INTERNATIONAL REVIEW PANEL REPORT FOR THE 2013 INTERNATIONAL FISHERIES STOCK ASSESSMENT WORKSHOP

2 – 6 December 2013, UCT

[A D M Smith (Chair)[1], S Cox[2], A Parma[3], and A E Punt[4]]

Introduction

The Panel recognised the very high quality of the research presented at the 2013 International Fisheries Stock Assessment Review Workshop. This included research on South African hake, sardine, and linefish, as well as research associated with the ECOFISH project. The Panel thanked the workshop participants for their hard work preparing and presenting the workshop papers, for the extra analyses undertaken during the workshop, and for the informative input provided during discussions.

This report starts with observations from the Panel on some general issues for the species reviewed, and then focuses on the more detailed technical review and recommendations concerning each fishery. The Panel deliberations were guided by a set of key issues (see Appendix 1) and the text in square parentheses at the end of some of the recommendations reflects the corresponding key issue(s). The Panel did not have time to address all of the key questions. The recommendations are annotated by their priorities (H, M, L and conclusions are indicated by asterisks).

Summary of general issues

Hake

The review focused on progress on steps in the process of revising the current hake OMP which commenced in March 2013 and is due for completion in September 2014. The current assessment model [MARAM IWS/DEC13/Hake/P2] was evaluated in some detail, with particular focus on fits to the longline fishery length-frequency data and the form of selectivity patterns [see recommendations A7, A9]. Alternative potential operating models were reviewed including a model that allows for movement among spatial strata rather than treating spatial differences in length-frequency and abundance trends as being due to differences in selectivity among "fleets" (reflecting different areas and commercial CPUE or surveys) [MARAM IWS/DEC13/Hake/P9], and a model incorporating inter-specific predation and cannibalism [MARAM IWS/DEC13/Ecofish/P10]. The Panel also provided advice on selection of robustness tests [recommendations A.x] and OMP issues [recommendations A.x].

Unavailability of the research vessel *Africana* continues to be an issue for hake surveys, hake assessments, and potentially hake OMPs. Issues associated with the use of industry vessels to conduct surveys were discussed [Section E] including the associated problem of calibration. Alternative scenarios for future surveys and their implications can be investigated in the OMP development process [Recommendations].

Sardine

To Come Later

Linefish

[1] CSIRO Marine and Atmospheric Research, Australia
[2] Simon Fraser University
[3] Centro Nacional Patagonico, Chubut, Argentina
[4] University of Washington, USA

The Panel noted the very good progress made since the 2012 review in testing the method developed to standardize CPUE for linefish [MARAM IWS/DEC13/Linefish CPUE/P1]. This method could be of broad interesting in multi-species fisheries and could have wide application. Some suggestions were made about final testing and application [Section D]. The method is sufficiently developed for use in stock assessments for some linefish species and future reviews might desirably focus on broader aspects of linefish assessment.

ECOFISH

The Panel reviewed several aspects of the ECOFISH program, particularly those related to spatial structure in hake populations off South Africa and Namibia. The GeoPop approach [MARAM IWS/DEC13/Ecofish/P6 & MARAM IWS/DEC13/Ecofish/P7] combined with the genetic analyses [MARAM IWS/DEC13/Ecofish/P9] should be used to develop hypotheses about stock structure and movement for future assessments. The Panel encouraged much closer interactions between biologists, geneticists and modellers involved in this work.

Other issues

The Panel was concerned about certain aspects of the arrangements for the review. These were the large number of issues and documents to be considered, compounded by the late delivery of a number of documents. The time pressure in the meeting also resulted in a number of papers not being presented or considered, of concern both to those who developed the papers and those who had read them.

The Panel also had some concerns about convergence issues for a number of model runs presented. Section F of this report provides some guidelines for overcoming such difficulties. However, there is also value in the modellers checking each others code and sharing techniques for overcoming problems such as a lack of convergence and how to avoid coding statements that are problematic for AD Model Builder.

A. **Hake**

Assessment-related

A.1 (*) The spatially-structured assessment framework that incorporates movement explicitly is a major potential step forward in understanding the dynamics of South African hake. However, several issues need to be addressed before this framework could be included in the reference set of operating models for this (or any future) hake OMP revision (see recommendation A.xx) below). While including this model in the robustness tests would be desirable, a number of assumptions regarding the spatial distribution of future effort would need to be made. Given the amount of time available it may not be possible to complete this model development in order to use it as an operating model to test candidate OMPs in the current review process due for completion by September 2014. [*Review progress on the development of approaches which model movement explicitly, and advise on their role in the current OMP review process*]

A.2 (*) Include the replacement line on all stock-recruitment relationships reported in Figures. [*Review progress on update of 2010 assessment approach leading to a new Reference Set*]

A.3 (H) Update the reference case specifications so that the penalty function on the change in survey catchability associated with the use of a new gear by *Africana* is set to the best estimate obtained in the most current calibration analysis: for *M. capensis* this should be 0.653 (SE 0.073) rather than the *ad hoc* value specified in the past (0.8), and for *M. paradoxus* it should be updated based on “Model 1 corrected”. [*Advise on appropriate calibration factors for Africana old vs new gear*]

A.4 (H) Take the sex-specificity of the available length-frequency data for the longline fisheries into account in the assessment. This may require that some of the selectivity patterns be modified to allow them to be sex-specific. See also recommendations A.x and A.y [*Consider the implications of the sensitivity of the results to the addition of further longline CAL data*]

A.5 (H) Dome-shaped selectivity is currently modelled as a logistic function of length, with an exponential reduction in selectivity above a certain length. The length at which selectivity begins to drop is pre-specified rather than being estimated. Consider implementing a selectivity function which includes dome-shaped and asymptotic selectivity as special cases, and which estimates the length when selectivity starts to decline. The double-logistic function included in Stock Synthesis is a 7-parameter function that has these properties and is differentiable. [*Review progress on update of 2010 assessment approach leading to a new Reference Set*]

A.6 (M) The current likelihood function for the length-frequency and conditional age-at-length data is not a true likelihood. Consider the alternative likelihood function for the length-frequency and conditional age-at-length data developed by Chris Francis (paper available on request form the author). [*Review progress on update of 2010 assessment approach leading to a new Reference Set*]

A.7 (M) The shape of the selectivity patterns for the south coast spring and autumn surveys for *M. paradoxus* in MARAM IWS/DEC13/Hake/P2 are surprising and hard to justify biologically. This might reflect imprecision of the estimates in question. Consider imposing a stronger penalty on how selectivity may change among length-classes. [*Review progress on update of 2010 assessment approach leading to a new Reference Set*]

A.8 (M) Use the approach of Francis (2011) to explore whether the extent to which the length frequency and conditional age-at-length data are downweighted is appropriate. [*Review progress on update of 2010 assessment approach leading to a new Reference Set*]

A.9 (M) The Panel has the following suggestions related to the stock assessment method which models movement explicitly [*Review progress on the development of approaches which model movement explicitly, and advise on their role in the current OMP review process]*:

1. Estimate the spatial distribution of recruits as a vector of parameters and start movement in the model at the first age at which hake are observed in surveys. This reduces the number of estimable parameters.
2. Estimate the initial distribution of abundance in 1978 using a vector of parameters by age or groups of ages.
3. Explore why the model suggests that survey selectivity for *M. capensis* should be dome-shaped when essentially the entire range of the species is covered by the model.
4. Longshore strata could be added to the model as needed and statistically justified by the data available for parameter estimation.
5. Report the proportion of each species in each spatial stratum by age, and develop methods for visualizing how this proportion changes over time.
6. Implement (weak normal) penalties on the parameters which determine movement to avoid parameters moving towards bounds.
7. Consider implementing smoothness penalties on the movement rates or functional forms for movement based on age and distance to avoid what appear to be unrealistic movement probabilities in some instances.

8. Work with biologists to evaluate whether the estimated movement probabilities and spatial distribution patterns match expectations. The output of the GeoPop model might be helpful in this regard.

A.10 (L) The GLM CPUE series are based on species-aggregated catch and effort data which are then disaggregated to species. There will be some correlation between the standardized CPUE series for the two hake species. Estimate the extent of between-species correlation in the residuals for the two species. If there is substantial correlation, develop a likelihood function which accounts for these correlations and generate future CPUE data by species with this correlation (as well as the temporal correlation referenced in A.? below). [*Review progress on update of 2010 assessment approach leading to a new Reference Set*]

A.11 (L) There are only a few unsexed animals which are not immature. Drop these animals from the analysis to avoid fitting data for which the sample size is very small. [*Review progress on update of 2010 assessment approach leading to a new Reference Set*]

A.12 (L) Determine exactly how the early ("ICSEAF") CPUE series were coarsely standardised.

OMP-related

A.13 (*) The OMP evaluation could consider changes over time in fishing mortality as a proxy for changes over time in effort.

A.14 (*) Analyses provided to the Panel in MARAM IWS/DEC13/Hake/P2 suggests that there is a limited ability to forecast commercial CPUE.

A.15 (H) Modify the future projection specifications for OMP testing so that allowance is made for temporal autocorrelation in catchability when generating future CPUE indices of abundance. The extent of such correlation should be calculated for each CPUE series separately. [*Review progress on update of 2010 assessment approach leading to a new Reference Set*]

A.16 (H) In relation to robustness tests [*Advise on the selection of robustness tests*]:

1) Drop robustness test A.catches.1 because robustness test A.catches.2 provides a more complete examination of the implications of using the observer data to split the historical catches to species.
2) Add a robustness test based on the current robustness test A.catches.2 in which the species split is based on the "old algorithm" which allows for year effects in the algorithm relating these splits to hake size and depth when predicting species splits.
3) Robustness test A.Catches.3 should refer to doubling the <u>catch</u> by the longline fisheries, not the fishing mortality rate. Also, the operating model should output the model-predicted discards (in total and by length-class) in absolute terms and relative to the landed catch, and this level of discards should be evaluated given the data collected by observers.
4) Add a robustness test in which there is hyper-stability in past and future CPUE-abundance relationships, for example, that CPUE is proportional to the square-root of abundance.
5) Add a robustness test in which there is hyper-stability in future CPUE-abundance relationships only.
6) Use CPUE standardization to explore the plausibility of the assumptions underlying robustness test A.CPUE.2 if it is selected for further consideration.

7) Robustness test A.CPUE.3 may involve a considerable amount of work to implement correctly, especially given the longline selectivity pattern is assumed to change over time. Completing this robustness test should be assigned a lower priority.
8) Implementation of robustness test A.survey.1 depends on having the relevant environment covariates for the entire time-series of survey estimates. It should only be implemented if such covariates are available and relationships have been established [*Advise on possible approaches to take environmental co-variates into account in estimating abundance indices*].
9) Robustness test B.sel.3 should be divided into two robustness tests, one in which the scaling factor is increased and another in which it is decreased.
10) Robustness test B.SR.1 should be assigned low priority given that implementing the assessment as a random effects model is likely to be very challenging.
11) Robustness test B.SR.3 should be divided into two robustness tests, one in which the sex ratio is skewed towards females and another in which it is skewed towards males.
12) Robustness test B.others.5 should be dropped as this aspect of robustness is covered by robustness test A.length.2
13) Robustness test C.future.3 involves undetected increases in catchability at 2% per annum. Arguments were made to the Panel that this may be an unrealistically high rate of increase to assume.
14) Add a robustness test in which catchability is decreasing at 2% per annum to reflect the possible implications of changes in fishing practices.
15) Add a robustness test in which the operating model is not fit to the annual conditional age-at-length data, but rather to the age-compositions which are obtained by multiplying the age-length keys by the length-frequencies for the years which age-length keys are available. The length-frequencies used to construct age-compositions for those years should be ignored when fitting the operating model. [*Consider whether the current approach of fitting to CAL and ALK data, rather than externally derived CAA data as previously, should be considered*]
16) Add a robustness test which involves using the movement model as the operating model.

A.17 (H) Generate future species split proportions accounting for the extent of autocorrelation about the average relative fishing mortality between the two hake species currently used for projections [*Review current projection approaches and handling of species split*]

A.18 (H) Consider developing an OMP variant in which the proportional catches of each species are compared to a “target range” and perhaps adjust TACs when the catch by species is outside of its target range [*Advise on appropriate forms of empirical catch control rules, including capabilities to avoid response delays*]

A. ECOFISH Program

The Panel reviewed several of the products that are currently available. The bulk of these are currently “works in progress”. Notwithstanding this, the Panel was able to evaluate the extent to which these projects should contribute to the objectives of ECOFISH and to management of the hake resources off Namibia and South Africa.

1. The GeoPop approach is a highly innovate modelling framework which integrates population dynamics processes and geostatistical modelling. GeoPop has been applied to the two hake species (*M. capensis* MARAM IWS/DEC13/ Ecofish/P6; *M. paradoxus* MARAM IWS/DEC13/Ecofish/P7). The results of this approach in its

current form could not be used as a stock assessment method at present, but are relevant for developing hypotheses regarding movement patterns and also to validate population dynamics models which have less spatial structure but are developed for stock assessment purposes (e.g. MARAM IWS/DEC13/Hake/P9). The Panel identified several areas in which the current implementation of GeoPop for southern African hake could be improved: (a) estimation of additional parameters, in particular survey selectivity, (b) use of shorter time-steps than a year to account for the timing of surveys and seasonal movement, (c) presentation of model fit diagnostics, (d) accounting for differences in the ability to assign species to cohorts, and (e) accounting for fishery size selectivity and spatial variation in fishing mortality. The modelling should account for observed spatial variation in growth (see MARAM IWS/DEC13/Ecofish/P8). If, GeoPop is to be developed to a stage that takes the factors raised above into account, it could be used as the basis for a transboundary operating model to test a future set of hake OMPs, including possible transboundary OMPs.

2. MARAM IWS/DEC13/Hake/P9 provides a first attempt at a spatially-explicit stock assessment with age-dependent movement, implementing a number of the specifications recommended in the 2011 Review Panel report. The application is currently restricted to hake in South African waters, but the framework could be applied to the entire range of hake off southern Africa given detailed specifications of alternative hypotheses about stock structure. The Panel emphasizes the importance of selecting spatial strata so that availability (as distinct from gear selectivity) of fish to at least one and hopefully both the fishery and survey can reasonably be assumed to be constant within a stratum so that there is no need to allow for dome-shaped selectivity patterns. More detailed technical comments on the method are given in recommendations A.x – A.y. [*Review progress on the development of approaches which model movement explicitly, and advise on their role in the current OMP review process*]
3. MARAM IWS/DEC13/Ecofish/P10 provides a preliminary version of a stock assessment which allows for the two hake species and inter-species predation as well as cannibalism. It combines features of previous multispecies assessment methods and the method used in recent years to assess South African hake. The current version of the model is difficult to fit because the population dynamics can be unstable given time-varying predation rates by age and species. The Panel recommends that (a) diet data used in the model be based on scaling hake prey-by-species data upwards to account for unidentified hake prey, (b) the model should examine the consequences of timing of age zero density-dependence relative to timing of cannibalism and inter-species predation (i.e. whether most of the predation occurs before or after density-dependence), (c) the model not be structured with pre-specified rations but instead the rations be included as estimable parameters in the likelihood function, (c) whether feeding relationships are different on the west and south coasts should be examined in due course, and (e) the feeling functional relationships should be parameterized so that it is possible to determine starting values for parameter estimation as reliably as possible.
4. MARAM IWS/DEC13/Ecofish/P3 provides a through, but primarily qualitative, evaluation of environmental hypotheses related to hake catchability. The key next step for this work is to develop a more quantitative evaluation of the effects identified; the aim should be to determine the extent to which incorporation of estimated quantitative relationships calculating abundance indices from surveys might reduce both bias and variance. The Panel emphasizes the value of collecting environmental covariates

during surveys, noting that any corrections should be made throughout the time-series and that the variance of the resulting survey estimates needs to reflect the uncertainty associated with the identified correction factors. MARAM IWS/DEC13/Ecofish/P3 outlines a way to expand past survey results into deeper water. The Panel cautions that while attractive the variance associated with the extrapolation needs to be quantified and taken into account when the resulting biomass indices are used in assessments. A method needs to be developed to predict the size-composition of animals in deeper water if a survey abundance estimate incorporating extrapolation is to be included in assessments. MARAM IWS/DEC13/Ecofish/P3 recommends that survey stations for which wind speed is higher than 25 knots should be omitted from the calculation of biomass indices. This approach needs further consideration and possibly analysis before being adopted, in particular whether this adjustment will lead to strata without hauls and whether the requisite data are available. [*Advise on possible approaches to take environmental co-variates into account in estimating abundance indices*]

5. MARAM IWS/DEC13/Ecofish/P8 provides strong evidence that *M. capensis* in Namibia lay down multiple growth rings annually and that growth ring formation likely differs between northern and southern Namibia. This is an important result which should lead to follow-up work in Namibia on *M. paradoxus* and in South Africa on both *M. capensis* and *M. paradoxus*. The follow-up work will require additional data collection, e.g. collection of monthly otolith samples to enable marginal increment analyses to be undertaken.
6. MARAM IWS/DEC13/Ecofish/P9 summarizes current progress related to genetic analyses for southern African hake. The work is preliminary and some of the results are surprising (e.g. Φ_{ST} between Namibia and the SA west coast is higher than between Namibia and the SA south coast). The Panel cautions against drawing conclusions regarding stock structure (the number of stocks of each species present, their distribution and their relative densities in areas of overlap) until the current study is complete. The current study includes samples from throughout Namibia and South Africa, as well as temporal replication, which should add robustness to any conclusions. The Panel supports use of tools (such as Geneland) to explore the spatial structure of any identified stocks.

Overall, the work conducted to date provides substantial information on the development of stock assessment methods / models which could form the basis for OMP evaluations as well as information to parameterize those models and identify the biological hypotheses which the models should represent. The Panel recommends that the biologists and modellers (South African, Namibian and Danish) collaborate to: (a) identify alternative hypotheses regarding stock structure, (b) test those hypotheses using existing data (i.e. the tests to be undertaken as part of the genetics study should be based on the identified hypotheses to the extent possible), and (c) population models should be implemented for the hypotheses that cannot be rejected given the tests conducted to ensure that the models used for management reflect the range of plausible stock structure hypotheses.

B. Sardine

To come later

C. Linefish CPUE standardization

D.0 (Tony) The Panel recognizes that considerable effort and progress has been made in developing the Direct Principal Component (DPC) method. Promising simulation results suggest an improved ability to index the abundance of South African linefish species, as well as a broader class of multi-species fisheries in South Africa and other parts of the world. In addition, the simulation research could lead to a better understanding of how CPUE standardization methods perform in general. The Panel also notes that index standardization is only one component of developing a stock assessment. There may be value in a future Panel reviewing the entire process of conducting stock assessments for some South African linefish stocks.

D.1 (*) The Panel supports empirical tests of the Direct Principal Component (DPC) and other methods, including applying them to experimental survey CPUE data from shore-based angling for which fishing tactics are known. It also supports test applications of the DPC method to other South African fisheries, including those based on pelagic longlines, demersal trawl and shore-based angling. In relation to demersal trawl, the Panel recommends that the DPC method can be applied to examine trends in both target species (e.g. hake) as well as bycatch species. It notes that care needs to be taken regarding when different species began to be recorded reliably in logbooks.

D.2 (H) The approach of MARAM IWS/DEC13/Linefish CPUE/P1 is an improvement on the earlier version of this approach because it accounts for zero catches and includes a way to select the number of Principal Components to include as covariates in the GAM. The revised method performs well in the simulations conducted to date. Additional standardization methods worth evaluating include (a) clustering trips and treating each cluster as a discrete covariate level, (b) the Stevens-MacCall subsetting method, and (c) treating the catch-rate of a bycatch species as a covariate. For method (c), the Panel suggests using a high volume bycatch species that is usually not caught with the principal target species being indexed by CPUE.

D.3 (H) Selecting the number of PCs used as covariates is a key part of the DPC method. Test a new DPC variant in which the number of PCs is selected objectively (e.g. using the Kaiser-Guttman rule or an objective version of Cattel's scree test [Cattell, 1996]). Ideally, explore a DPC variant that involves selecting between a model with no covariates and one in which PCs are covariates. This selection might be accomplished using cross-validation, given that methods such as AIC and BIC are likely to perform poorly based on results of simulations conducted to date, and that many observations (left out in the data reduction/subseting step) will be available for prediction testing.

D.4 (H) Use the simulations to identify diagnostic tests aimed at indicating conditions in which the DPC method (and other methods) are likely to perform poorly.

D.5 (M) A follow-up project could be conducted to test the DPC standardization under realistic operating models in which fishing effort is correlated to the abundances of target (positive correlation) or avoidance (negative correlation) species. Avoidance species are increasingly important in multi-species fisheries limited by species-specific individual vessel quotas, and probably also in fisheries constrained by individual bag limits. Dynamics of fishing effort can be linked to biomass as well as other covariates (e.g., distance from port, vessel class, tactics) in gravity or ideal free distribution models (aggregated effort), as well as discrete choice models (individual-based effort). Modelling the dynamic response of individual fish species/populations is another key component of this modelling framework, but there now appears to be improving trend and abundance information for building these models for some species. Effort dynamics would probably capture the main effects leading to hyperstable CPUE, but other features such as gear saturation and random variation in catchability could be added to the dynamics. Multiple species could be combined into higher order groups to reduce overall complexity.

D.6 (M) Consider possible Year*FT and Year*PC interactions in the models to explore whether the estimated abundance trend differs among fishing tactics.

D. Surveys

E.1 (*) The Panel supports the suggestion that future surveys be conducted exclusively using the new gear.

E.2 (H) Consider analyses of the calibration data to explore why the CVs for the estimates of the calibration factor (the ratio of the *Africana* catchability for the new gear relative to the old gear) increase given additional data and examine whether length-specific calibration factors can be estimated if the calibration factor is related to length using a smooth functional form. Use the updated estimates from the new calibration analysis [MARAM IWS/DEC13/Hake/P1; Table 1], which now takes account of data from 2006 as well for both species in the reference set and OMP, replacing the *ad hoc* 0.8 factor used for *M. capensis* and the 2004 analysis' estimate for *M. paradoxus*. [*Advise of aspects of hake abundance survey strategy, particularly as regards inter-vessel calibration*]

E.3 (H) Conduct OMP projections to assess the consequences of conducting future surveys using industry vessels. Projections should be conducted for two cases: 1) assuming a single future survey vessel and 2) assuming that the survey vessel changes each year. The projections should also consider the benefits of conducting calibration experiments in the future. These OMP projections should be tuned to achieve the same level of risk to the resource as would occur if surveys continue to be conducted using *Africana*. The cost associated with each option should be determined as the loss in catch relative to the use of *Africana*. Projections should be undertaken for the reference case trials as well as trials in which there are trends in catchability and a non-linear relationship between CPUE and abundance. [*Advise on a strategy for developing calibration factors between industry vessels and the Africana*]

E.4 (H) The default CV for the extent of variation in catchability among vessels should be taken to be 0.2 based on an estimate for Pacific hake from an analysis of a multi-vessel survey of the US west coast (Thorson and Ward, in review). The Panel did not review Thorson and Ward (in review) in detail, but recommends that the Working Group conduct a detailed review of this paper before making final decisions. [*Advise on a strategy for developing calibration factors between industry vessels and the Africana*]

E.5 (H) The OMP projections should allow for variation in the mean difference in catchability between *Africana* and *Andromeda* which could be informed by (i) data from Rob Leslie on the performance of the net when towed by the two vessels and (ii) the results of the summer 2013 surveys by each vessel, which occurred a month apart. Account should be taken of the difference in the timing (and associated related uncertainty) between these two surveys. The results of the GLM standardization of the CPUE data (specifically the month effects and their precision) could be used to quantify the latter source of uncertainty.

E. Other matters

To Come

References

Francis, R.I.C.C. 2011. Data weighting in statistical fisheries stock assessment models. *Canadian Journal of Fisheries and Aquatic Sciences*. 68: 1124-1138.

Thorson, J.T. and E.J. Ward. In review. Accounting of vessel effects when standardizing catch rates from cooperative surveys. *Fisheries Research*. 00: 00-00.

Table 1: Estimates of catchability ratios for *Africana* new compared to old gear, with their associated standard errors in parenthesis, for the length-independent model correcting the 2006 data.

	M. paradoxus		*M. capensis*	
Brandão *et al.* (2004)	0.948	(0.117)	0.610	(0.141)
Model 1	1.176	(0.097)	0.718	(0.054)
Model 1 (excluding 2006 data)	0.938	(0.085)	0.597	(0.050)
Model 1 - corrected	0.883	(0.082)	0.652	(0.073)

Appendix 1
SA HAKE – KEY ISSUES

Basic Objectives

1) Review progress on current hake OMP revision process, and make recommendations regarding completion of Operating Models for the resource by March and the testing of Candidate OMPs to be finalised by September 2014
2) Advise of aspects of hake abundance survey strategy, particularly as regards inter-vessel calibration

Assessments/Operating Models

1) Review progress on update of 2010 assessment approach leading to a new Reference Set
2) Consider the implications of the sensitivity of the results to the addition of further longline CAL data
3) Consider whether the current approach of fitting to CAL and ALK data, rather than externally derived CAA data as previously, should be considered
4) Review progress on the development of approaches which model movement explicitly, and advise on their role in the current OMP review process
5) Advise on the selection of robustness tests

Surveys

1) Review past survey practice on the *Africana*, and advise on the implications for use of these data in assessments, and on the future use of old and new gear
2) Advise on appropriate calibration factors for *Africana* old *vs* new gear
3) Advise on a strategy for developing calibration factors between industry vessels and the *Africana*, with particular attention accorded to:
    a) the development of an informative prior, and
    b) taking account, through the OMP evaluation process, of the implications of simply setting this calibration factor to 1
4) Advise on possible approaches to take environmental co-variates into account in estimating abundance indices

OMP

1) Review current objectives, in particular:
    a) what further objectives might be added (eg related to effort stability/TAC caps)?
    b) how might these appropriately quantified?
    c) if recovery targets need reconsideration, what factors should be taken into account?
2) Review current projection approaches and handling of species split
3) Advise on appropriate forms of empirical catch control rules, including capabilities to avoid response delays
4) Advise on approaches to deal with missed surveys

Appendix 2

SARDINE TWO-STOCK MODEL – KEY ISSUES

Basic Objectives

Review the current two-stock sardine assessment model and associated projection models, and advise how these might best be further developed if necessary and taken forward to provide a basis for management advice for the directed sardine fishery

Present models

1) Briefly review evidence for multiple stocks
2) Review current two-stock assessment model
3) Review models for projecting future west/south movement
4) Review implications of resource projections under these models

Items for possible further consideration

1) Might existing measures of stock differentiation place bounds on the extent of interchange between stocks, and how might these be estimated?
2) Does a wider range of movement scenarios than at present require exploration – which would be priorities?
3) Are projections from some combinations of the current model and movement scenarios implausible, what further analyses might inform on that, and if so how should the model be adjusted to circumvent this situation. Possible issues/approaches to be considered include:
    a. the form and estimation of stock-recruitment relationships
    b. assumptions about pre-1994 movement in the assessment
    c. incomplete coverage in recruitment surveys
    d. the use of retrospective analyses
4) How should relative plausibility best be assigned to different models, and how should such relative plausibilities best be taken into account in developing management advice