REPORT OF THE MCM/NRF/INDUSTRY SA ROCK LOBSTER INTERNATIONAL STOCK ASSESSMENT WORKSHOP

University of Cape Town – Tuesday 29 November to Saturday 3 December 2005

The Workshop focussed on the South African West and South Coast Rock Lobster resources, and also included a session to discuss elephant metapopulation modelling being undertaken by Dr Rudi van Aarde and colleagues at the University of Pretoria. The Workshop was funded jointly by the Marine and Coastal Management Branch of the Department of Environment Affairs and Tourism, the National Research Foundation (through a research grant to D S Butterworth), and the local industry associations for the South African West and South Coast rock lobster fisheries.

An External Review Panel of four invited scientists participated in the Workshop. These were Tony Smith (Australia) who chaired the event, Ana Parma (Argentina), Andre Punt (USA) and Paul Starr (Canada and New Zealand). In total, some 30 scientists and industry members attended throughout the event, and about another 40 occasionally.

This report does not cover all the discussions that took place. Instead it is comprised of four primary Annexes related to key elements of these discussions, as follows:

Annex A: *Summary of Co-management Presentations*

This incorporates summaries of the presentations made by each of the four Panellists concerning co-management arrangements in fisheries with which they are familiar.

Annex B: *Comments and Recommendations from the External Review Panel*

This comprises the views of the Panel on a series of questions related to the rock lobster resource which were pre-posed by scientists from MCM, MARAM, UCT and OLRAC (for industry). The first draft of the Panel's responses was discussed by the Workshop, after which the Panel finalised their commentary taking account of those discussions. The views expressed in this Annex nevertheless remain those of the Panel, and do not necessarily all reflect the agreed conclusions of all Workshop participants.

Annex C: *Agreed Workshop Recommendations*

This contains a prioritised list of recommendations (and agreements) for further research related to improved assessment and management of the West and South Coast rock lobster resources. The list was formally agreed and adopted by the Workshop's full-time participants (including the Panel).

Annex D: *Tasks to be Conducted to Update the Assessment of the South Coast Rock Lobster*

This contains an elaboration developed during the Workshop of some of the recommendations of Annex C related to improving the assessment of South Coast rock lobster resource.

The Report concludes with three further Annexes:

Annex E: *The Annotated Agenda and Programme for the Workshop*

Annex F: *The List of Workshop Documents*

Annex G: *A List of both Full-Time and Occasional Workshop Attendees*

Electronic copies of the documents listed in Annex F may be obtained from:

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It is planned to have all these documents available on the following website from about mid-January 2006:

http://www.mth.uct.ac.za/maram/workshops

Annex A : Summary of Co-management Presentations

A.1 New Zealand (Paul Starr)

The NZ rock lobster commercial fishery has been managed under an ITQ system since 1990 and the recreational fishery is managed using a daily bag limit. Maori commercial interests have been subsumed into the commercial fishery and, while Maori customary rights are not limited, catches are relatively minor. There is an appreciable illegal component of catch in many areas. There are nine fishing zones managed as separate units, with TACs set for the commercial fishery and "allowances" set for the non-commercial fisheries (including illegal catch). The National Rock Lobster Management Group (NRLMG) has been the effective manager of this fishery since its establishment in 1992, and consists of representation at the national level of all the major stakeholders in this fishery, including government, commercial, recreational, Maori and NGOs with an independent chair. The NRLMG proposes to the Minister of Fisheries TAC changes and other management measures based on scientific advice which it obtains under a research contract let by the Ministry of Fisheries.

Fisheries science in NZ has been provided under a "contestable" model since 1995. The major science provider is NIWA, which is the previous science component of the Ministry of Fisheries, and is kept at arms length from the government. Research in support of the Minister of Fisheries' statutory obligations is put out for tender and the rock lobster stock assessment research contract has been held since 1997 by the Rock Lobster Industry Council (RLIC), the national commercial fisheries stakeholder organisation. RLIC subcontracts the analytical work to NIWA and external consultants. The rock lobster industry directly provides some of the tagging and the fish size sampling logbooks while NIWA is subcontracted to undertake tagging and on-board vessel monitoring.

Simple "decision rules" based on CPUE are used in two "super-zones" as triggers to instigate a stock assessment and consequent management attention. These rules have never been triggered. An evaluated rebuilding management procedure (MP) which triggers mandatory TAC changes was put into place by the NRLMG for the NSS "super-zone" in 1997 and resulted in two successive 20% TAC reductions in 1999 and 2001. This rule was completely re-evaluated in 2002, including setting a new rebuilding target based on historical CPUE levels. This rule led to a 6% TAC increase in 2004 and has recommended a 22% increase for 2006. This area has almost reached its rebuilding target nearly a decade ahead of schedule.

The information supporting NZ stock assessments include CPUE (analysed using a simple GLM model), representative length sampling from commercial vessels to obtain the size, sex and maturity structure of fish entering the pots, and tagging for growth rates. The size and sex distribution sampling is conducted in some zones by fishermen through a logbook programme, where the fishermen measure and sex every lobster in four designated pots each time these traps are pulled. Conventional observer sampling is used in the remainder of the zones to obtain the same type of information. All research projects are reviewed through the NRLMG. The commercial industry pays all research

and compliance costs proportional to its share of the total TAC, while the government pays the balance of the costs proportional to the "allowances" set for the other sectors. Attendance at NRLMG and at regional meetings is self-funded by each sector.

A.2 Australia (Tony Smith)

Rock lobsters in Australia are managed under State jurisdictions, which means that there is a variety of models for management of these resources. The main fisheries are for the western rock lobster, managed by Western Australia, and for southern rock lobster, managed by South Australia, Victoria, Tasmania and New South Wales. In some cases there are different management approaches within jurisdictions – for example until recently the southern zone in South Australia was managed using output controls (ITQs), while the northern zone was managed using input controls. All management units for southern rock lobster are now managed using output controls, but the western rock lobster fishery (Australia's most valuable single fishery with annual catches between 10,000 and 14,000t) remains under input controls.

Despite the variety of jurisdictions, all rock lobster fisheries adopt a strong co-management approach, consistent with the general approach across all Australian fisheries. Co-management occurs at a range of levels in the management process, from involvement of fishers (and usually other stakeholders) in stock assessment groups, through active involvement in various forms of management advisory committees (including research prioritization), to involvement in peak body councils and co-management councils with broad advisory powers across a range of fisheries. Rock lobster fisheries are generally the most valuable fisheries within each of the State jurisdictions, so these assessment and advisory structures are taken seriously and have considerable influence in the management process.

While co-management is strong at the assessment and management advisory levels, in most instances this has not translated into active engagement of commercial fishers in monitoring and research (except to advise on priorities). Having said that, there is widespread use of industry vessels as platforms for research, and several fisheries operate successful voluntary logbook programmes, where fishers report on more than the basic catch and effort data required by legislation. Some of these programmes have persisted for considerable periods of time, while others have been established and vigorously pursued for several years, but have subsequently been discontinued. In nearly all of the State based rock lobster fisheries in Australia, government research laboratories provide the vast majority of research, active scientific monitoring, and quantitative stock assessment skills. Independent (of government) scientific consultants are employed in some fisheries, but again, this is the exception rather than the rule. The direct involvement of fishers in research and monitoring in rock lobster fisheries is generally less than for other fisheries in Australia, perhaps reflecting the mostly healthy state of stocks and economic performance of these fisheries.

A.3 Chile (Ana Parma)

Starting in 1997, Chile introduced the use of territorial use right for fishing (TURFs) for the co-management of shellfisheries. Organizations of artisanal fishers are given exclusive rights to exploit the benthic resources within requested territories, provided

they complete a base-line ecological study and present a management plan for government approval. Implementation of TURFs followed the failure of a quota-based system, which proved unenforceable given the small scale of the operations. About 400 TURFs have been granted involving a variety of benthic species, most significantly the "loco" (*Concholepas concholepas),* a snail that supports a very lucrative export market. This is the largest contemporary attempt to introduce a TURF system where it was not established by tradition.

Critical to the success of the TURFs system has been the involvement of fishers in data collection, protection of their fishing rights and enforcement of self-imposed internal rules. The government is responsible for enforcement of quotas and compiling of landing statistics, and the Institute for Fisheries Development, a semi-governmental agency, has a contract to sample the landings. The fishers' organizations are required to conduct annual surveys of the grounds within their TURFs under the coordination of a certified consultant. Surveys are largely subsidized through different types of government funds, which are granted to the fishers' organizations. Local management plans, developed by the fishers and their consultant, mostly involve catch quotas determined at some fraction of the abundance estimates. Access to fishing rights and allocation of quotas within the TURFs are the exclusive prerogative of the fishers' organizations.

Most applied research in fisheries is funded through a fund partially raised from fishing license fees. Terms of reference for research projects are developed with input from the Regional Fisheries Councils, and interested parties bid for the research work. Fishers' organizations are represented in the Regional Fisheries Councils, together with other stakeholders.

The performance of the TURF system is just beginning to be evaluated and wide contrasts in results are apparent, from TURFs that turned into very successful, profitable enterprises to others that never succeeded in promoting sustainable practices. Information about the loco fishery from one of the central regions indicates that abundance within TURFs increased rapidly after their establishment and has now stabilized, together with the legal catch. Perceptions about the biological sustainability of TURFs are generally positive. Fishers' organizations have self-imposed strict regulations and severe penalties to transgressors, and make a significant investment in the vigilance of their TURFs. Background areas outside TURFs, which are nominally closed, continue to be overfished. Success of TURFs appears to be favoured by:

- Strong leadership and organization at the fishing community.
- High productivity of the area and rapid response of the resources to conservation measures.
- The existence of a natural unit composed by the "caleta", the small landing site where the fleet is based, and its adjacent historical fishing grounds.

A.4 U.S. West Coast (Andre Punt)

Most of the data used in stock assessments are collected by the government (State and Federal), although there are few exceptions where data collected by academics have been used. Industry are therefore involved in the data collection primarily through co-operative research (e.g. surveys conducted using industry vessels rather than dedicated research

vessels) and some funds are earmarked by the U.S. Federal government specifically for co-operative research. Funding for research related to West Coast resources comes from a very wide range of sources (Federal and State government agencies, and private foundations), each of which has its own research planning strategy. However, the public (including industry and conservation groups) has a role in providing advice regarding research priorities, at least for the government agencies. There is, however, no requirement to follow that advice. The government is somewhat limited in terms of what functions it can outsource. Nevertheless, the Federal government outsources (admittedly to the States) activities related to monitoring, observer services, ageing, etc., and the States have also outsourced assessments.

There is a separation between conducting assessments and providing management advice. Scientists (generally State and Federal scientists) conduct assessments and produce draft assessment reports. These are then reviewed by a STAR (Stock Assessment Review) Panel which consists of representatives of the Pacific Fishery Management Council (PFMC), the body established under the Magnusson-Stevens Act to make recommendations related to management decisions, local scientists and independent experts. The results of the STAR Panel are provided to the PFMC Scientific and Statistical Committee who make a final recommendation whether the assessment can be used as the basis for management. Assessment scientists do not make management recommendations. Rather, these are developed by a group consisting of State and Federal scientists, and are subject to comment from the public. The Council has a committee that consists primarily of users for each Fishery Management Plan; in the context of the groundfishery, the Groundfish Advisory Panel. This group is appointed by government and provides comment on research, assessment and management decisions.

Annex B : Comments and Recommendations from the External Review Panel

A series of specific questions was posed to the Panel prior to the meeting. The comments from the Panel in this part of the report are structured around a slightly modified set of the original questions.

Both South and West Coast rock lobster

1) *Are the differences in the stock assessment and management approaches for the West and South Coast rock lobster resources consistent with their differing biology and the associated differences in the nature of the fishery?*
   Size-structured models are the preferred approach for rock lobster assessments in most parts of the world, though there are considerable differences in details of these models that take account of particularities of biology, data, and management. The Panel recommends to the south coast assessment move to a size-structured approach, not necessarily identical to that used on the west coast, recognizing that this will take some time to accomplish (see Annex D).

2) *In what proportion of the rock lobster stocks in Australia, the US, South America and New Zealand is a formally specified OMP (as defined in South Africa) the final determinant of the annual TAC or other annual control measure?*
   The Panel first notes a distinction between three applications of the OMP approach. In some circumstances, simulation testing leads to formally specified OMPs being adopted (the approach widely used in South Africa). In other circumstances, formal harvest strategy rules are adopted, but these have not necessarily been tested using the simulation methods used to test OMPs (an approach widely used in the US). A third approach is to use OMP-like methods to simulation test management strategies (not necessarily restricted to TAC setting), and to use the results to inform management without the full adoption of a formally specified OMP (the so-called "management strategy evaluation" approach widely used in Australia and elsewhere). The Panel response to this question focuses only on the first of these categories.

   The *TAC*s for one of the New Zealand rock lobster fisheries (two stocks in the NSS region) are based on a decision rule that has been simulation-tested. A decision rule for the NSS region was developed in 1997, and re-evaluated (and revised) in 2002. OMPs are currently being evaluated for rock lobster off Victoria, but these are unlikely to be adopted formally, at least in the short term. Similarly, OMPs are currently being evaluated for other New Zealand rock lobster fisheries.

3) *What are the preconditions with respect to the scientific knowledge about a resource which would warrant the introduction of OMP type management? For example, are these more or less appropriate in circumstances of a poverty or a surfeit of knowledge about the resource?*
   The OMP approach can be appropriate across a wide range of circumstances of scientific knowledge about a resource and a fishery. The important precondition is an understanding of the major uncertainties, particularly about resource size and productivity, and the identification of a range of plausible hypotheses that span those

uncertainties. An important consideration in introducing an OMP is the time and resources required to complete the analyses and to provide for effective involvement of stakeholders. The time taken will depend to some extent on the state of development of the assessment, but typically would be about two years. This time consideration has a bearing on the Panel's advice about development of an OMP for South Coast rock lobster (see introductory paragraph to questions on South Coast rock lobster below).

4) *What benefits can the industry expect from OMP management of the resource? Are there any potentially detrimental effects of introducing OMPs into resource management and what are they?*
The Panel considers that there are several benefits to OMP management to industry compared to traditional management. Specifically, the OMP testing approach: a) allows the trade-offs among catches, risk, and variation in catches for different management schemes to be evaluated, b) allows the implications of different types of constraints on year-to-year variation in catch limits to be determined, and c) should prevent over-reaction to short-term fluctuations in the data on which scientific management advice is based. These, and other benefits, also pertain to other stakeholders. The quality of the OMP itself can be detrimental if it is not constructed appropriately and/or tested adequately. An inappropriately designed and tested OMP may lead to management recommendations that are poorer than would be expected to occur under more traditional management methods. Following concerns raised by industry about the lack of flexibility in an OMP approach, the Panel notes that some aspects of flexibility can be incorporated into both the process (e.g. rules for review) and into the management procedures themselves (see also WCRL question 1 below).

West Coast rock lobster

1) *A new OMP is scheduled for implementation during the second half of 2006. Should this be on an area-aggregated or area-disaggregated (assessment and management) basis?*
The Panel recommends using a spatially-disaggregated operating model for evaluating candidate OMPs for the west coast fishery. This approach is appropriate where there are clear spatial differences in the dynamics of a resource, which are evident for the West Coast fishery. Both spatially-aggregated and -disaggregated OMPs should be tested. Within the context of a spatially-disaggregated OMP, it may be possible to assess the overall status of the resource, use this assessment to determine a global TAC, and then use an appropriate and agreed method to allocate the TAC both spatially and between sectors (gear types).

   For the West Coast fishery, a source of uncertainty is the possible eastward movement of rock lobster resulting in a potentially substantial distributional shift (with implications for resource access). Response to further evidence of such a distributional shift could be made part of the formal review process for the OMP.

2) *Past OMP testing was based on a reference set of operating models spanning the three seemingly major uncertainty axes: historic recruitment (2 scenarios, RC1 and RC2); future somatic growth trends (3 scenarios); and future recruitment (3 scenarios), with weightings chosen across each set of scenarios. What adjustments, if any, are needed to this choice of axes, scenarios and weightings for testing the new OMP?*

The Panel notes that RC2 leads to selectivity patterns that appear unrealistic (sharply declining selectivity with increasing length). The assumption within a spatially-disaggregated framework that all recruitment is local seems unrealistic given what is known about the recruitment dynamics of rock lobsters. Implementing a model that is spatially-disaggregated and forces a global stock-recruitment relationship will, in any case, be computationally infeasible. The Panel recommends that: a) RC2 becomes one of the sensitivity tests, and b) two scenarios based on RC1 be investigated in which the current spawning biomass is constrained to be higher and lower than the best estimate. Examining scenarios in which current spawning biomass is larger and smaller than the best estimate captures a key source of uncertainty, namely that associated with current (absolute) population size. If a likelihood profile for current spawning biomass can be constructed, the lower and upper 12.5%iles can be selected for the larger and smaller current spawning biomasses. The weight given to these scenarios would be 0.25 while the weight assigned to the best estimate would be 0.5.

The Panel notes that there is no evidence for an increase in somatic growth in recent years. The weight assigned to the hypothesis that somatic growth will increase to average levels over the next 3 years should be lower than 0.15.

3) *A new OMP algorithm will again likely be based upon CPUE, FIMS and somatic growth input data. What relative weights should be accorded to the first two data types, and how responsive should the OMP be to changes in the third?*

There are three aspects of data weighting relevant to OMP development. The first is the weight given to different data sets in developing the operating model. The second is the weight given to data in the assessment model used within the OMP. The third is the weight given to different data sets used in the decision rule itself. The Panel response below is concerned with the third of these aspects.

The weights assigned to the different data types used within the OMP could, in principle, be examined using the OMP testing framework. The results of this evaluation should reflect the levels of process and measurement errors assumed in the operating model. In practice, the variances used to simulate future data are commonly set to the empirical estimates of variances obtained by fitting the model to the historical data. Therefore, as a first approach, the weights assigned to the different data types in the OMP could be based on these variances. Changes to these initial weights should be tested because the different sources of process and measurement error interact (e.g. the variation assumed to model future selectivities and catchabilities both affect the variation of CPUE) and to avoid overreacting to short-term fluctuations in the dynamics (e.g. short-term fluctuations in growth rate).

4) *How fine a spatial grid is needed for data collection for a likely and meaningful improvement in CPUE standardisation, to provide an unbiased index of abundance?*
The annual spatial distribution of the CPUE data should be plotted to search for patterns of recurring density aggregations, similar to the VMS/CPUE spatial analysis near Cape Point presented to the Workshop. It is likely that such spatial analyses would suggest ways to aggregate the data and may also suggest potential sources of area*year interactions. The Panel considers that it would be easy to use too fine a level of spatial disaggregation in the CPUE analyses and that it is better to look for areas of natural concentration in the data. However, this is easier to achieve if the data are collected at a finer scale than the scale of the aggregations (areas of high density of CPUE).

5) *Should resource modelling commence in 1870 or ±1975 (in the latter case then taking no cognisance of earlier catch levels)?*
The Panel recognises that there are valid reasons for including the large catches that occurred in this fishery prior to 1970 in the model. However, this approach leads to considerable uncertainty when moving to spatially disaggregated models because of the lack of reliable information to allocate the total catch spatially. The Panel also notes that the estimates of B_0 are unreliable because they are conditioned on assumptions rather than on data when projecting backwards for such a long period. Therefore target recovery levels should not be based directly on the estimates of B_0.

The Panel recommends that, for models using the historical catch series, the start year should be at least 1910 (when the catches began in earnest). Sensitivity to the first year in the assessment should be examined, taking account of when length-frequency data are available.

The Panel does not think it appropriate for it to make recommendations on target levels for possible recovery, as these are policy issues for management. However, notwithstanding its concerns about reference points related to B_0, the Panel agrees that assessments should take account of historical catch levels and apparent changes in resource abundance across areas in forming judgements about appropriate targets.

6) *In spatially disaggregated models, should super-area A3-6 be further subdivided into A3-4 and A5-6?*
There are a number of considerations that should be taken into account when deciding whether to split super-area A3-6 further when conducting a spatially-disaggregated assessment. These considerations include: a) can an assessment be conducted for areas A3-4 and A5-6 separately (i.e. is the split technically possible), b) are there differences in patterns of historical removals in those areas, c) are there differences in trends in the data (catch-rate trends, size-compositions, and growth rates), and d) are there differences in other biological parameters (such as the size-at-maturity)? The information provided to the Workshop suggests that it is possible to conduct assessments for areas A3-4 and A5-6 separately. The Workshop did not review all of the data for areas A3-4 and A5-6 in sufficient detail to draw a definitive decision regarding whether these areas should be assessed separately; this should be accomplished by a group of local scientists.

7) *Given the present degree of variability in FIMS indices, is this a useful management tool in its present form? Would a more intensive FIMS, carried out throughout the year lead to substantially improved information for resource management?*
The offshore FIMS appears to be an informative series that can be used in the West Coast rock lobster stock assessment in its present form. However, it clearly has some stratification issues both in time and in space which should be addressed. It is also possible that the continuity of the existing series might be compromised by addressing these issues. Therefore, the Panel suggests that changes to the offshore FIMS programme be initiated cautiously and that there should be a period of overlap which would allow for calibration.

The Panel believes that it is unlikely that it will be possible to use the inshore FIMS survey quantitatively in the stock assessment in its current form. This is because the inshore FIMS uses a different fishing method and does not cover the full distribution of the population, making it difficult to link the offshore and inshore FIMS. It is more likely that increasing the station density of the existing offshore FIMS in the shallow inshore waters is a better option for addressing the bias that might be occurring because of the methodological restrictions of the offshore FIMS. For instance, it may be possible to use vessels with shallow draft to distribute traps into these strata. The Panel notes that the design of the existing offshore FIMS included these inshore shallow strata and that sampling these areas with the existing trap methodology is, in principle, a better way to address this issue. In redesigning the offshore FIMS, consideration should be given to detecting the possible eastward shift of rock lobster.

The Panel suggests that the areas used when calculating the FIMS indices include the available rock lobster habitat in the existing MPAs, even if they are not actively surveyed. Other non-surveyed rock lobster habitat (possibly in the northern part of Area 3) should be added to the area scalars used in the analysis of the survey data.

Document RLWS/DEC05/DAT/6/1/2/2 provided insight on how the design could be modified to improve the survey CVs without adding appreciably to the cost. The Panel recommends that this line of enquiry be continued so that the design of this survey can be rationalized and improved.

8) *Should one make provision for a degree of tagging induced growth rate retardation, and should the adjustment be differentiated post-1990 versus pre-1990?*
Experimental results presented to the Workshop indicate that tagging conducted during the pre-moult period may retard growth rate. Furthermore, any effect of tagging on growth rate is expected to change over time because the fraction of lobsters tagged during the pre-moult period appears to have increased since 1990. Factors related to the time of tagging (week, month or period) should be added to existing models of somatic growth to determine their impact on growth rates based on *in situ* information. The effect of the period of tagging will be confounded to some extent with the likelihood that lobsters have moulted because of the uncertainty about the time at moulting. It is likely to be necessary to design experiments to disentangle these effects. This issue is being addressed through a current project, but details of the project were not reviewed during the Workshop.

9) *To what degree can a decline in CPUE over the past three years be ascribed to (a) a general shift by the industry away from striving to achieve maximum CPUE levels, to striving to maximize the quality of the landed product, (b) lobsters being caught later in the annual cycle, (c) the easterly shift of lobsters from traditional fishing grounds, (d) declines in resource abundance, and (e) environmental changes affecting catchability?*

   In principle, the Panel suggests that options (a), (b), (c), and (d) should be amenable to analysis using GLM and GLMM methods, given the passive nature of trap fishing for lobster. The implementation of this will depend on the quality of the data, particularly the level of fine-scale area reporting. If the data are available only at a coarse area level, then hypotheses (a) and (c) will be difficult to differentiate from other plausible hypotheses. Hypothesis (b) should be relatively easy to examine using present methodology while hypothesis (e) is not likely to be amenable to analysis without the collection of additional data.

South Coast rock lobster

In reviewing the assessment for South Coast rock lobster, the Panel identified several longer term improvements that should be considered (Annex D). The Panel also notes that these improvements would take considerable time to bring into effect, and that it would not be realistic, given current resources, to implement an OMP for the 2006/07 season. A more reasonable time for OMP development is two years, provided unforeseen difficulties do not arise. This leaves open the question of an appropriate basis for determining advice on TACs during 2006. The Panel agrees that this advice could be provided based on a simple update (using new season data) of the existing South Coast rock lobster model. How the updated assessment is used to provide management advice is a matter for the local management process to decide. The Panel suggests that a simple approach would be to use the same basis for recommending a TAC as was used last time, provided that the new assessment does not indicate a substantial change in the conclusions from the previous assessment. Whatever process is used to provide advice, the Panel urges that the updating of the assessment should not delay starting to implement the improvements in the assessment outlined in Annex D.

1) *Has the stage yet been reached where OMP development can readily proceed (i.e. in particular have alternative hypotheses to explain past data been sufficiently developed in modelling to date)?*

   The Panel recommends that the development of an OMP for South Coast rock lobster awaits the development of the revised assessment outlined in Annex D.

2) *How best should annual changes in selectivity be modelled, including whether on an age- or a length-specific basis?*

   The selectivity pattern should be length-based. Annex D provides additional information on the model that should be applied to the South Coast rock lobster resource.

3) *What is the priority for improvement of provision of the catch-at-length/age information currently used in assessments?*
The Panel notes that the catch at length data are not fully utilised in the current assessment. Specifically, these data can be further disaggregated by sex and possibly stage of maturity. The value of the existing data should be examined more fully before a decision is made regarding changing the scheme used to collect catch-at-length data. The Panel recommends that future assessments should fit to the catch-at-length data.

4) *To what extent should catch-at-length/age data be down-weighted to allow for positive co-variance in population model fitting?*
The Panel recommends that the data included in the assessment be length- rather than age-frequencies (see Annex D).

With regard to down-weighting of data, it is not desirable to deliberately down-weight data just because they are in conflict. The need to down-weight the catch-at-length data should be re-considered once the initial modelling work outlined in Annex D is complete. Note that it may be necessary to select the width of the length-classes used to summarize the length-frequency data to ensure that the data points are essentially uncorrelated.

5) *How fine a spatial grid is needed for data collection for a likely and meaningful improvement in CPUE standardisation to provide an unbiased index of abundance, and how might observer-based CPUE data best be incorporated into this standardisation and/or assessments?*
Annual plots of the existing spatial distribution of CPUE should be examined to detect recurring patterns of aggregation which could be used to determine an appropriate level of spatial aggregation in the CPUE models. See also question 4 for West Coast rock lobster.

Observer-based CPUE data could be used in a number of ways: a) as a separate series to use as a comparison with the equivalent trends obtained from the commercial CPUE data; and b) as an audit tool for the vessels with observers by comparing the fisher-generated logs with the observer logs. Experience has shown that the latter comparisons are often difficult because of the lack of adequate linking between the two data sets.

6) *What weight (if any) should be given to the effort saturation hypothesis in future modelling?*
The paper on the effect of gear saturation (RLWS/DEC05/DAT/6/2/1/3) indicated that this effect was difficult to detect experimentally. The Panel notes that the assessment run which attempted to model this effect showed that this hypothesis has a considerable impact on the results, given the existing age-structured model and its assumptions. The Panel suggests that this issue be reconsidered once a new length-based model for this stock is developed (see Annex D).

7) *Could industry data on catch-at-size from an appropriate area with greater prevalence of small lobsters be used to provide an index of recruitment?*
Such a programme would be expensive to implement and would in effect be another FIMS. MCM and the industry need to weigh the expense of adding another fishery-independent index with other options which could be used to obtain reliable and consistent size data from this fishery. For instance, an extension of the existing observer programme may be a more cost effective way to collect length data from this fishery without the need for an additional survey. These data already provide potential information about recruitment when incorporated in the assessment model.

8) *Would a Fisheries Independent Survey (FIS) lead to substantially improved information about the resource? Are initiatives to collect more detailed logbook information worth pursuing?*
These questions are difficult to answer without resorting to simulation modeling based on an operating model which adequately reflects the stock and the fishery, preferably in the context of an OMP framework. Such an operating model is clearly lacking at present. It is likely that the answer to both of these questions is "yes", but they should be tested in a simulation framework, particularly the introduction of a new FIS. On the other hand, it is very likely that better length sampling coverage of this fishery will be beneficial and could be implemented immediately, as would be finer scale reporting of the catch.

Annex C : Agreed Workshop Recommendations[1]

The following represent the agreed recommendations arising from the discussions held during the Workshop. Each recommendation was ranked High, Medium or Low by the Workshop participants based on the importance of the recommendation in terms of its likely impact on management decisions, and its feasibility. Some research tasks were assigned low priority if they are straightforward even if they are important. The Workshop did not rank research recommendations within the H, M and L categories. Items are annotated by an asterisk if they are required to initiate the OMP testing process for West Coast rock lobster.

The Workshop noted that a considerable amount of work is involved in conducting the spatially-disaggregated assessments needed to form the basis for testing of OMPs for West Coast rock lobster and in implementing and fitting the length-structured model advocated for South Coast rock lobster. The priority assigned to work on West Coast rock lobster compared to South Coast rock lobster needs to be made by the relevant authorities based on management needs. The Workshop noted, however, that given existing resources, it is almost impossible to conduct both of these tasks in less than a year.

A. West and South Coast rock lobster

A.1 (H). **Add an ecosystem section to the annual report to MCM management giving scientific advice of measures such as TACs.**

Although information on ecosystem impacts is not currently used directly in OMPs in South Africa, such information is increasingly becoming a focus for fisheries management and should be included in the document on management advice.

A.2 (H*). **The basis for developing standardized catch-rate indices should be revisited starting with model selection. During this exercise, it is necessary to: a) compare the standardized and nominal catch-rate series and determine which factors cause the standardized catch-rate indices to differ from the nominal catch-rate series, and b) examine all of the standard regression diagnostics (e.g. standardized residuals versus predicted values; q-q plots; residual trends with time).**

The models and methods used for catch-rate standardization were selected by the MCM Rock Lobster Working Group several years ago and it is now appropriate to revisit these given new information and techniques. Consideration should be given to treating the logarithm of catch as the dependent variable if measures of effort are to be included in the catch-effort standardization. In addition, the number of years that each vessel has used GPS and plotter should be considered as a factor if the relevant data are available.

[1] This Annex includes both recommendations and Workshop agreements.

A.3 (H). **Convene a meeting to discuss the best way to expand the data recorded in logbooks.**
It is possible, in principle at least, to explore the relative probabilities of alternative explanations for changes in standardized catch-rate over time by analyzing data reported at a fine spatial scale. In addition, collection of further data, e.g. on fishing location, could be used to refine the indices of relative abundance. Possible additions to the existing information in logbooks that merit incorporation include: location (at a level sufficient to determine depth), soak time, and the catch in numbers (in addition to that in mass).

A.4 (H). **Examine the sensitivity of the results of the assessment to choice of width of each length-class.**
The speed with which calculations can be conducted, and hence the number of scenarios that can be examined, depends in part on the width of each length-class. The sensitivity of the results to these widths should be examined to determine whether it is possible to assume wider length-classes than is currently the case.

B. West Coast rock lobster

B.1 (H). **Convene a meeting to review the FIMS programme and provide recommendations for how it could be refined**.
The Workshop agreed that there is value in having a reliable cost-effective fishery-independent index of abundance, particularly when the nature of the fishery is changing due to changes in the make-up and fishing practices of the industry. There is, however, a need to review and refine the FIMS programme at regular intervals, and a workshop consisting of local scientists is the most appropriate way to achieve this. Such a workshop should consider the benefits of spreading the sampling temporally and moving the sampling to months during which catch-rates vary the least, in terms of the implications of this for the precision of the index of abundance and other quantities provided by FIMS (e.g. the size-composition information). Care should be taken to capture the impact (if any) of between-month correlations in catch-rates. That workshop should also consider how the results for the inshore FIMS could be used quantitatively rather than only qualitatively, and whether the ability to calibrate the inshore to the offshore FIMS would be enhanced by changing how the inshore FIMS is conducted (e.g. by using some traps). The Workshop endorsed the practice of not visiting stations that consistently have zero catches as long as the area of the stratum in which the station is found is reduced appropriately.

B.2 (H*). **It is necessary to check whether the results of a GLM that analyses the catch and effort data for all methods and areas simultaneously differ from those in which each method by area data set is analyzed separately.**
The standardized catch-rate series (by area) all have a peak in 2001/02, but this peak is not evident in all the nominal catch-rates. This may be due to the use of a GLM model that has factors that are common across areas and methods.

B.3 (H*). **Modify the areas used when calculating standardized catch-rate indices and the FIMS indices of abundance so that these include all of the area within the relevant strata.**
The areas currently used when calculating area-aggregated catch-rate series, and the FIMS index of abundance, exclude areas in MPAs and that north of the Olifants River. However, the biomass in the assessment pertains to entire resource so that these areas need to be taken into account. The Workshop noted that this implies the assumption that the average density in unsampled areas equals that in sampled areas.

B.4 (H). **Convene a meeting of local experts to discuss the logistical considerations (including issues related to education, type of traps, etc.) related to implementing an at-sea programme to collect length-frequency information.**
This is an additional data source that would enhance the assessment of West Coast rock lobster. It is possible that an at-sea sampling programme could replace the currently shored-based sampling programme.

B.5 (H*). **It is important to try to resolve problems related to the minimization behaviour of the assessment model**.
The simplex method currently used when fitting population dynamics models to West Coast rock lobster struggles to identify the global minimum of the negative log-likelihood function automatically. This leads to difficulties when quantifying uncertainty and concern that the parameter vectors used when evaluating OMPs may not be the best estimates. Several other minimization methods exist (Marquard's method, Powell's method, Fletcher's method, and alternative versions of the simplex method). Use of these alternative methods as well as alternative parameterizations should be examined to determine whether improved performance is possible. In addition, the possibility of there being multiple minima of the objective function should be investigated.

B.6 (H*). **The decision whether to split super-area A3-6 into two areas should be based on an examination of trends in catch-rates, and an investigation into whether there are differences in catch size-composition, growth and biological parameters.**
The papers presented to the Workshop indicate that it is possible to conduct separate stock assessments for areas A3-4 and A5-6. However, there needs to be an objective basis to decide whether or not to split super-area A3-6 because doing so is likely to lead to greater imprecision.

B.7 (H*). **The operating model to be used when evaluating OMPs should be based on spatially-disaggregated assessments rather than a spatially-aggregated assessment.**
A spatially-disaggregated operating model is preferred as the basis for evaluating candidate OMPs primarily because in cases for which there are biological differences (growth, size-at-maturity, trends in catches and catch-rates, etc.) spatially, as appears to be the case for West Coast rock lobster, the default approach to assessment should always be to try to capture this. Furthermore, the only way to determine the implications of using spatially-aggregated OMPs when there are spatial differences in, for example, biological parameters is to have a spatially-disaggregated operating model. The Workshop noted that the OMPs for West Coast rock lobster may not necessarily involve conducting

assessments at fine spatial scales, but rather involve using a spatially-aggregated assessment to determine overall resource status and some other approach (such as dividing this TAC in proportion to the estimated abundance by area) to assign catch limits spatially.

B.8 (H*). **Attempt to simplify the population dynamics model.**
The assessment model fits currently take a long time to converge, which makes it difficult to conduct many analyses quickly. While in the longer term the ideal is to improve the coding of the model in ADMB, substantial reductions in run times can be achieved by: a) increasing the length-class width from 1mm to 2mm, b) increasing the lowest and decreasing the highest lengths included in the model, c) increasing the first year in the model from 1870 to 1910, and d) increasing programming efficiency for multiplying of sparse matrices. It is necessary to specify how the catches between 1870 and 1910 are to be treated (e.g. all allocated to 1910) if the first year in the model is increased to 1910.

B.9 (H*). **RC2 should become one of the sensitivity tests and two scenarios based on RC1 in which the current spawning biomass should be constrained to be higher and lower than the best estimate should be examined**.
RC2 leads to selectivity patterns that appear unrealistic (sharply declining selectivity with increasing length). Implementing a model that is spatially-disaggregated and forces a global stock-recruitment relationship will, in any case, be computationally infeasible. Examining scenarios in which current spawning biomass is larger and smaller than the best estimate captures a key source of uncertainty, namely that associated with current (absolute) population size. If a likelihood profile for current spawning biomass can be constructed, the lower and upper 12.5%iles can be selected for the larger and smaller current spawning biomasses. The weight given to these scenarios would be 0.25 while the weight assigned to the best estimate would be 0.5. The Workshop noted that there is no evidence for an increase in somatic growth in recent years. The weight assigned to the hypothesis that somatic growth will increase to average levels over the next 3 years should lower than 0.15.

B.10 (H). **The scenarios on which OMPs for West Coast rock lobster are based should include some in which the model is configured to mimic the recent downward trend (last four years) in catch rate.**
The area-aggregated assessment model does not mimic the recent downward trend in catch rates very well. While this recent trend may simply reflect the effects of correlated environmental factors, it is nevertheless important to confirm that any OMP is robust to this trend reflecting an actual downward change in abundance. One possible way to mimic the trend in catch-rates is to estimate additional recruitment parameters. The Workshop noted that the poor fits to the recent catch-rate data may be the result of spatial aggregation of data (the fits to recent catch-rates are better when the data are disaggregated spatially) and the declining trends in catch-rate for some of the areas may be a reflection of problems with the GLM-based catch-rate series and not a real effect (see also recommendation B.2).

B.11 (H*). **Target abundance levels used for candidate OMPs should not be based on reference points linked directly to the population size in 1870.**
There is considerable uncertainty regarding the recruitments prior to the 1970s. As a result, the 1870 population size is not estimated with sufficient reliability to the form the basis for choice of a target abundance level.

B.12 (H*). **Take the nature of the spatial distribution of the rights holders into account.**
The OMP needs to be allocate catch limits spatially and the operating model needs to divide catch limits by area into catch limits by area and gear type.

B.13 (M). **Factors based on the impact of week (or month) of tagging should be added to existing models of somatic growth to determine the impact of this factor based on *in situ* information.**
Analyses were presented to the Workshop related to the possible impact of tagging on moult increment, but they were insufficient to enable final conclusions to be drawn regarding the impact *in situ* of tagging on growth rates.

B.14 (M*). **The assessment should examine the sensitivity of the results to alternative assumptions regarding the magnitude and spatial split of the historical catches.**
If the assessment is to be spatially-structured, it is necessary to disaggregate the historical catches spatially. The analyses presented to the Workshop were based on the assumption that the historical catches in each area are a constant (over time) proportion of the total catch. However, there is considerable uncertainty regarding both the magnitude and spatial distribution of the historical catches, and it is clear that the pattern of catches today is very different from that in the past.

B.15 (M). **The sensitivity of the results of assessments to ignoring the data on somatic growth for the years for which the data set is small should be examined.**
The tag-recapture sample sizes for some years are small (particularly when the data set is pruned to capture a 'moult window'), which results in estimates of somatic growth for those years that are very imprecise. However, the assessment model currently ignores the precision of the estimates of somatic growth. In the longer term, consideration should be given to integrating the analysis of the growth data within the assessment model, as is suggested for South Coast rock lobster (see Annex D).

B.16 (M). **Consider the use of an Empirical Bayes approach to estimating the values for the hyper-parameters when analyzing changes over time in somatic growth. Alternatively, examine whether the random effects variant of ADMB (e.g. Trenkel and Skaug, 2005: ICES J. Mar. Sci. 62:1543-1555) which is based on the Laplace approximation can be used to estimate the variance of the random effects.**
The moult probability model used to analyse the tag-recapture data includes random effects. However, estimating the variance of the random effects can be difficult, especially when a Bayesian estimation approach is used.

B.17 (M). **Conduct a systematic evaluation of the factors which lead to reductions in estimates of recruitment prior to 1970 for the RC1 model.**
The RC1 model implies a large decline in recruitment before 1970. It is important to understand the reasons for this. The factors that should be considered in this investigation include: a) the early length-frequencies (ignore the earliest length-frequencies in sequence), b) levels and trends in somatic growth, and c) the survival rate for males.

B.18 (M). **Conduct sensitivity tests in which the data for females are ignored or down-weighted**.
The selectivity patterns for females appear fairly unrealistic, particularly because of the marked changes in selectivity over small length ranges. However, it is not clear that these data have a marked impact on the final results of the assessment and hence whether it is important to resolve the issue of the plausibility of the selectivity patterns that are estimated for females.

B.19 (M). **Estimate additional recruitment deviations.**
The number of recent recruitment deviations that are treated as estimable parameters is small compared to the case for most other rock lobster assessments worldwide. The number of such recent recruitments should be increased, and an analysis conducted to determine whether this leads to appreciable improvements in fit.

B.20 (L). **Hypotheses related to shifts in rock lobster population distribution should be developed and tested to the extent that this is possible. Environmental factors should be considered during this exercise.**
Several shifts in distributions (inferred in part from catch patterns) have occurred over the history of the fishery (e.g. a historical southward shift, and most recently in the East of Hangklip area). There are various hypotheses related to why these shifts have occurred, but no quantitative analyses were presented to the Workshop.

B.21 (L)**. Plot the time-sequence of selectivity-at-length patterns.**
Selectivity-at-length changes over time, but the documents presented to the Workshop did not show the annual selectivity-at-length patterns. These should be plotted and checked for realism.

B.22 (L*). **Place lower bounds on the residual variances.**
The residual standard deviations for several of the data sources for some of the areas in the spatially-disaggregated assessment are unrealistically low, indicating the possibility of overfitting.

B.23 (L). **Examine the sensitivity of the results to starting the model in recent years**
There is uncertainty about the dynamics of the population in the years prior to the first year for which length-frequency data are available. The robustness of the performance of the OMP to starting the operating model in a recent year (e.g. 1975) should be evaluated. It is necessary to specify a method to determine the initial abundance and length-structure of the population in the first year considered in the model for a complete specification.

C. South Coast rock lobster

C.1 (H). **Tabulate the number of lobsters, trips and grids sampled on which each annual length-frequency is based. If these numbers vary considerably inter-annually, it may be necessary to weight the data for each year by the sample size in some way (e.g. Xi He *et al*. 2005: Status of the widow rockfish resource in 2005: available from the Pacific Fishery Management Council).**
The data on the length- and age-composition for each year were given equal weight in the assessments presented to the Workshop. In principle, the weight assigned to the data for a given year should reflect the sampling effort on which the length-frequency data for that year are based.

C.2 (H). **The stock assessment of South Coast rock lobster should be based on a sex- and length-structured population dynamics model fitted to catch-rate, length-frequency and moult increment data.**
The assessments presented to the Workshop are sex-aggregated (even though there is strong evidence for sexual dimorphism) and are fitted to catch-at-age data determined using cohort-slicing. Annex D provides an outline of the data analyses and assessment calculations needed to conduct an assessment that uses the available data more fully and is based on a sex- and length-structured population dynamics model.

C.3 (M). **Exclude further catch and effort data for the Hout Bay Fishing Company when standardizing CPUE data.**
Only the 1997/98-2000/01 data were excluded from the catch-effort standardization, but it seems that the data for earlier years may also have been contaminated.

C.4 (M). **Examine whether it is possible to include interactions with grid by: a) modelling these interactions as random effects; and b) defining sets of grids as 'areas' (based on examining plots of, for example, catch-rate) and consider interactions at the level of "area".**
The GLM used to standardize the catch-rate data include a factor for grid, but the large number (291) of grids means that it is not possible to examine interactions with grid even though such interactions may provide an important indication of changes in the fishery.

C.5 (M). **The decision to ignore the tagging data should be revisited once the assessment is revised to be based on a length-transition matrix, as this revision may reduce the ability to estimate age-specific quantities such as the rate of natural mortality.**
Tagging data were included in the assessment in the past, but this is no longer the case.

Annex D : Tasks to be Conducted to Update the Assessment of South Coast Rock Lobster

I. New Data Required

1. The raw tag-recapture data (to allow growth rates to be estimated). The data should include: length-at-release and -recapture, date-at-release and -recapture, location-at-release and -recapture, and sex.
2. Catch-at-length data (observer and research) by year, spatial and temporal strata[2], sex and maturity stage (females only). The data for Port Alfred should be extracted separately from those for the remaining areas. The length-classes to be used when summarizing the data should be selected after the growth data have been analyzed.

II. Analyses of Raw Data

1. Catches: Catches need to be extracted by the agreed spatial and temporal strata.
2. Catch-rate standardization: Repeat the catch-effort standardization including model selection. Examine the implications of interactions with grid by: a) aggregating the data to "areas" and examining interactions with "area", and b) using a mixed-effects modeling framework. Annual catch-rate series as well as catch-rate series for each temporal stratum should be investigated. Diagnostic statistics (e.g. q-q plots) should be examined and reported.
3. Length-frequency and effort distribution data: Conduct an analysis of the spatial and temporal structure of the length-frequency data, and of possible changes in the spatial distribution of effort over time, to develop hypotheses to explain the changes over time in the length-frequency of the catches.
4. Tagging data: Estimate sex-specific growth curves and size-transition matrices. These matrices should be compared with those estimated within the assessment model. There appear to be differences in growth spatially, particularly between Port Alfred and the remaining areas. Tests need to be conducted to check whether any spatial differences in growth rates remain when the data for Port Alfred are ignored. Consider whether the moult probability depends on length and, if this is the case, account for this when developing the size-transition matrix.
5. Maturity-at-length data. Estimate a relationship between maturity and length. This relationship needs to be compared to that estimated within the assessment model.

III. Assessment Model Analyses – initial

1. Basic model: Sex- and length-structured with selectivity a function of size.
2. Estimable parameters: Virgin recruitment, natural mortality, the annual deviations in recruitment about mean recruitment, the parameters of the selectivity pattern, the parameters that define maturity as a function of size, and the parameters that determine size- and sex-specific growth.

[2] The temporal and spatial strata will be selected after consideration of hypotheses related to growth and effort distribution as well as to data availability.

3. Fitted to:
    a. Catch–rate indices (perhaps separately for each temporal / spatial stratum).
    b. Length-frequency data. The observer and research length-frequencies need to be treated separately and fitted as the proportion of the total catch in numbers by length- and sex-class. The manner in which the length-frequency data are included in the likelihood function should be robust to occasional outlying residuals.
    c. Tag-recapture data on growth.
4. Objectives:
    a. Determine whether the conflicts identified in the current assessment persist when the data are revised and the model is sex- and length-structured.
    b. Provide diagnostic statistics that can be used to identify the behavior of the model (e.g. bubble plots of residuals, fits to the catch-rate series, fits to the catch-rate and tag-recapture data).

IV. Assessment Model Analyses – next steps

Depending on the outcome from the initial modeling work, the following modifications could be made to the assessment model.

1. Allow for effort saturation.
2. Allow for variation over time in selectivity. Note that it will be necessary to examine a variety of ways to scale the selectivity ogives to account for the possible effect of effort redistribution on catchability, and to add a penalty on the deviations in selectivity over time.
3. Allow for multiple “fleets”, each of which represents the catch in an area (a set of grids). The selectivity pattern for each “fleet” will initially be time-invariant.
4. Include the tagging data in the likelihood function, with a view to estimating fishing (and natural) mortality rates.

Finally, once a set of models that is able to fit all of the data is identified, the uncertainty associated with the results of the assessment should be explored using the Markov Chain Monte Carlo (MCMC) algorithm. Note that it may be necessary to select the width of the length-classes used to summarize the length-frequency data to ensure that the data points are essentially uncorrelated.

Annex E : Annotated Agenda and Programme

1. OPENING (*Tuesday 9 am*)
 1.1 Welcome
 1.2 Introduction of Chair and Participants [1]
 1.3 Terms of Reference [2]
 1.4 Daily time schedule, meal and other arrangements [3]
 1.5 Rapporteurs [4]
 1.6 Computing arrangements [5]

2. REVIEW OF DOCUMENTS (*Tuesday 9 am*) [6]

3. GENERAL BACKGROUND TO THE FISHERIES (*Tuesday 9 am*)
 3.1 West Coast Rock Lobster
 3.2 South Coast Rock Lobster

4. ECOSYSTEM ASPECTS OF THE FISHERIES (*Tuesday 11 am*)
 4.1 West Coast Rock Lobster
 4.2 South Coast Rock Lobster

5. CO-MANAGEMENT CONSIDERATIONS [7]
 5.1 Brief presentations by four invited external scientists on approaches to management of related fisheries with which they are familiar, followed by discussion (*Tuesday 2 pm*)
 5.2 Possible co-management arrangements for the SA West and South Coast rock lobster fisheries (*Tuesday 4pm*)

6. BASIC DATA INPUTS AND REFINEMENTS
 6.1 West Coast Rock Lobster (*Wednesday 9 am and 11 am*)
  6.1.1 Catch, Effort and standardisation
  6.1.2 Fishery Independent Monitoring Surveys (FIMS)
  6.1.3 Biological data (maturity, growth, stock structure, etc.)
 6.2 South Coast Rock Lobster (*Wednesday 2 pm*)
  6.2.1 Catch, Effort and standardisation
  6.2.2 Fishery Independent Monitoring Surveys (FIMS) – future possibilities?
  6.2.3 Biological data (maturity, growth, stock structure, etc.)

[NOTE: The final Wednesday 4pm session will be reserved for a presentation (by Drs Sampie Ferreira and Rudi van Aarde of the University of Pretoria) and discussion of certain South African Elephant metapopulation modelling approaches.]

7. RESOURCE ASSESSMENTS
 7.1 West Coast Rock Lobster (*Thursday 9 am and 11 am*)
  7.1.1 Area-aggregated assessments
  7.1.2 Area-disaggregated assessments
 7.2 South Coast Rock Lobster (*Thursday 2 pm and 4 pm*)

8. APPROACHES FOR MANAGEMENT RECOMMENDATIONS (TAC, TAE AND POSSIBLE OTHER)

8.1 West Coast Rock Lobster (*Friday 9 am and 11 am*)

8.1.1 Summary of recent OMP approaches

8.1.2 Future plans and proposals

8.1.3 Overview of OMP approach (Fixed for during *Friday 11 am* session) [7]
Discussion will be more general, not restricted to the West Coast rock lobster resource context alone, and will include consideration of suggested formal protocols for metarule processes and review advancement

8.2 South Coast Rock Lobster (*Friday 2 pm and 4 pm*)

8.2.1 Summary of recent bases for recommendations on TAC and TAE

8.2.2 Possible future approaches including OMP development

9. EXTERNAL SCIENTIFIC PANEL REPORT (*Saturday 9 am*)

9.1 General discussion of first draft of Panel report, prior to its finalisation by the Panel

10. RESEARCH RECOMMENDATIONS (*Saturday 2 pm*)

10.1 Adoption of the text of a set of prioritised and briefly motivated research recommendations arising out of the discussions of the Workshop

11. CLOSURE

NOTES:

1] As in previous years for BENEFIT events, the Workshop will be chaired by Dr Tony Smith (Australia); others attending will be asked to briefly introduce themselves under this item. The other invited external scientists are Dr Ana Parma (Argentina), Dr Andre Punt (USA) and Mr Paul Starr (Canada and New Zealand).

2] The Terms of Reference are:

i) to critically review data available for, and past assessments and bases for scientific management advice for the South African West and South Coast Rock Lobster resources;

ii) to further develop these assessments and management approaches during the Workshop;

iii) to make prioritised recommendations for future research on these topics; and

iv) to discuss co-management approaches for these resources.

3] The Workshop will generally commence at 9-00 am and end at about 5-30 pm each day, with a break for lunch usually from 12-30 to 2-00 pm, and mid-morning and mid-afternoon tea breaks. A light lunch will be provided for full-time participants on each day. Though initially meeting in plenary session, it is possible that smaller groups may be convened during the course of deliberations to discuss certain issues in more depth and report back

Two social functions will be held during the event:

i) all those participating in any capacity at the Workshop are invited to a welcome "finger supper", to be held in the new ground floor bar area at the Southern Suns Hotel (ex-Holiday Inn), Main Road, Newlands from 6-30 to 8-00 pm on Monday 28 November.

ii) all full-time participants are invited to attend a dinner at Simons Restaurant, Groot Constantia, from 7-30 pm on Thursday 1 December.

4] The rapporteurs will be co-ordinated by Andre Punt. West Coast agenda items will be covered by Steve Brouwer, Rebecca Rademeyer and Eva Plaganyi, and South Coast by Johan Groeneveld and Trevor Branch. Note that there will not be a full report of all aspects of the proceedings. Rather the record of the meeting will consist of the following documents:

i) A brief summary of the co-management presentations made by the invited external scientists (*Compiled by those scientists*)

ii) A report with recommendations, in particular on key pre-listed issues, from the external scientists (*Compiled by those scientists*)

iii) A set of prioritised research recommendations, together with brief accompanying rationale, arising out of Workshop discussions as adopted by participants.

5] Certain scientists will be in a position to carry out limited further assessment computations that the Workshop may request during its deliberations.

6] As many meeting documents as possible will be pre-circulated by email to all attendees. Documents must be forwarded to Susan Johnston (susan@maths.uct.ac.za) and Di Loureiro (dll@maths.uct.ac.za). Authors unable to email their documents by 23 November must please bring 35 copies with them to the Monday 28 evening function (unless separate arrangements are made with Susan), so that these can be distributed to attendees. Non-emailable documents provided to Susan by 23 November will be copied by the organisers. Full-time attendees will be provided with a file containing a complete set of documents at the commencement of the Workshop.

7] Attendance of scientists and industry members involved in other South African fisheries, in particular those for hake and for pelagics (sardine and anchovy) will be invited for these items.

Annex F : Workshop Documents

RLWS/DEC05/GEN/1: Workshop announcement
RLWS/DEC05/GEN/2: Annotated agenda
RLWS/DEC05/GEN/3: List of workshop documents
RLWS/DEC05/GEN/4: MCM + MARAM + OLRAC/Industry: Initial list of issues of high priority for guidance/recommendation by the external scientific Panel
RLWS/DEC05/GEN/5: Extracts from BENEFIT workshops of recommendations and Panel comments regarding the West Coast rock lobster

RLWS/DEC05/BAC/3/1/1: Brouwer, S: West coast rock lobster resource and fishery

RLWS/DEC05/BAC/3/2/1: Groeneveld, J: Summary of South Coast rock lobster (*Palinurus gilchristi*) information: 1) Biology and fishery

RLWS/DEC05/ECO/4/1/1: Shannon, L, Brouwer, S L and Cockcroft, A C : Ecosystem aspects of the West Coast rock lobster fishery
RLWS/DEC05/ECO/4/1/2: Plaganyi, E E: Summary of East-of-Hangklip lobster-abalone-urchin models and abalone projections

RLWS/DEC05/ECO 4/2/1: Shannon, L and Groeneveld, J C: Ecosystem aspects of the South Coast rock lobster fisher

RLWS/DEC05/COM/5/1/1: Starr, P J: Management of the New Zealand rock lobster (*Jasus edwardsii*) fishery
RLWS/DEC05/COM/5/1/2: Smith, A D M: Industry involvement in management of rock lobster fisheries in Australia
RLWS/DEC05/COM/5/1/3: Parma, A: TURFs and co-management in Chilean artisinal shellfisheries
RLWS/DEC05/COM/5/1/4: Punt, A E: Co-management experiences: the U.S. west coast groundfishery

RLWS/DEC05/DAT/6/1/1: Johnston, S J and Butterworth, D S: A list of data inputs to the West Coast rock lobster assessment
RLWS/DEC05/DAT/6/1/2: Brouwer, S L: Summary of MCM current and planned data gathering exercises
RLWS/DEC05/DAT/6/1/1/1: Glazer, J P: Standardisation of West Coast rock lobster commercial CPUE data
RLWS/DEC05/DAT/6/1/1/2: Brouwer, S L: West Coast rock lobster CPUE data collection current and planned

RLWS/DEC05/DAT/6/1/2/1: Glazer, J P and Brouwer, S L: Analysis of the Fisheries Independent Monitoring Survey (FIMS) CPUE data

RLWS/DEC05/DAT/6/1/2/2: OLRAC: Consideration of the benefits of modifications to the design of the FIMS based on the statistical properties of commercial CPUE data

RLWS/DEC05/DAT/6/1/3/1: Johnston, S J and Brouwer, S L: Summary of further data sources used as input for the assessment of the West Coast rock lobster

RLWS/DEC05/DAT/6/1/3/2: Breen, P A, Starr, P J and Kim, SW: Medium-term research plan for NZ rock-lobster (Extracts from August 2005 paper)

RLWS/DEC05/DAT/6/1/3/3: Brandao, A and Butterworth, D S: Summary of the most recent GLMM standardised male West Coast rock lobster somatic growth trend based upon the "Less data" approach

RLWS/DEC05/DAT/6/1/3/4: OLRAC: Methodology for the growth rate moult probability analysis for male West Coast rock lobsters, allowing for the treatment of area*season interactions as random effects

RLWS/DEC05/DAT/6/1/3/5: Dubula, O, Groeneveld, J C, Santos, J, van Zyl, D L, Brouwer, S L, van den Heever, N and McCue, S A: Effects of tag-related injuries and timing of tagging on growth of rock lobster, *Jasus lalandii* (*Fish. Res:*74(2005)1-10)

RLWS/DEC05/DAT/6/1/3/6: Brandao, A and Butterworth, D S: Summary results for the effect of the time of tagging on the somatic growth of West Coast rock lobster males

RLWS/DEC05/DAT/6/1/3/7: OLRAC: Implications of the growth rate experiment for male West Coast rock lobsters

RLWS/DEC05/DAT/6/2/1: Johnston, S J and Butterworth, D S: A list of data inputs to the South Coast rock lobster assessment

RLWS/DEC05/DAT/6/2/1/1: Groeneveld, J C: Summary of South Coast rock lobster (*Palinurus gilchristi*) information: 2) Data used in assessments

RLWS/DEC05/DAT/6/2/1/2: Glazer, J P: Standardizing the South Coast Rock Lobster (*Palinurus gilchristi*) commercial CPUE data

RLWS/DEC05/DAT/6/2/1/3: Groeneveld, J C, Butterworth, D S, Glazer, J P, Branch, G M and Cockcroft, A C: An experimental assessment of the impact of gear saturation on an abundance index for an exploited rock lobster population (*Fish. Res*.: 65(2003)453-465)

RLWS/DEC05/DAT/6/2/1/4: Groeneveld, J C*:* Summary of South Coast rock lobster (*Palinurus gilchristi*) information: 3) Further available data

RLWS/DEC05/DAT/6/2/3/1: OLRAC: A description of the cohort slicing technique used to reduce catch-at-length to catch-at-age for South Coast rock lobster

RLWS/DEC05/ASS/7/1/1: Johnston, S J and Butterworth, D S: Underlying assumptions for the stock assessment of West Coast rock lobster

RLWS/DEC05/ASS/7/1/2: Johnston, S J and Butterworth, D S: The size-structured (length-based) stock assessment methodology applied to West Coast rock lobster

RLWS/DEC05/ASS/7/1/3: Johnston, S J and Butterworth, D S: West Coast rock lobster updated stock assessment results for length-based model for both area-aggregated and area-disaggregated approaches

RLWS/DEC05/ASS/7/1/4: Johnston, S J and Butterworth, D S: A summary of the pro's and con's of area-aggregated *vs* area disaggregated assessment approaches for the West Coast rock lobster

RLWS/DEC05/ASS/7/1/5: Butterworth, D S and Johnston, S J: A summary of the pro's and con's of using 1870 as the starting year for West Coast rock lobster population modelling

RLWS/DEC05/ASS/7/1/6: OLRAC*:* Summary of updated spatially aggregated and disaggregated assessments for the West Coast rock lobster resource

RLWS/DEC05/ASS/7/1/7: *Withdrawn*

RLWS/DEC05/ASS/7/1/8: Johnston, S J and Butterworth, D S: Results of a surplus production modelling approach for three spatially disaggregated components of the West Coast rock lobster resource

RLWS/DEC05/ASS/7/1/9: Johnston, S J and Butterworth, D S: Sensitivity of the West Coast rock lobster length-based stock assessment to a consistently higher somatic growth rate

RLWS/DEC05/ASS/7/2/1: Johnston, S J and Butterworth, D S: Underlying assumptions for the stock assessment of South Coast rock lobster

RLWS/DEC05/ASS/7/2/2: Johnston, S J and Butterworth, D S: The age-structured production model for the South Coast rock lobster population

RLWS/DEC05/ASS/7/2/3: Johnston, S J and Butterworth, D S: The 2005 age-structured production model assessments and constant catch projections for the South Coast rock lobster resource

RLWS/DEC05/ASS/7/2/4: Johnston, S J and Butterworth, D S: Future projections for the South Coast rock lobster resource using Bayesian methodology

RLWS/DEC05/ASS/7/2/5: OLRAC: South Coast rock lobster stock assessment results relevant to proposals for alternative approaches to the treatment of catch-at-age and CPUE data

RLWS/DEC05/MAN/8/1/1/1: Johnston, S J and Butterworth, D S: Evolution of operational management procedures for the South African West Coast rock lobster (*Jasus lalandii*) fishery (*NZ J. Mar. and Frw. Res*. 39 (2005) 687-702)

RLWS/DEC05/MAN/8/1/1/2: Johnston, S J, Glazer, J P and Brandao, A: OMP-2003 for the West Coast rock lobster

RLWS/DEC05/MAN/8/1/2/1: Johnston, S J and Butterworth, D S: Updated performance statistics for the existing OMP and modified tunings thereof for the West Coast rock lobster resource

RLWS/DEC05/MAN/8/1/3/1: Butterworth, D S: Some positives and negatives of the OMP approach

RLWS/DEC05/MAN/8/1/3/2: Butterworth, D S: Draft proposed procedures for deviating from the West Coast rock lobster OMP output for a recommendation for a TAC, and for initiating an OMP review, together with procedures for within-review scheduling

RLWS/DEC05/MAN/8/1/3/3: OLRAC: Industrial needs for flexibility in an OMP for the west coast rock lobster resource.

RLWS/DEC05/MAN/8/2/1/1: Augustyn, J: Extracts from recommendations for the sustainable management of the South Coast rock lobster resource as submitted to the Department and Minister by the Chief Director, Research, MCM, for the last two years

RLWS/DEC05/MAN/8/2/2/2: Johnston, S J and Butterworth, D S: Initial OMP development suggestions for the South Coast rock lobster resource

<u>Additional document</u>

Ferreira, S M, van Aarde, R J, Loarie, S and Pimm, S: Elephant metapopulations

Annex G : Attendees

NAME	AFFILIATION
External Panel	
Parma Ana	CENPAT, Argentina
Punt Andre	University of Washington, USA
Smith Tony	CSIRO, Australia
Starr Paul	Canada/New Zealand
South Africa	
Anthony Luyanda	MCM
Barkai Amos	OLRAC
Bergh Mike	OLRAC
Branch Trevor	MARAM, UCT
Brandão Anabela	MARAM, UCT
Brouwer Stephen	MCM
Butterworth Doug	MARAM, UCT
Cockcroft Andy	MCM
Fairweather Tracey	MCM
Gaylard James	OLRAC
Glazer Jean	MCM
Groeneveld Johan	MCM
Iiyambo David	MARAM, UCT
Jacobs Albie	OLRAC
Johnston Susan	MARAM, UCT
Makhado Azwianewi	MCM
Mori Mitsuyo	MARAM, UCT
Ndzipha Pule Vicky	Fort Hare University
Plagányi-Lloyd Éva	MARAM, UCT
Somhlaba Sobahle	MARAM, UCT
Weimar Gunther	Industry
Namibia	
Kirchner Carola	NatMIRC
Grobler Kolette	NatMIRC
Moroff Nadine	NatMIRC
Other	
Kurota Hiroyuki	NRIFSF, Japan
Edwards Charlie	Oxford University, UK

NAME	AFFILIATION
Occasional	
Akkers Theressa	MCM
Attwood Claire	Fishing Industry News SA
Augustyn Johann	MCM
Badenhorst Awie	Industry (pelagic)
Bailey Danny	Industry
Ball Richard	Industry
Barendse Jaco	MCM
Blamey Laura	Zoology, UCT
Brink Neville	Industry
Coetzee Janet	MCM
Copeland Mike	Industry (pelagic)
Durholtz Deon	MCM
Effenberger Etienne	de Beers Marine, Namibia
Fernandes Gaston	Industry
Fernandes Romano	Industry
Ferreira Sam	Zoology, Univ Pretoria
Foley Peter	Industry
Grant Donald	Industry
Hendricks Chemize	Industry
Kaye Andrew	Industry (hake)
Leslie Rob	MCM
Levendal Herbert	Industry
Maletzky Erich	MCM
McKenzie Angus	MCM
Mngxunyeni Patrick	Industry
Mtsheketshe Mbuyi	Industry
Nel Dean	WWF-SA
Osborne Renee	MCM
O'Toole Mick	BCLME,Namibia
Penney Andrew	PISCES Envirtl Services
Petersen Paul	Industry
Pope John	Industry
Rademeyer Rebecca	MARAM, UCT
Shannon Lynne	MCM
Sikiti Gloria	MCM
Sweijd Neville	BENEFIT, Namibia
Tarr Rob	MCM
van Aarde Rudi	Zoology, Univ Pretoria
Technical Assistance	
Loureiro Di	Mathematics, UCT
Omari Navo	ENGEO, UCT