ECOFISH WORK PACKAGE 1: STOCK ASSESSMENT

Report of the Phase 1 Workshop: Compilation of Hake Data for Transboundary Analyses

28 – 29 November 2011, University of Cape Town, South Africa

SUMMARY

A workshop was convened in November 2011 to clarify data issues pertaining to cross-boundary stock assessments of the Namibian and South African hake resources through Work Package 1 of the ECOFISH programme. The workshop was convened in conjunction with the DAFF/MARAM annual International Stock Assessment Review Workshop at the University of Cape Town. The ECOFISH WP1 component of the workshop aimed firstly at reviewing the data available for cross-boundary assessments of hake resources in the Benguela Regions. The second objective was to then agree on the data that would be made available to all participants in ECOFISH WP1 for use in the various stock assessment approaches and models that are being developed in this component of the ECOFISH programme.

INTRODUCTION

Work Package 1 (Stock Assessment) of the ECOFISH programme is being conducted in two phases:

Phase 1: Extend existing hake stock assessments to take better account of current data and knowledge, as well as setting up alternatives to these models to determine how robust their outputs are

Phase 2: Use new information gathered from WP2 to further improve and elaborate the stock assessments.

Both phases are initiated by a workshop to clarify data issues for cross-boundary analyses. This document reports on the first of these workshops that was convened in November 2011 (in conjunction with the annual DAFF/MARAM international stock assessment review workshop) with the intention of:

- Reviewing the data available for cross-boundary hake stock assessments
- Agreeing on the data sets that would be made available to the ECOFISH WP1 team members for use in the various modeling approaches being explored within the work package.

The workshop was attended by representatives from Namibia (MFMR), South Africa (DAFF and MARAM) and Denmark (DTU-Aqua). Available data were reviewed during open session of the DAFF/MARAM International Stock Assessment Review Workshop by all participants in that workshop as well as the International Review Panel. Discussion of which data would be required and could be made available was conducted during a separate meeting of the ECOFISH WP1 representatives.

REVIEW OF AVAILABLE DATA

NAMIBIA

1. Research survey data

Stratified random bottom trawl annual Spanish surveys were undertaken off the Namibian coast from 1983 to 1990 in both summer and winter. The biomass estimates (with associated CVs) of hake of these surveys (Macpherson and Gordoa, 1992), are being recalculated (Gordoa, *pers. comm*.). CPUE indices are also available for each of the surveys.

Demersal biomass surveys using a transect design were undertaken by the Ministry of Fisheries using the *R.V. Dr Fridtjof Nansen* from 1990 to 1999, and subsequently using a commercial fishing vessel. In the 1990s, two surveys (one in summer and one in winter) were undertaken annually. However, since 1997, only the summer (January-February) survey has been conducted. Biomass estimates (with associated CVs) as well as catch-at-length are therefore available for the winter survey of 1990 and from 1992-1996, and for the summer surveys from 1990 to 2011.

2. Commercial catch data

Total Catch:

Annual catches are available for the period 1964 to the present. There are concerns that the data may be compromised by substantial under-reporting by the foreign fleets that operated prior to 1990. The species-split of the catches is based on observer and survey data and carried out using the method developed by Johnsen and Kathena (2011).

Spatial data associated with catches (species aggregated) for the period 1992 – 1997 are available at a daily level, while data post-1997 are available on a tow-by-tow basis.

CPUE:

Three commercial CPUE indices are available:

- ICSEAF areas 1.3 and 1.4 (1965 – 1988) – represents Spanish bottom trawlers in the tonnage class 7 (1000 – 1999 GRT). Post-1980 data should not be used as they have been found to be positively biased.

- ICSEAF area 1.5 (1965 – 1988) – pools the Spanish data described above with South African bottom trawlers in tonnage class 5 (300 – 600 GRT). Post-1980 data should not be used as they have been found to be positively biased.
- A GLM standardised CPUE index for the Namibian bottom trawl fishery (1992 – present). This is based on commercial catch data split by species according to the method of Johnsen and Kathena (2011).

Catch-at-length and Catch-at-age:

- Commercial catch-at-length data are available from the commercial sampling program (CSP) by observers since 1997.
- Survey catch-at-length data are available since 1990, from annual swept-area biomass surveys
- Commercial ICSEAF catch-at-age data (1968-1988) used in the assessment is published in Butterworth and Geromont (2001). However, the origin of these data could not be traced in the ICSEAF documentation. In some assessments these data are referenced to ICSEAF (1989), which is a compilation of historical data series selected for Cape hake stock assessments. However, this ICSEAF (1989) does not include any catch-at-age data. In Punt and Butterworth (1989), these data are referenced as (B. Draganik, ICSEAF, pers. comm.). An alternative catch-at-age matrix (1968-1986) is published in Gordoa *et al.* (1995) and Gordoa and Hightower (1991), and referenced to Draganik and Sacks (1987).
- From 1990, age data were obtained for some years by reading annual rings on otoliths (Margit Wilhelm, unpublished data). For the years for which such observed age data is not available, an iterative age-length key method (Lai *et al.* 1996) was used to estimate proportions in each age group from the proportions of the length frequency distributions (Clark, 1981). Also available is a recruitment index from 1994 to 2009, which was obtained on an annual basis by determining the proportion of *M. capensis* otoliths found in seal scat samples (Jean-Paul Roux, unpublished data).

SOUTH AFRICA

1. Research survey and biological data

Demersal research surveys have generally been conducted annually (Table 3) on board the FRS *Africana* from 1986 on the south coast (in autumn with some surveys also in spring) and from 1985 on the west coast (in summer with some surveys also in winter). The surveys are aimed primarily at estimating hake abundance using the swept area approach. West coast surveys cover the shelf off the west coast of South Africa from the border with Namibia (Orange River mouth) to 20°E (Cape Agulhas). South coast surveys cover the shelf off the SA south coast from 20°E (Cape Agulhas) to Port Alfred. The surveys extend from the coast to the 500 m isobath, and are designed following a

pseudo-random stratified approach to station selection. The survey area is stratified by depth and latitude/longitude with the number of stations per depth stratum being proportional to the area of the stratum. Abundance estimates (with associated errors) are calculated per stratum, and for the survey as a whole as described in Rademeyer *et al*. 2010. Hake length frequency data (by sex) collected from each trawl are raised to each stratum and to the survey area as a whole, and expressed as proportions-at-length using the methods described in Rademeyer *et al*. 2010.
It must be noted that:

- Surveys in 2000 and 2001 were conducted on board the *Dr Fridtjof Nansen* because of technical problems with the *Africana.*
- A change in the fishing gear was implemented in 2003. A calibration factor for each hake species is available to account for the change.

Data available for each of the hake species from each of the surveys listed in Table 3 are:

- Station details (date, time, position, depth, stratum, trawl duration, gear, total catch by species, area swept)
- Density (kg.nm^{-2}) at each station
- Biomass estimates (tons) with associated standard errors for each depth stratum
- Biomass estimates (tons) with associated standard errors for the entire survey area
- Length frequencies per station (these can be disaggregated by gender for some surveys – see Table 4)
- Length frequencies per depth stratum (these can be disaggregated by gender for some surveys – see Table 4)
- Length frequencies for the entire survey area (these can be disaggregated by gender for some surveys – see Table 4)

Biological data available for each of the hake species:

- Maturity-at-length – assumed to follow a logistic curve (Fairweather and Leslie 2008)
- Weight-at-length – calculated for each species taking the average of data from the west and south coasts (Fairweather 2008)
- Age-length keys – age data collected by a number of different readers over time (see Rademeyer 2011) are available, disaggregated by gender

All research data are in the public domain and freely available.

Table 3: Summary of abundance estimate surveys completed since 1985. Surveys 069 and 109 did not achieve adequate sampling and several south coast surveys were completed within the 200m depth contour in contrast to the entire 500m area. Surveys completed on the *RV Fridtjof Nansen* are underlined and *RV Africana* surveys using "new gear" are in bold.

	WEST COAST		**SOUTH COAST**	
Year	**Summer (Jan)**	**Winter (July)**	**Autumn (April)**	**Spring (Sept)**
1985	AFR 028	AFR 033		
1986	AFR 039	AFR 046		AFR 048
1987	AFR 050	AFR 054		AFR 056
1988	AFR 059	AFR 066	AFR 063	
1989	AFR 069	AFR 075	AFR 072 <200m	
1990	AFR 079	AFR 084	AFR 082 <200m	AFR 086 <200m
1991	AFR 088		AFR 093	AFR 095 <200m
1992	AFR 100		AFR 102	AFR 106 <200m
1993	AFR 109		AFR 111	AFR 116 <200m
1994	AFR 118		AFR 122	AFR 125 <200m
1995	AFR 127		AFR 129	AFR 131 <200m
1996	AFR 133		AFR 135	
1997	AFR 139		AFR 144	
1998	**NO SURVEYS COMPLETED - AFRICANA OUT OF COMMISSION**			
1999	AFR 150		AFR 152	
2000	NAN 001		NAN 003	
2001	NAN 004			AFR 160
2002	AFR 165			
2003	AFR 173		AFR 177	**AFR 182**
2004	**AFR 188**		**AFR 191**	**AFR 200a**
2005	**AFR 203**		**AFR 206**	
2006	AFR 214		AFR 217	AFR 224
2007	**AFR 228**		**AFR 232**	**AFR 236**
2008	**AFR 238**		**AFR 241**	**AFR 246**
2009	**AFR 249**		**AFR 252**	
2010	AFR 259		AFR 261	
2011	**AFR 270**		**AFR 273**	
2012	**AFR 279**			

Table 4: Summary of length frequency data collected during South African demersal surveys that are available for the two hake species. Periods for which data can be separated by gender are indicated in the "Disaggregated" column.

Coast	Survey	Gender	
		Disaggregated	**Combined**
West	Summer	1993-1999	1985-1992
		2006-2011	2002-2005
	Winter		1985-1990
South	Spring	2006-2008	1986-1987
			2001-2004
	Autumn	1993-1997	1988-1992
		2006-2011	1999-2005

2. Commercial catch data

Total Catch:

Annual hake catches disaggregated by fleet, species and coast are available for the period 1917 – 2011.

Catches made by the hake longline fleet on the west coast are assumed to comprise 30% *Merluccius capensis* for the period 1994 – 2011 (longline catches prior to 1994 are assumed to be negligible), while those made on the south coast during this period are assumed to comprise 100% *M. capensis*.

Catches made by the hake handline fleet for the period 1985 – 2008 (catches prior to 1985 are considered to be negligible) are assumed to be 100% *M. capensis* because the fleet only operates in relatively shallow water on the south coast.

Catches made by the inshore trawl fleet (operates only on the south coast) are considered to be 100% *M. capensis* because the fleet only operates in relatively shallow water.

A number of assumptions and approaches are used to split the landings of the deep sea trawl fleet by species:

1917 – 1977: Splitting is based on an assumption regarding the expansion of the fishery into deeper water. Specifically, the proportion of *M. capensis* in the catches is assumed to decrease following a logistic function over this period (Rademeyer *et al*., 2008)

1978 – 2011: The species splitting algorithm developed by Gaylard and Bergh in 2004 (and updated in 2009) is used to split catches based on coast, depth, size of hake, year (west coast model) and longshore position.

CPUE:

Six time series of commercial hake CPUE indices are available:

- Species-aggregated CPUE indices for each of the south and west coasts were developed by ICSEAF and cover the period 1955 to 1977. These CPUE series cannot be disaggregated by species, as there are no effort-by-depth data available for the pre-1978 period (the species splitting approach described below requires effort and depth information for each trawl).
- GLM-standardised CPUE indices derived from catch and effort data from the deep sea trawl fleet (Glazer and Butterworth, 2009) are available by species for each of the south and west coasts, and cover the period 1978 – 2011. Catch data used in the CPUE computations are split by species using the Gaylard and Bergh (2009) algorithm.

Catch-at-length and Catch-at-age:

Length frequency data for catches made by the deep sea trawl fleet are currently not available at the level of species. The reason for this is that measurements are generally based on cleaned (headed and gutted) fish, which cannot be readily identified by species. Generally, length structure information on commercial size categories is obtained from a few fishing companies. The data are then scaled up to the annual catch per commercial size category for the sampled companies, from which the length structure data are then scaled up to the annual catch per coast. The raw data used to estimate catch-at-length of the deep sea trawl fleet prior to 1999 no longer exist. The aggregated data are in the public domain and freely available.

In the case of the inshore trawl sector, it is assumed that catches are exclusively *Merluccius capensis*. Length structure per commercial size category information is collected at shore-based processing establishments. Observed length data are scaled up to yield estimated length structures per individual landing, which are then summed over sampled landings and scaled up to the annual catch by the inshore fleet. The raw data used in these computations cannot be made available, as they were collected from specific companies, and are therefore confidential. The aggregated data are, however, in the public domain and freely available.

Catch-at-length information for the longline sector is obtained from sea-based length frequency data collected by scientific observers. These data are scaled up to the annual catch per coast. Note that it is assumed that, as with inshore trawl, all longline hake catches on the south coast are assumed to comprise only *Merluccius capensis*.

Available commercial catch data are summarized in Table 5.

FAO-NANSEN

Data concerning both hake species have been collected by the *Dr. Fridtjof Nansen* during the BENEFIT/BCLME/BCC Transboundary surveys. These surveys have been conducted following a transect survey design and using Gisund trawl gear (a modified shrimp trawl).

Table 5: BENEFIT/BCLME/BCC Transboundary surveys conducted by the *Dr. Fridtjof Nansen*

Cruise	Year	Month	Area	Purpose
2000401	2000	Jan-Feb	Orange River – Cape Agulhas	Abundance
2000405	2000	May-Jun	Cape Agulhas – Port Alfred	Abundance
2001401	2001	Feb	Orange River – Cape Agulhas	Abundance
2002401	2002	Jan-Feb	St Helena Bay	Transboundary
2003401	2003	Jan-Feb	Orange River – Cape Agulhas	Transboundary
2004403	2004	Feb-Mar	Orange River – St Helena Bay	Transboundary/intercalibration
2005402	2005	Feb-Mar		Transboundary
2006402	2006	Jan-Feb	Orange River – Cape Agulhas	Transboundary/intercalibration
2007401	2007	Jan-Feb	Orange River – Cape Agulhas	Transboundary
2008401	2008	Jan-Feb	Orange River – Cape Agulhas	Transboundary
2009401	2009	Jan-Feb	Orange River – Cape Agulhas	Transboundary
2010401	2010	Jan-Feb	Orange River – Port Alfred	Synoptic
2011401	2011	Jan-Feb	Orange River – Cape Agulhas	Transboundary

DATA TO BE USED AS INPUTS TO CROSS-BOUNDARY HAKE STOCK ASSESSMENTS

NAMIBIA

1. **Research survey data**
   a. Biomass estimates with associated standard errors for each species for each survey.
   b. Catches-at-length (length frequency data for each species raised to the survey level).
   c. Catches-at-age (all age length keys available for surveys).
   d. Maturity-at-length/age (maturity-at-length parameters per species).
   e. Weight-at-length/age (weight-at-length parameters per species).

2. **Commercial catch data**
   a. Total Catches - annual catches for the period 1964-2011, disaggregated by species and fleet (offshore trawl and longline).
   b. CPUE
      - Species-aggregated ICSEAF CPUE for Divisions 1.3 + 1.4 and for Division 1.5
      - Species-disaggregated GLM-standardised CPUE for the period 1992-2010.
   c. Catches-at-length/age

SOUTH AFRICA

1. **Research survey and biological data**
   a. Biomass estimates with associated standard errors for each species and survey, disaggregated by depth strata.
   b. Catches-at-length (length frequencies for each species and surveys, disaggregated by depth strata).
   c. Catches-at-age (all age-length keys available for survey samples)
   d. Maturity-at-length/age (maturity-at-length parameters for each species)
   e. Weight-at-length/age (weight-at-length parameters for each species)

2. **Commercial catch data**
   a. Total Catches - annual catches (tons) by species for the period 1917 – 2011, disaggregated by fleet (offshore trawl, inshore trawl, hake longline and hake handline) and coast (west and south).
   b. CPUE - species-aggregated ICSEAF CPUE for the periods 1955-1977 (West coast) and 1969-1977 (South coast) and species- and coast- disaggregated GLM CPUE series for the period 1978-2010.
   c. Catches-at-length/age - species-aggregated catch-at-length for all years and fleet combinations for which data are available.

FAO-NANSEN

1. **Research survey data**
   a. Biomass estimates with associated standard errors for each species and survey, disaggregated by depth strata.
   b. Catches-at-length (length frequencies for each species and surveys, disaggregated by depth strata).
   c. Catches-at-age (all age-length keys available for survey samples)

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