ATTACHMENT 1

AGREED REPORT OF THE JOINT HAKE RESEARCH PLANNING WORKSHOP

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(NAMIBIA AND SOUTH AFRICA)

Cape Town. 9-12th May 2006

1. Introduction

The workshop was convened by BCLME with broad participation by national scientists from Namibia and South Africa, as well as stakeholders involved with the hake fisheries in each country. An External Review Panel of three invited scientists participated in the Workshop. The external scientists were Tony Smith (Australia) who chaired the meeting, James Ianelli (USA), and Ana Parma (Argentina). Neville Sweijd (BENEFIT) convened the workshop and Dave Japp and Martin Purves assisted as rapporteurs.

This report does not cover all the discussions that took place during the workshop. Instead it briefly summarizes the key conclusions regarding sharing of stocks of Cape hake species between Namibia and South Africa, and presents workshop recommendations for further research involving both the synthesis of available information and the collection of new data. It also recommends an approach to assessing the potential costs and benefits of joint management, provides suggestions about structures to coordinate future research, and concludes with a recommended plan of action.

The objectives of the workshop were agreed on the first day as follows:

1.0 What can be said on the basis of information available now about stock status, particularly in the context of whether or not *M. capensis* and/or *M. paradoxus* resources are shared?

2.0 If the situation about whether or not the stocks are shared is not yet clear, what are the priority projects required to resolve this issue as regards:
   a) further data collection; and
   b) further analyses?

3.0 If a joint assessment is deemed desirable to estimate the extent of possible sharing of either hake species:
   a) what are the associated data needs and procedures;
   b) what would be the best structure/methodology for that assessment;
   c) how best can the results from such and assessment be used to ascertain whether or not there would be benefits from joint management; and
   d) what structures are needed to best conduct and review the results from such a process?

The majority of the workshop was spent addressing objectives 1 and 2, with little time spent on objective 3.

A summary of the main outcomes of the workshop is at Appendix A, in the form of a power point presentation given to senior management from Namibia and South Africa immediately following the workshop.

2. Main conclusions about shared stocks

The workshop reviewed a large amount of information related to stock structure of the two Cape hake species. The preponderant scientific view before the workshop was that the shallow water species *M. capensis* consists of separate stocks in Namibia and South Africa, while the deepwater species *M. paradoxus* is a shared stock. Review of the evidence presented during the workshop served to undermine the certainty of these views. Evidence of spawning of *M. capensis* in both Namibia and South Africa lends weight to the hypothesis of separate stocks for this species, though considerable mixing could still be occurring. For *M. paradoxus*, there is no direct evidence of spawning in Namibia, though mature fish are found there. There is preliminary genetic evidence for more than one stock of this species, but no evidence for a boundary at the SA/Namibia marine boundary. The workshop concluded that there are major uncertainties about whether there are multiple or shared stocks for both Cape hake species, particularly for *M. paradoxus*.

3. Management implications of uncertainty about shared stocks

A view was expressed at the workshop that justification for a joint management approach (between Namibia and South Africa) of the hake resources of the region needed to demonstrate a reasonable plausibility that one or more stocks are shared. However it was pointed out that consideration of justification also requires evaluation of the consequences (for stock status and fishery performance) of alternative management arrangements under different scenarios about the extent of stock sharing. The following table is illustrative of such an evaluation.

	State of nature		
Action	No sharing of stocks	Little sharing of stocks	Large sharing of stocks
Separate management			--
Joint management	-	-	

If there is little or no sharing of stocks, separate management is quite adequate, and there are no adverse implications for either country arising from the actions or management success of the other. It is only in the case of substantial sharing of stocks (e.g. a single stock fished in both countries) that negative consequences can arise for one country from fishing of the stock by the other. Such negative consequences can be avoided by joint management (such as agreed objectives and bases to divide allowable catches, and adequate catch controls in both countries). However joint management comes at an additional cost in terms of coordination and management. If there is little or no sharing of stocks, this additional cost represents a negative consequence of joint management.

Appendix B outlines definitions and the broad range of experience from other situations of shared-stock management around the world. A common theme from this experience is that there tends to be a progression through a sequence of steps from research collaboration through to joint management. Generally, cooperation begins in areas of scientific research starting with the development of common sampling protocols and basic data sharing, and leading on to integrated research planning and potentially to joint stock assessments. As these research programs mature, they naturally lead to an evaluation of the need for joint management strategies with considerations of implementation approaches.

4. Recommendations for reducing uncertainty about stock structure

While the workshop reviewed many papers and presentations relating to information about stock structure, it also identified other relevant data that were not presented or reviewed. Review of such data may have led to different conclusions concerning sharing of stocks, and potentially may have resulted in much less uncertainty. This led workshop participants to identify and **recommend** the following high priority project.

Synthesis and evaluation of available literature and data

There is a need to undertake a comprehensive review and collation of available literature and data relevant to shared stock issues for Cape hake. The objective would be to identify, collate, review and place in context to the shared stock issues the relevant literature, data sets, and other information on Cape hakes. In particular, the study should reference the following:

- Historical publications, particularly those of ICSEAF;

- "Grey literature" – such as unpublished in-house reports and working group documents;
- Historical and current research data and publications relevant to Cape hakes (including theses);
- Reports on Spanish ichthyoplankton surveys during the ICSEAF period;

and should also seek to establish:

- the value/relevance of historical research programmes such as CELP and SWAPELS to the current transboundary debate relating to hake;
- the compatibility of the available data sets.

Information of particular interest includes: spatial and temporal distribution of hake spawning (maturity stages and GSI); standardization of biological methods (e.g. GSI indices); distribution and abundance of various life stages of hake; examination of both commercial and research based data sets including biomass estimates, age and growth, spatial and temporal length frequency data (including by depth), genetics, morphometrics and other data relating to stock differentiation.

The analyses of survey data should be refined to include species-specific maps of density vs latitude by length group, as well as plots of density vs length (size composition) by latitude. With regard to commercial data, mapping of effort, catch and CPUE by month would allow visualization of the spatial fleet dynamics to help identify possible spawning migrations.

In summary, the project should include:

- Development of a comprehensive bibliography
- An inventory of data relevant to stock structure identification
- Review and analysis of data in relation to alternative hypotheses on stock structure and their plausibility
- Identification of data and information gaps, and recommendations for research and monitoring

Time frame for the review: This work is urgent and should be completed within 9 months. A meeting would be held within a year to review the results of the project.

5. Approaches for stock structure discrimination

The workshop discussed a range of approaches to discriminate between alternative stock structure hypotheses (see Appendix C) and identified several research areas where further work would help reduce uncertainties regarding sharing of stocks. Cost-effectiveness, as well as the likely power of the approach to detect separate stocks where they may occur, both need to be taken into account when prioritizing the different research approaches.

The workshop reviewed the following eleven areas of research from the point of view of stock structure discrimination, providing advice and in some cases specific recommendations in relation to each.

1.1 Scientific surveys

The workshop **recommended** that comprehensive scientific surveys continue with the goal of collecting data on:

- spatial and temporal distribution of Cape hake
- distribution of eggs and larvae by species (with collections made suitable for genetic studies)
- genetic samples
- indices of abundance as input to stock assessment
- biological samples to determine maturity stages

- diet composition data of both hake species

2.2 On-board sampling programs

The workshop **recommended** that observer programs that provide information that allows species disaggregation of the catch and CPUE should continue. Additional biological sampling on board commercial vessels was also **recommended**. For example, it might be an effective approach to contract a specially trained group of scientific observers to obtain a variety of biological and other samples (e.g., genetic tissue, otolith samples, GSI measurements, identification of gonad maturity stages, stomachs, etc.). The possibility for BCMLE/BENEFIT to fund the training and deployment of such dedicated staff was discussed. One of the primary benefits of on-board sampling on commercial vessels is the wider spatial and seasonal coverage that this would allow.

5.3 Spawning site studies

The workshop **recommended** that sampling of GSI and gonad maturity on board commercial trawl and longline vessels be conducted. This would greatly increase the temporal and spatial coverage for such data, an important issue given current uncertainties about time and location of spawning, particularly for *M. paradoxus*. Standardisation of maturity stages is needed between Namibia and South Africa.

5.4 Egg and larval studies

Egg and larval surveys hold the prospect of helping to identify time and location of spawning. This would be particularly valuable for *M. paradoxus*, where collection of spawning adults is difficult (perhaps because they are off the bottom and in the water column). This also requires genetic analyses to identify eggs and (early stage) larvae to species.

A number of recommendations were made in addition to the study of distribution of early stages from comprehensive surveys. The importance of examining possible seasonal trends in abundance of eggs and larvae at particular sites was recognized. Monthly plankton surveys are being conducted near Agulhas with collection of eggs/larvae; these should be stored in alcohol rather than formalin so that future genetic identification would be possible. Photographs of larvae should be taken prior to genetic sampling to help with species identification protocols.

The possibility of identification of larvae of *M. capensis* and *M. paradoxus* based on vertebral counts was suggested for further examination. If this method works, samples preserved in formalin could be identified to species.

5.5 Genetics research

A sequence of questions can be addressed by genetics, in order of priority:

a) Are there multiple stocks of each of *M. capensis* and *M. paradoxus*?
b) If multiple stocks exist, where are they distributed at different life-history stages?
c) What are the gene flow rates between possible stocks?
d) What are the evolutionary and ecological processes determining genetic variation within the two species?

The workshop noted that sampling early larval stages or spawning adults would be optimal for discriminating stock-structure hypotheses using genetic methods. However given the difficulty of obtaining such samples, the workshop **recommended** that initial studies be based on analysis of samples already collected and on further samples to be collected from as wide a geographic range as possible. Subsequent studies should carefully consider the recommendations of international fisheries genetic experts with regard to structured sampling. Objectives and protocols for selection of samples should be discussed further by the geneticists and those involved in sample collections. Another possible source of genetic material includes stored otolith collections. It was suggested that otolith samples be collected for further genetic analysis.

The workshop **recommended** both further mitochondrial analyses to refine recent results and the initiation of microsatellite analyses to complement these and enhance power to detect stock structure.

It was acknowledged that the main obstacle to the genetic work is the funding needed to undertake the genetic analyses. Further motivation for the genetics research is provided in Appendix D.

5.6 Tagging

Tagging would provide important information to discriminate between alternative migration hypotheses. The effectiveness of different methods was discussed, including the use of indirect tagging with hooks (break-off tags), and other techniques that have been developed for tagging fish that reach the surface in poor condition. In particular, a technique developed in Iceland involving the use of an *in situ* device to place tags (possibly of an archival nature) was discussed but the workshop concluded that it is premature at this stage to consider these approaches and that conventional and other (e.g. break-away hooks from longline gear) tagging approaches are likely to be more cost effective. The workshop emphasized the need for adequate observer coverage to ensure high tag recovery rates.

5.7 Morphology

Morphological and meristic differences in *M. capensis* adults from northern and southern Namibia were mentioned, [[with indications of possible geographic variation in the number of gill rakers.]] These differences have not yet been systematically investigated for use in stock structure discrimination, and further morphological and meristic investigations of both species are **recommended**.

5.8 Otolith micro-chemistry

The analysis of otolith micro-chemistry to evaluate differences of natal sites was considered to be potentially valuable, as it has shown promise in some other species. The method requires access to expensive equipment for analysis.

5.9 Assessment of birth-dates of different cohorts in different areas

The workshop **supported** the analysis of birth dates (obtained from counting growth rings in otoliths) to evaluate possible divergence or consistency between distributions for different cohorts in different regions. Additional otolith samples should also be collected aboard commercial vessels to supplement this research.

5.10 Diets of predators

The workshop **recommended** evaluating latitudinal differences in diet composition of *M. capensis* and other predators to look at the distribution of juvenile *M. paradoxus* and to evaluate consistency with inferences from survey information.

5.11 Modeling approaches

Model selection techniques could be used to help discriminate between alternative stock structure hypotheses by examining fits of alternative models (embodying the hypotheses) to data. The workshop **recommended** that initial investigative modelling approaches be pursued to assist determine whether certain stock-structure hypotheses were incompatible with available data.

6. Views of the external panel regarding these research areas for stock discrimination

The following table provides an initial prioritization of the research areas presented above. Both survey and commercial vessel sampling programs were given high priority by the workshop, and these are programs of activity rather than specific research areas. The organisation of the table reflects this distinction.

Approach (research focus)	Commercial vessel sampling (low program-level costs)			Scientific surveys (high program-level costs)		
	Information potential	Additional Cost	Priority	Information potential	Additional Cost	Priority
Distribution and abundance	Medium	Low	Medium	Medium	Low	Medium
Spawning characteristics	High	Low	High	Med-high	Low	High
Egg and larval sampling	NA	NA	NA	Medium	Medium	High
Genetics	High	High	Med -high	High	High	Med-high
Tagging	Med-high	Medium	NA	Med-high	Medium	Medium
Morphometrics	Low	Low	Low	Low	Low	Low
Otolith microchemistry	Medium	Medium	Low	Medium	Medium	Low
Birth-date distributions	Med-high	Low	High	Med-high	Low	High
Diet composition	Medium	Medium	Medium	Medium	Medium	Medium

Approach (research focus)	Information potential	Cost	Priority
Investigative modelling	Medium	Med-low	High

The ‘information potential’ column indicates the likely ability of the approach to resolve stock structure.

The ‘additional cost’ column is intended to include cost of data collection and subsequent analysis.

This “portfolio” table reflects performance and priorities of each activity in isolation. In practice the ability to resolve stock structure issues is likely to involve a combination of these approaches. For example, a combination of genetic analyses with egg and larval sampling will potentially resolve stock structure more effectively than either method in isolation.

The external panel noted that there are other limitations to this simple characterisation of priorities. Some of the scores require more detailed justification and explanation – for example, the information potential of spawning characteristics (e.g. collecting data on GSI and gonad stage) is higher for the commercial on-board sampling than for the scientific surveys because of the greater temporal and spatial coverage of the former. It is also noted that the same scores for information potential and additional cost do not always result in the same overall priorities (e.g. egg and larval sampling, and otolith microchemistry are both medium/medium for information/cost, but have been assigned high and low priorities respectively). This reflects the influence of “other factors” in judgements about priority based on prior experience.

The priorities reflect the views of the external panel and not of the workshop. It was agreed that the national demersal working groups would also provide their views on priorities, and these would be better informed with regard to operational limitations of the various approaches, and any conflicts or synergies with existing programs.

7. Assessment modeling approaches and data inputs

The workshop **supported** ongoing efforts to move to split-species assessments. In the case of *M. paradoxus* in Namibian waters, investigative split-species models would allow evaluation of whether or not the catch and survey data can be reconciled under the assumption of a separate Namibian stock. Some problems in assessments were identified, such as low recruitment variability, and high estimated natural mortality when this parameter is unconstrained, some of which could be a result of model misspecification in terms of stock structure and/or multi-species interactions.

Experimental results presented to the workshop indicate that trawl catchabilities (see section on survey trawl performance below) may be different for the two species. This finding also supports the move to split-species assessments.

The following **recommendations** were made:

a) ICSEAF reports must be examined for information leading to ways to help split catches to species from historical data. It will be important to confer with people knowledgeable about the data collection programs during these times to better understand these data.
b) As an alternative, catch-splits to species could simply be dealt with by using alternative values to evaluate sensitivity.
c) If the above approaches prove not to be feasible, it may be appropriate to undertake sensitivity tests involving starting the assessment model from 1990.

A summary of availability of assessment data for both countries was presented, which compared the status and quality of types of information useful for fisheries assessment purposes.

Several **recommendations** were made concerning the current status of hake-related data in the region:

a) If a decision was made to go ahead with formal joint stock assessments, it is essential that a detailed description of data sets be prepared, and a process for agreeing on the data to be used as input to such formal assessments be put in place; a dedicated workshop is one suggested mechanism to achieve this. The appropriate authorities also need to address the issue of data availability for use in joint assessments to all participants in the process.
b) Algorithms used to split catches and CPUE should take into account inter-annual variability, seasonality and selectivity effects.
c) The workshop emphasized the importance of continuing the current observer programs (for at least 10 years) for the collection of data by species, including age-composition data. Some aspects of the program could be considerably enhanced, as described elsewhere in this report.

It was noted that ICSEAF sampling bulletins (from research vessels) contain historical catches split by fleet, species, division (generally 5 degree latitude blocks) and month.

The workshop reviewed the paper on survey gear performance experiments and recognized this work as critical to interpret how survey data are used within assessments. This work is encouraged, especially if consistent comparisons can be made across species and between areas (Namibia, and the west and south coasts of South Africa). The potential interaction with oceanographic conditions should be analyzed (e.g., dissolved O_2 levels) and the use of bottom contact sensors (particularly with depth) should be pursued. The meeting noted that further examination of gear deployment in these experiments is required.

8. Methods for modeling stock structure hypotheses

Alternative single-species approaches

The recommendation from the January 2004 BENEFIT/NRF/BCLME workshop calling for spatially disaggregated modeling remains unchanged (see Fig. 9 of Appendix C). The difficulties with obtaining sufficient numbers of aged fish within depth strata were recognized. For practical purposes, the model outlined in Fig. 9 can be configured as a special case of Fig. 10. It may be advantageous to start investigative exercises with a flexible modeling tool (such as in Fig. 10) that can more easily evaluate alternative stock structure hypotheses, while still capturing essential features of the data. There is an understanding that exactly how the alternative investigative models are specified will be up to the analysts.

There are growth rate differences between males and females and the effect of ignoring these differences should be evaluated, though the associated difficulties were recognized. Discussing this further would be an appropriate activity for a small joint working group.

Multispecies considerations

The workshop indicated that application of a geographically explicit multi-species model to the hake stocks was a reasonable way forward and useful for evaluating aspects of the ecosystem effects of fishing. However, the workshop recognized that application of such approaches to practical fisheries management problems is currently poorly developed. This type of study will provide a broader assessment of the impacts of fishing than currently available. The model proposed (GADGET) appears to be well suited to this problem. It was noted that presently the dominant hake predator in Namibia is hake. Further it was noted that the diet of *M. paradoxus* in Namibia is different than *M. paradoxus* in RSA. Collaboration among the two countries in exchanging data will be critical for this task.

The workshop agreed that collection of a large coordinated sample of hake diet composition every few years was preferable to a small sample every year. Before such a large sampling exercise is contemplated, the results of a modeling analysis to guide and prioritize data collection should be considered. Dedicated additional personnel (special observers, described above) might be appropriate for such data collection projects.

The meeting reviewed a risk assessment on the effects of joint management on a variety of ecosystem and economic issues. The method might help achieve stakeholder agreement, for example for the scenario analysis presented in the following section.

9. Assessing the need for and potential benefits from joint management

The workshop **recommended** that an analysis be conducted on the consequences of alternative management arrangements under a range of scenarios about stock structure and the extent of sharing between Namibia and South Africa. Costs and benefits of joint management should consider not only the consequences on the hake resources and their fisheries but also the ecosystem implications and the costs of implementation. This type of risk analysis should involve all stakeholders and should consider a range of performance measures that reflect the different viewpoints and interests. Typical performance measures include expected catches, CPUE, and different measures of risks to the stock. Trade-offs between conflicting management objectives would need to be considered.

10. Structures to best co-ordinate future joint stock-structure evaluation and assessment-related hake research

The workshop discussed existing models for international collaboration on fisheries research and management, including models from regional fishery commissions. These models would be relevant to the development of scientific committees under the umbrella of the intended Interim Benguela Current Commission (IBCC). Such committees might include a Joint Hake Scientific Working Group (JHSWG). One of the first tasks of the JHSWG would be to focus on the shared stock issue, and to carry forward the plan of action described below. This committee would generally meet annually to review and set priorities for assessments, research, and data collection programs, perhaps assisted from time to time by the inclusion of external experts. In the start up phase, more frequent meetings might be necessary. Once established, joint inter-sessional meetings (perhaps of sub-sets of the full JHSWG) would need to take place to address specific issues recommended for action at the annual meeting. An important consideration is that the right incentives need to be in place to motivate cooperation in such a process (both for individuals and governments). The meeting also noted that there would be benefits arising from a JHSWG irrespective of the issue of possible joint management of shared stocks (including sharing of research ideas and methods, economies of scale in infrastructure and survey planning, improving and standardizing research and monitoring protocols, sharing data etc.).

Recommended plan of action

Please see Workshop Report

- Pick up key recommendations from this report and turn into specific actions
- It was suggested that authorities from both countries confer with BCLME to refine the action plan developed here
- Include time frames noting the need for a small coordinating group to meet within the next few months.

Appendix A. Presentation by the External Panel to Senior Management

Joint Hake Research Planning Workshop

Cape Town
9-12 May 2006
Report to Senior Management

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Workshop Objectives

- On the basis of the information available, what can be said about the likelihood of shared stocks?
- If the situation is not clear, what are the priorities for further data collection and analysis?
- If a joint assessment is required, what are the data needs and what is the most appropriate form of assessment?

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Defining terms

- Shared stock
  - Where mixing or movement across a maritime boundary is so great as to require cooperative or joint management between two states
- Joint management
  - Independent management informed by a joint scientific working group
  - Intergovernmental agreement on a joint management plan
  - Establishment of a regional commission

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Motivation for the workshop

Do Namibia and South Africa have shared stocks of hake?

- If so, what are the risks of management failure (stock collapse) with separate management?
- What are the costs and benefits of joint management?

Note: complicated by two hake species

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Scenario analysis

	No sharing of stocks	Little sharing of stocks	Large sharing of stocks
Separate management			--
Joint management	-	-	

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Objective 1 – evidence for shared stocks

Assumptions prior to the workshop

- Management assumption
  - Separate stocks for both hake species
- Biological assumption
  - Shallow water hake (capensis) separate
  - Deepwater hake (paradoxus) shared

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Information presented

- Recent BCLME/BENEFIT trans-boundary research surveys
- Recent genetic research
- Studies on spawning biology
- Other information

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Summary of results

M. capensis

- Evidence for spawning in both countries
- No genetic evidence for stock separation

M. paradoxus

- No (direct) evidence for spawning in Namibia
- Juveniles found in the south of Namibia
- Preliminary genetic evidence for multiple stocks (not necessarily at the border)

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Summary of results

At face value, conflicting results for both species, BUT ….

- Absence of evidence for multiple stocks does not necessarily imply a shared stock
- Genetic results are preliminary
- Spawning biology for paradoxus in particular is quite uncertain (where and when they spawn)

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What can be concluded?

- From the evidence presented, there are still major uncertainties about whether there are multiple stocks (for both species but particularly for paradoxus)
- Not all of the available data were presented
- Further compilation and analysis of existing data is required

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Objective 2 – future work

Key recommendation – synthesis of existing information for both countries relevant to stock structure

- Comprehensive bibliography (with keywords)
- Inventory of data (type, area, season, …)
- Review and analysis of data
- Identification of plausible hypotheses
- Gap analysis and development of priorities for research and monitoring

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Objective 2 – future work

Workshop discussed ongoing or planned research for stock discrimination in several key areas

- Fishery surveys
  - Provide useful information on distribution and abundance
  - Useful platform for other observations (objectives may conflict)
  - Not so good for seasonal coverage
- Commercial observer data
  - Would improve seasonal and spatial coverage
  - Specialist observers could collect key data (GSI, otoliths, genetic samples, stomachs etc)
- Egg and larval surveys
  - Useful to identify spawning (time and place)
  - Need genetics to identify species
  - Plans for further surveys but spatial coverage should be extended

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Objective 2 – future work

- Further genetic studies
  - Preliminary results show promise
  - Powerful tool but relatively expensive
  - Staged approach recommended
- Tagging
  - Gives direct evidence of movement
  - Relatively expensive
  - Observer coverage essential for recovery
- Morphometrics
  - Cheap but uncertain benefit
- Other (birth date, otolith chemistry, diet etc)

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Objective 2 – future work

General points about future research

- Need for ‘synoptic’ (coastwide) data
- Also need for seasonal data
- Advantages of cooperative research with industry (including use of specialist observers)
- Need for agreed and shared protocols on sampling between Namibia and South Africa
- Need “portfolio” approach – biology, genetics, tagging, modelling – advance on all fronts together

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Objective 3 – joint assessments

- Some concerns expressed about rushing to joint assessments
- However modelling will play a key role in testing hypotheses about shared stocks
- Priorities for such modelling include
  - Separation of data into the two hake species
  - Development of a shared and agreed database

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International experience with shared stocks

- Agreement to act and burden of proof
  - Arguments presented that burden of proof is to establish “beyond doubt” that stocks are shared (default is separate stocks)
  - Dangers of this approach if stocks are shared but scientific evidence is uncertain
  - Recommend scenario analysis to look at costs and benefits of joint management given uncertainties about extent of sharing of stocks

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International experience with shared stocks

- Establishment of mechanisms for cooperation
  - Establish joint scientific working group
    - Compile relevant data
    - Establish joint database
    - Develop collaborative research program
    - Evaluate extent of stock sharing
    - Undertake joint stock assessments

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Conclusions

- Do Namibia and South Africa share stocks of either hake species?
  - Less likely for capensis
  - Possible for paradoxus but still uncertain
  - The possibility of shared stocks should be taken seriously by both countries
  - Priority to reduce uncertainty through a collaborative research program
  - Value of joint scientific working group

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Research recommendations (relevant to shared stocks)

- Synthesis project (urgent)
  - Compile and evaluate existing information
  - Identify key gaps and develop research program
- Collection of further data
  - Portfolio approach – biology, genetics, tagging, etc
  - Need to balance cost versus likelihood of success
  - Industry cooperation and specialist observers
  - Role for modelling in testing hypotheses
- Scenario analysis for costs and benefits of joint management

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Appendix B. General Discussion on Management of Shared Stocks

(submitted by Andrew Penney)

Definition of "Shared Stocks" (Hayashi 1993)

> *"A group of commercially exploitable organisms distributed over, or migrating across, a maritime boundary between two or more national jurisdictions, whose exploitation can only be managed effectively by cooperation between the States concerned, but where emigration to or immigration from other jurisdictions need not be taken into account."*

Required components and sequence of steps for effective shared stocks management

- The first requirement is a need to demonstrate the shared status of a stock "beyond reasonable doubt". (Note that this is facilitated by, and may require, the implementation of further steps below, such as conducting of joint assessments.)
- Comprehensive and comparable fisheries and biological data are required for the shared stock across all areas / jurisdictions within which the stock occurs. These need to be collected in accordance with agreed standards.
- The usual next step is the establishment of a joint / shared database of catch, effort, size-frequency and other data required for assessments. This may initially comprise separate databases from the neighbouring countries concerned, but these need to be merged into a shared database for use in joint assessments. The contents of this shared database should be made openly available to all participants in the respective scientific working groups of the countries concerned, or of the Joint Scientific Working Group, where such exists.
- The need for shared data collected in accordance with agreed standards can be best facilitated and managed under the auspices of Cooperative Research Programs. Such programs typically form the first stage of formal cooperation between neighbouring states in the move towards cooperative management of a shared stock. They serve to coordinate efforts to reach agreement on the degree of sharing of the stock concerned, data collection, preparation and exchange standards and establishment of a joint database. Even where actual cooperative management does not occur, cooperative research programs usually serve to align management objectives and approaches in the countries fishing the shared stock.
- Emanating from cooperative research programs, the Establishment of a formal Joint Scientific Working Group between the countries concerned is often the first major step towards actual cooperative management. The establishment of such a group is almost essential to the conducting of joint assessments. Recognising the important role that industry needs to play in providing and commenting on data, agreeing on management objectives and providing funding through fishing levies, adequate industry representation should be included in working groups.
- Agreement of the shared nature of a stock, development of a shared fisheries database and establishment of a Joint Scientific Working Group are usually pre-cursors to the conducting of Joint Stock Assessment/s for the shared stock. Joint Assessments are, in turn, required to explore alternate stock sharing hypotheses, to generate assessments of the state of the stock under these alternate hypotheses, to demonstrate the risks and benefits of cooperative approaches to management of the stock and underpin management recommendations from the Joint Scientific Working Group to the governments of the countries concerned.
- In particular, demonstrating the risks and benefits of cooperative *vs* separate management of the stock under various sharing hypotheses can be an important requirement for reaching agreement on the degree of sharing of the resource concerned, and the need for this to be cooperatively managed.

Range of options for cooperative management

Even once agreement has been reached on the shared nature of a stock, joint assessments conducted and agreement reached on the need for cooperative management, there remain many options for actually conducting such joint management, These include:

- Independent declaration of country TACs, sharing arrangements and other management measures by each of the countries concerned, in response to the advice of the Joint Working Group.
- Independent management by countries, but in accordance with inter-governmentally agreed objectives, including the option of an agreed joint Management Plan
- Formal establishment of an inter-governmental cooperative management commission of some sort, within which allocation, sharing, effort limitation and other measures are negotiated.

Use of socio-economic data in support of socio-economic objectives

- It is recognised that both Namibia and South Africa have strong socio-economic objectives included within their objectives for fisheries management.
- As yet, there are few examples of the explicit incorporation of quantitative socio-economic data directly into assessments. There are often problems associated with obtaining and sharing reliable quantitative economic data for fisheries.
- However, there are a number of levels at which socio-economic information can interact with, or be considered within the context of, fisheries assessments:
  - Where different fishery components (~socio-economic strata) have differential access to various areas or depth ranges, or use different gears, and so target different size ranges of fish, implications of differential allocation between these components may need to be considered in evaluating fisheries selectivities and F on various age classes when conducting assessments.
  - Broader socio-economic objectives may be important in influencing the choice management objectives used to evaluate performance of assessment projections, management plans and stock rebuilding strategies. For example, slower rebuilding may be required to accommodate reliant fisheries participants. Conversely, more rapid CPUE-related rebuilding objectives may outweigh B rebuilding objectives to restore profitability of a fishery.
- However, consideration of socio-economic objectives is usually, and appropriately, a second phase process, after assessments have been conducted. It is important to ensure that (short-term) socio-economic objectives are not allowed to jeopardise the (longer term) sustainability of the stock.
- Direct consideration of socio-economic constraints and requirements usually occurs at the management decision making (government or Commission) level, where socio-economic information and motivations often underpin inter-governmental negotiations on TAC allocation and sharing arrangements, and subsequent within-country allocation processes designed to ensure equitable distribution of access across fishery sectors or participants so as to maximise benefits to various socio-economic strata.

How great a degree of sharing needs to be established to warrant consideration of possible (eventual) joint management ?

What capacity and analyses are prerequisites for successful joint management ?

These questions are typically answered by conducting simulations to evaluate the effects of various degrees of stock sharing, and of various options for cooperative management responses. Such simulations are required to evaluate the risks of not cooperating in management of a resource that is shared, and the benefits of cooperative management of a shared resource.

- Results of simulations will depend on the specific circumstances of a fishery. There may or may not be benefits to be derived from cooperative management.

- Simulations need to be conducted using assessments for the shared stock, perhaps using a range of alternative plausible sharing hypotheses. Such assessments must therefore be available, and considered to be acceptably plausible and reliable. Where assessments are considered to be incorrect or uninformative, these will first have to be improved before being used in simulations.
- There preferably needs to be agreement that a stock is shared, or on a set of sharing hypotheses, before proceeding to simulations of alternative cooperative management approaches. However conducting simulations on alternate sharing hypotheses can be an important aid to understanding the benefits of cooperative management, and promoting common understanding of these benefits.

Papers Presented

Ianelli, J. 2006. Cooperative international fisheries research programs: Selected examples from the North Pacific. *BCLME Joint Hake Research Planning Workshop, Working Document*, 13pp.

Penney, A.J., I. Hampton, R.P. van der Elst, A.D. Wood, H.J. Boyer, S. Fennessy and ZT.G. Andrew 2003. Extracts from: Requirements for the development of effective cooperative arrangements for the management of shared fish stocks in the SADC region. *EFA Report to the RFIS Project*, 174pp.

Punt, A.E. and V.R. Restrepo 1995. Some effects of ignoring mixing when managing fish populations subject to “limited” mixing. *ICES Long-Term Management Measures Working Group, Working Document*, 26pp.

Other References

Hayashi, M. 1993. The management of transboundary fish stocks under the LOS Convention. *International Journal of Marine and Coastal Law*. 8(2): 245 - 261.

Payne, A.I.L, C.M. O'Brien and S.J. Rogers (Eds) 2004. Management of Shared Fish Stocks. *Proceedings of the CEFAS Centenary Symposium “International Approaches to Management of Shared Stocks - Problems and Future Directions”*. Blackwell Publishing, Oxfordshire. 384pp.

Appendix C. Figures of alternative stock structure hypotheses

(from Butterworth and Rademeyer BCLMEHW/MAY06/5.1 and Butterworth and Rademeyer BCLMEHW/MAY06/9.2.1)

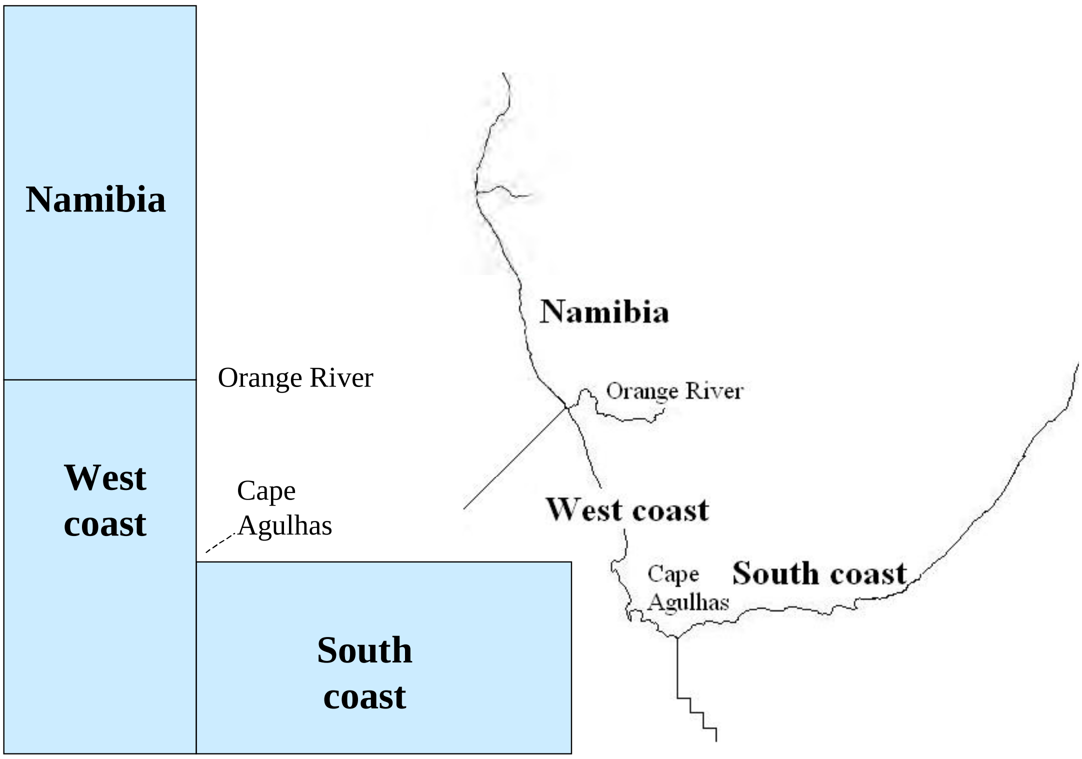

Fig. 1: Schematic representation of the three regions.

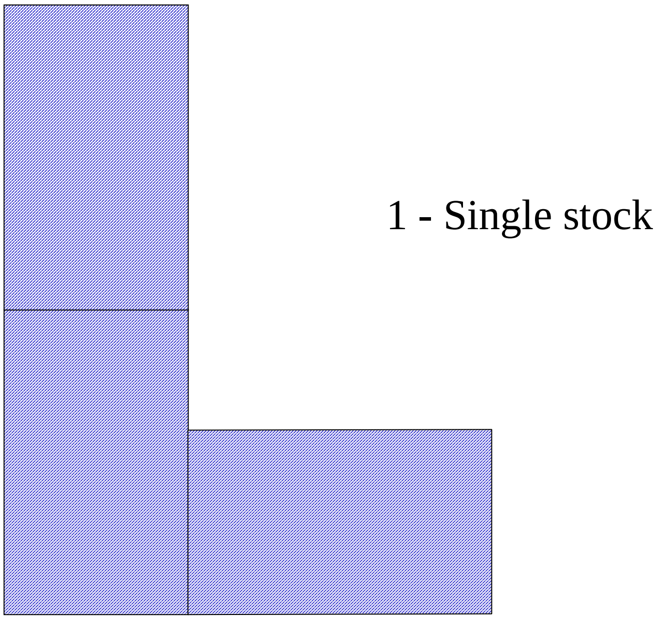

Fig. 2: Single stock hypothesis.

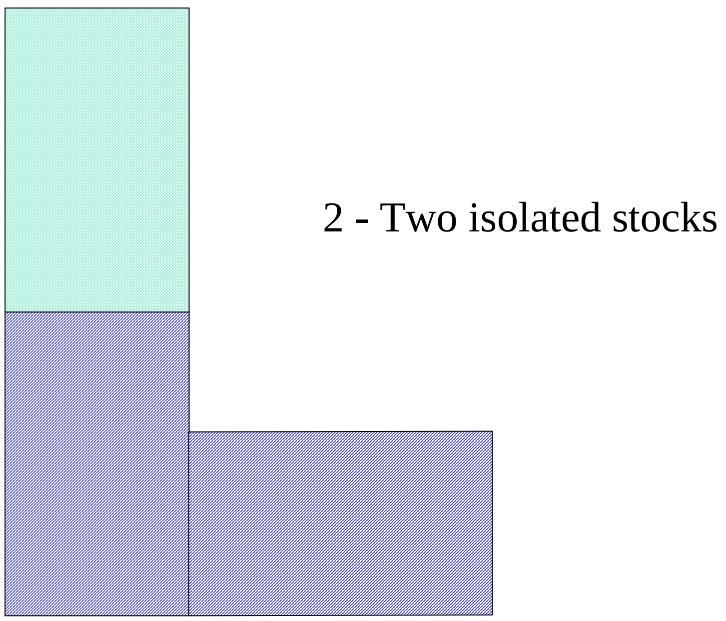

Fig. 3: Two isolated stocks hypothesis.

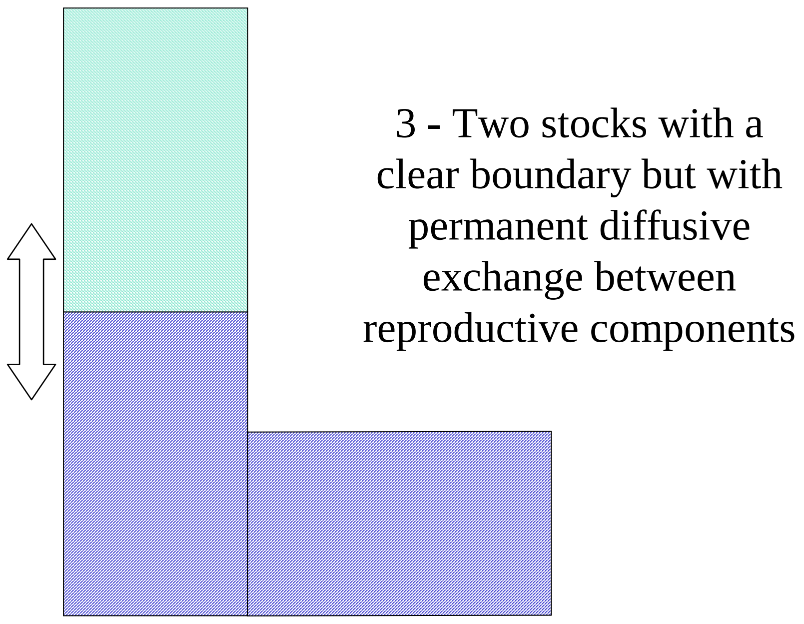

Fig. 4: Two stocks with a clear boundary but with a permanent dispersal between the reproductive components.

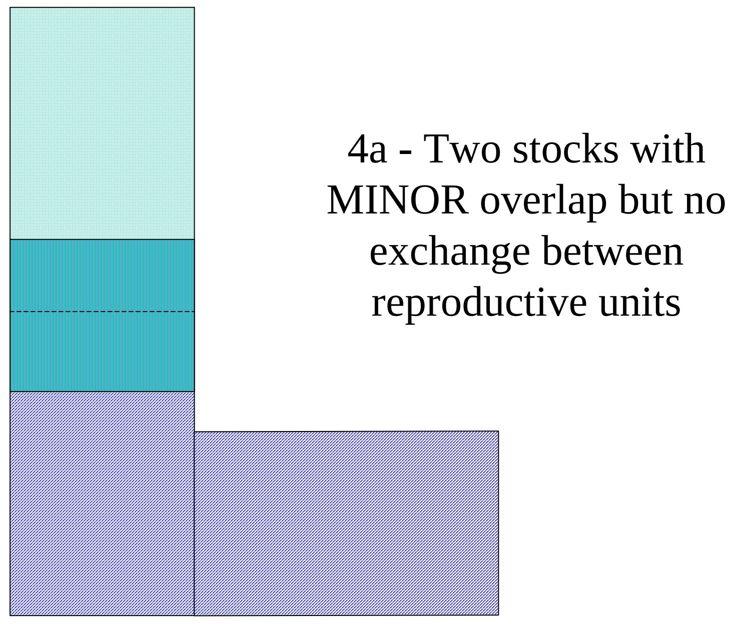

Fig. 5: Two stocks with a minor overlap but no dispersal between the reproductive components.

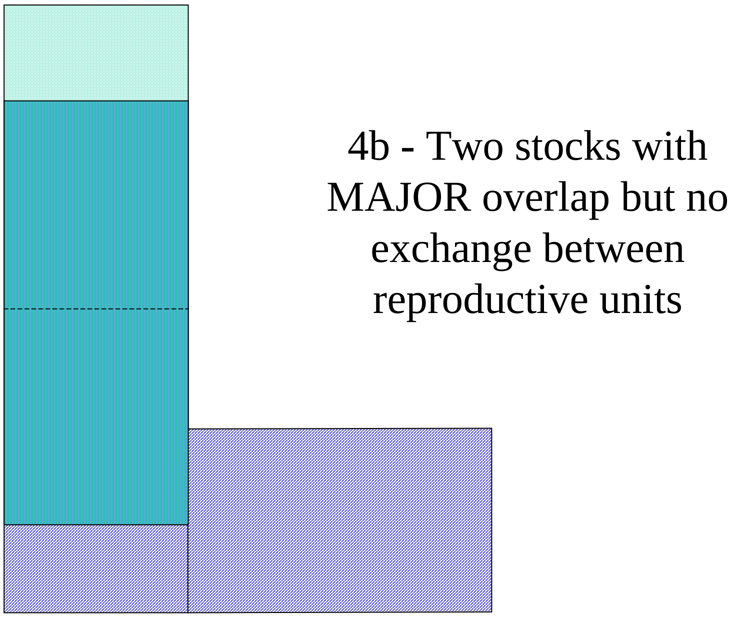

Fig. 6: Two stocks with a major overlap but no dispersal between the reproductive components.

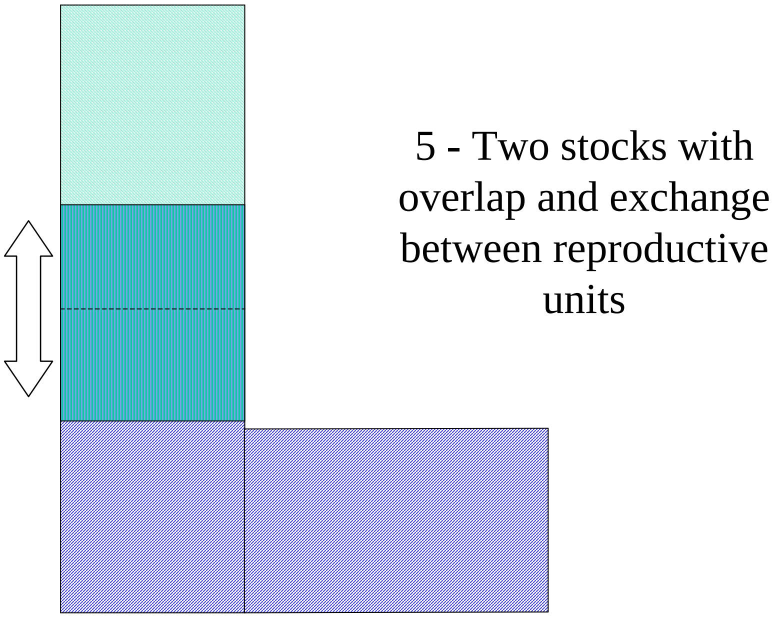

Fig. 7: Two stocks with overlap and exchange between reproductive units.

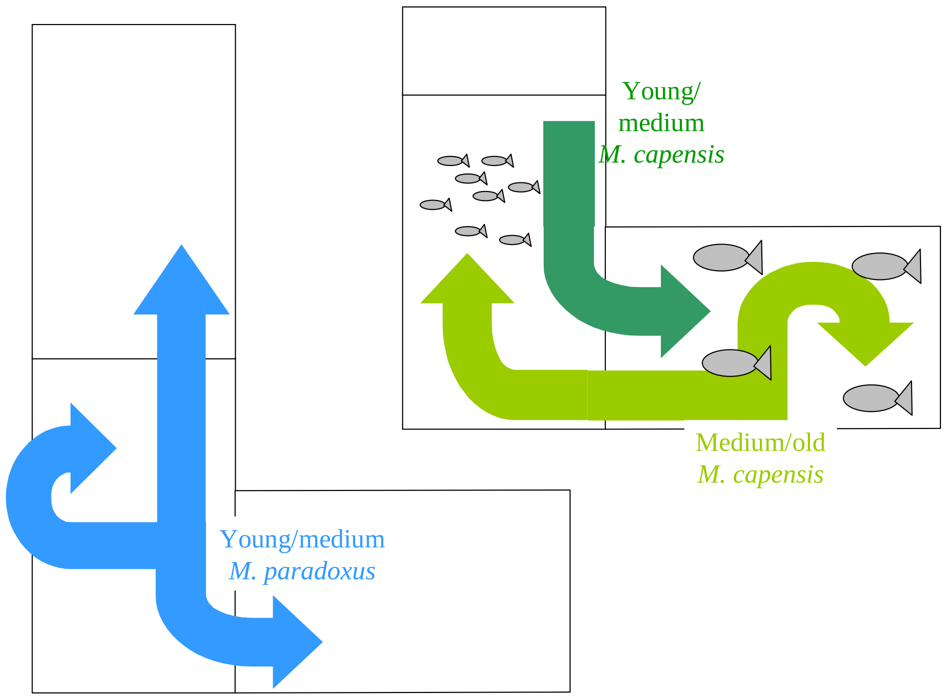

Fig. 8: Possible age-specific movements within regions for the two species; note the differences for *M. paradoxus* and *M. capensis*, and that for the latter only representation of a stock restricted to South Africa is intended here.

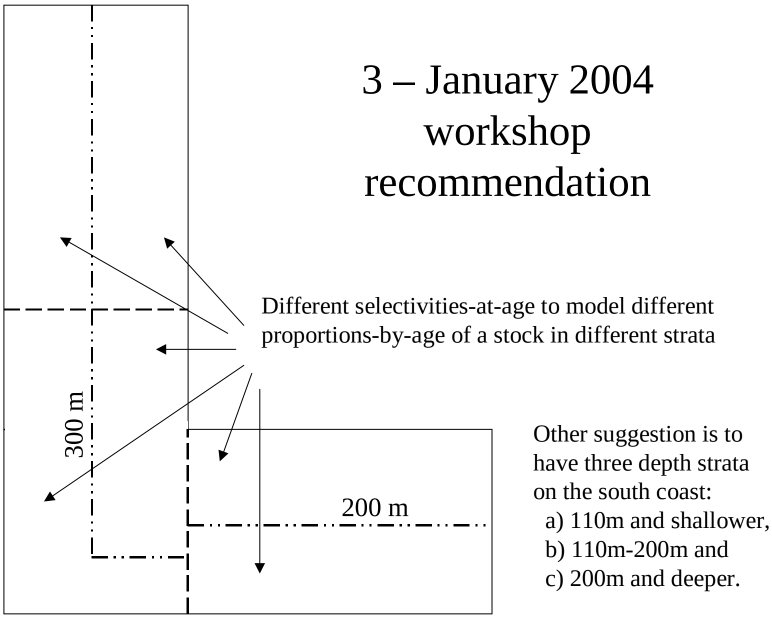

Fig. 9: Single-species modelling approach as recommended by the January 2004 BENEFIT/NRF/BCLME workshop (BENEFIT, 2004). The depth boundaries shown for South Africa are as chosen by the MCM Demersal Working Group (WG/07/04/DH09)

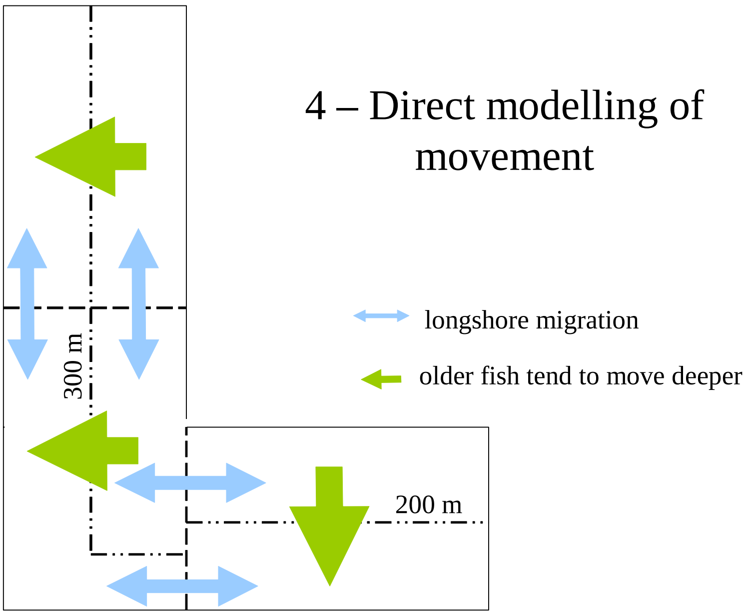

Fig. 10: Single species approach with direct modelling of movement.

Appendix D. Motivation for genetics research

(by Sophie von der Heyden and Paulette Bloomer)

Genetic markers such as mitochondrial DNA and microsatellites are powerful tools to detect spatial and temporal distribution of genetic variation within species, as well as in the detection of structuring within species and the extent of this (i.e. no structure, structure or structuring with some mixing).

Given the appropriate sampling a null hypothesis of no differentiation can be rigorously tested for the *M. capensis* and *M. paradoxus* populations.

Once a baseline (i.e. are there multiple stocks?) is established, appropriate and thorough sampling will allow establishment of the distribution of the stocks at different life history stages and at different times within a year (testing for seasonality).

Migration rates can be estimated from these data, depending on the complexity of the stock structuring recovered (and given appropriate sampling in terms of where and how many samples). Estimating migration rates is very important for fisheries stock assessments.

Further, species-specific mitochondrial DNA sequences allow the identification of egg and larval stages, assisting in the interpretation of biological and catch data (such as the distribution of eggs and larvae recovered from surveys).

We firmly believe that for the long-term sustainability of the Cape hake fishery, we need to understand the evolutionary and ecological processes that determine the level and distribution of genetic variation in these species. Using a combination of mitochondrial DNA and microsatellite markers, we aim to understand the processes driving possible stock structuring in Namibian and South African hakes.