions, estimates, and major sources of uncertainty and provide constructive suggestions for improvements if technical deficiencies or additional major sources of uncertainty are identified.
5. Determine whether the science reviewed is considered to be the best scientific information available.
6. Provide specific suggestions for future improvement in any relevant aspects of data collection and treatment, modeling approaches and technical issues.
7. Provide a brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations

Annex 3: Tentative Agenda

Stock Assessment Review (STAR) Panel for greenspotted rockfish and blackgill rockfish

**Santa Cruz Lab
NMFS Southwest Fisheries Science Center
110 Shaffer Road
Santa Cruz, CA 95060
August 8-12, 2011**

Finalized agenda will be provided by NMFS project contact two weeks before the review.

Monday, August 8, 2011

- 9:00 a.m. Welcome and Introductions
- 9:15 a.m. Review the Draft Agenda and Discussion of Meeting Format (Panel Chair)
 - Review Terms of Reference for Assessment and Review Panel
 - Assignment of reporting duties
 - Discuss and agree to format for the final assessment document
- 9:45 a.m. Stock Assessment Team (STAT-1) Presentation of Species 1 (Authors)
 - Overview of Data and Stock Synthesis Modeling
- 12:30 p.m. Lunch (On Your Own)
- 1:30 p.m. Q&A session with the STAT-1 & Panel discussion
- 3:30 p.m. Coffee Break
- 3:45 p.m. Panel develops request for additional model runs / analyses for STAT 1
- 4:30 p.m. Panel provides written requests for additional model runs / analyses to STAT 1
- 5:00 p.m. Adjourn for day.

Tuesday, August 9, 2011

- 9:00 a.m. Stock Assessment Team (STAT-2) Presentation of Species 2 (Authors)
 - Overview of Data and Stock Synthesis Modeling
- 12:00 p.m. Lunch (On Your Own)
- 1:30 p.m. Q&A session with the STAT-2 & Panel discussion
- 3:00 p.m. Coffee Break
- 3:15 p.m. Panel develops request for additional model runs / analyses for STAT 2
- 4:00 p.m. Panel provides written requests for additional model runs / analyses to STAT 2
- 4:30 p.m. Panel check in with STAT-1 if needed
- 5:00 p.m. Adjourn for day.

**Stock Assessment Review (STAR) Panel for
Greenspotted rockfish and Blackgill rockfish**

Wednesday, August 10, 2011

- 9:00 a.m. STAT-1 Presentation of first set of model runs for Species 1
- Q&A session with the STAT-1 & Panel discussion
 - Panel develops written request for second round of model runs / analyses for STAT 1
- 12:00 p.m. Lunch (On Your Own)
- 1:30 p.m. STAT-2 Presentation of first set of model runs for Species 2
- Q&A session with the STAT-2 & Panel discussion
 - Panel develops written request for second round of model runs / analyses for STAT 2
- 3:30 p.m. Coffee Break
- 3:45 p.m. Continue Panel discussion with STAT-2
- 5:00 p.m. Adjourn for day.

Thursday, August 11, 2011

- 9:00 a.m. STAT-1 Presentation of Second Set of Model Runs for Species 1
- Q&A session with the STAT-1 & Panel discussion
 - Identification of preferred model and elements for the decision table.
 - Panel develops third list of model runs for decision table and begins drafting STAR report.
- 12:00 p.m. Lunch (On Your Own)
- 1:00 p.m. STAT-2 Presentation of Second Set of Model Runs for Species 2
- Q&A session with the STAT-2 & Panel discussion
 - Identification of preferred model and elements for the decision table.
 - Panel develops third list of model runs for decision table and begins drafting STAR report.
- 3:30 p.m. Coffee Break
- 3:45 p.m. Panel discussion or report drafting continues
- 5:00 p.m. Adjourn for day.

Friday, August 12, 2011

- 9:00 a.m. Consideration of remaining issues
- Review decision tables for Species 1 and Species 2

11:00 a.m. Panel agrees to process for completing final STAR report by Council's
September meeting Briefing Book deadline

5:00 p.m. Review Panel Adjourns

APPENDIX 3
PERTINENT INFORMATION FROM THE REVIEW

1) Participants List

Technical Reviewers

Vladlena gertseva, Panel Chair, Scientific and Statistical Committee (SSC)

Kevin Stokes, Center for Independent Experts (CIE)

Mike Armstrong, Center for Independent Experts (CIE)

Lou Botsford, UCSC and SSC

Panel Advisors

John DeVore, Pacific Fishery Management Council (PFMC) Staff

Sean Matson, PFMC Groundfish Management Team (GMT)

Gerry Richter, PFMC Groundfish Advisory Subpanel (GAP)

Stock Assessment (STAT) Teams

John Field, NMFS, Southwest Fisheries Science Center, Dover Sole STAT

E.J. Dick, NMFS, Southwest Fisheries Science Center, Sablefish STAT