Report from the assessment simulation task team on Chilean jack mackerel stock assessment

August 16-20th 2010

University of Washington, Seattle USA

1. Introduction

The Assessment Simulation Task Team (ASTT) was created in 2009 during the Chilean Jack Mackerel Assessment Methods Workshop in Lima (SPRFMO 2009). The task of the group was to compare various existing stock assessment models using a set of simulated data. On the basis of the results of this simulation experiment, one of the models would be proposed as the standard model for future assessments of jack mackerel within SPRFMO.

The results of the simulation experiment were presented and discussed at a meeting of the ASTT in Lima from 6 – 9 April 2010 (ASTT 2010a). It appeared that most of the models were able to estimate the parameters of the underlying hypothetical model with some degree of accuracy, but that none of them clearly stood out from the rest. In general, the Statistical Catch at Age (SCA) models appeared to be able to use the maximum amount of information, and therefore it was decided to develop one of these models into a version that could be used as the standard tool for the Jack Mackerel Sub Group (JMSG). As there was not sufficient time at the Lima meeting to actually develop this joint model, it was decided to call an extra meeting of the ASTT in August in order to draw up the specification for this joint model, and to compile the input data for the 2010 assessment. The actual assessment of the jack mackerel stock in 2010 would be done by the JMSG at its meeting in October 2010.

The present meeting was succeeded by a one-week workshop on the use of the new joint model (the "joint jack mackerel" or JJM model). The results of this workshop will be reported separately (ASTT 2010b).

2. Meeting arrangements and Terms of reference

2.1. Meeting arrangements

The meeting was organised from 16 – 20 August 2010 at the University of Washington in Seattle. The University kindly offered to host the meeting which was run by Jim Ianelli. The meeting was chaired by Ad Corten and all attendees participated in the report preparation. The agenda is provided in Annex 1 and the list of meeting participants in Annex 2.

2.2. Terms of Reference

The following terms of reference were based on decisions taken during the Lima meeting in April, propositions made by the chairman of the JMSG, and a proposal from participants at the 1st preparatory conference in Auckland in July 2010.

1) Specify the framework of the joint model that will be used for the 2010 JM assessment and propose projection methods and reference points

2) Specify provisional input data for the 2010 JM assessment

3) Identify missing data that have to be provided for the final assessment in October 2010

4) Train ASTT members in the use of models that will be used for JM assessment

3. Choice of joint model for JM assessment in 2010

The participants discussed the advances to the modeling work that had been achieved since the Lima Meeting. They noted that a more flexible version of the statistical catch-at-age (SCA) model had been developed that can be applied for the October assessment. In particular, two separate model applications had been developed specific to the jack mackerel stock assessment. These were compared and shown to produce the same results. Consequently, the more flexible (extendable) version of the model was proposed as joint model for the assessment. The features of this model include:

- Flexibility of adding multiple fisheries and surveys or indices
- The ability to share selectivities over different fisheries or index values
- A variety of projection options are built in already and can be modified easily
- The possibility of using length data and aging errors in catch at age data

4. Model description / specifications

For this first round of assessments, a number of simplifying assumptions have been made. Following a recommendation by the Science Working Group in November 2009, the jack mackerel caught in all areas of the Southeastern Pacific is considered to belong to a single management unit (SPRFMO 2009). The spatial structure of the fisheries is accounted for by defining four fisheries that generally operate in different areas. Also, selectivity for these fleets is allowed to vary over time which can help account for the evolution of fishing effort.

It was noted also that for this assessment, while different mean weights-at-age over time could be specified for different fisheries and surveys, the same matrix of values was used throughout. This could be an area where refinements to the data used in the assessment might be improved in the future."

The participants discussed at length how best to treat the extensive length frequency data (Figure 1) that has been made available from the Peruvian fishery. In particular, the issue of what growth relationship to use was debated, noting that there are significant differences among studies (Figure 2.; Kochkin 1994). It was proposed to use cohort sliced length compositions directly as derived from the different growth relationships (Peruvian and that of Kochkin 1994) to evaluate the sensitivity of

the model to these data. This was preferred since applying a selectivity pattern from another fishery may not well reflect the fishing patterns observed in waters off Peru.

The workgroup specified that 4 fisheries and 6 indices will be used in the reference model. These are shown in the following table with linkages between items in cases where length or age composition were unavailable:

Item	Description	Selectivity assumption
	Fisheries	
1)	Chilean northern area fishery	Estimated from age composition data
2)	Chilean central and southern area fishery	Estimated from age composition data
3)	Peruvian fishery	As a first proposal, use cohort sliced length comps directly as derived from different assumed growth relationships (Peruvian and that of Kochkin) to evaluate sensitivity
4)	International fishery	Estimated from age composition data
	Index series	
5)	Acoustic survey in south-central Chile	Estimated from age composition data
6)	Acoustic survey in northern Chile	Assumed to be the same as 1)
7)	South-central Chile fishery CPUE	Assumed to be the same as 2)
8)	Spawning biomass (Egg production) survey	Estimated from age composition data
9)	Acoustic survey in Peru	Assumed to be the same as 3)
10)	Peruvian fishery CPUE	Assumed to be the same as 3)
11)	EU Fleet CPUE	Assumed to be the same as 4)

The workshop will use these data for developing a final set of model configurations for the October stock assessment document.

5. Proposed projections

5.1. Recruitment

The following recruitment scenarios were proposed for projections:

1) Uncorrelated, based on a stock-recruitment relationship (could result in artificially high increase in near-term values).
   Rationale: the spawning biomass directly impacts expected recruitment

2) Use recent 5 year average recruitment (with historical variability).
   Rationale: the recent 5-year average may be a new state for the jack mackerel stock but with the same level of historical variability.

3) Use recent 5 year average recruitment (with recent 5-year variability).
   Rationale: the recent 5-year average may be a new state for the jack mackerel stock (mean and variability)

4) Use recent 10 year average recruitment (with historical variability).
   Rationale: the recent 5-year average may be overly pessimistic

5.2. Harvest strategy proposals

SPR (spawning biomass per recruit) rates were presented and discussed as alternative harvest strategies that are commonly used in other parts of the world. These are considered as proxies for Fmsy levels and have the advantage of being independent of assumptions and/or estimates from stock-recruitment relationships. The F40% SPR rate was proposed as being an appropriate value to consider (this level is the fishing mortality that would reduce spawning biomass per recruit to 40% of the unfished value).

The following constant catch levels should also be considered in future projections:

a) 0 t (no fishing)

b) 50% of the 2010 catches in t by fleet

c) 100% of the 2010 catches in t by fleet

5.3. Biomass reference points

The value of current biomass (2010) relative to that if no fishing had occurred will be computed for reference. For management targets, the group proposes to use the long term expected biomass under fishing with the F40% rate assuming alternative recruitment levels (i.e., the recent 5- and 10-year average, and the full time series average).

6. Input data

6.1. Data available at the current meeting

One of the tasks of the ASTT at the current meeting was to compile data that will be used for the final assessment in October 2010. Members of the ASTT had been asked to bring along as much data as possible to the meeting. In addition, the SPRFMO secretariat had asked member states to provide new data that would be put at the disposal of the ASTT. Finally, the SPRFMO secretariat provided an update of catch statistics up to 2009. A inventory of the data available is given in table 1. The main data compiled during the meeting are listed below.

6.2 Landings data

National landings data provided by the SPRFMO secretariat were in some cases different from the statistics that were brought by ASTT members to the meeting. In case of discrepancies between the SPRFMO data and scientific data, in principle the SPRFMO data were used. Only in cases where strong arguments existed in favour of the scientific data, the latter were used.

The new landing data provided by the SPRFMO secretariat did not contain information for cases in which less than 3 vessels of a particular country had been fishing in a given year. This is because the SPRFMO secretariat is not authorized to release these data for reasons of confidentiality. Hence, the catches for those years and those countries have not been included in the data set.

Landing data provided by the SPRFMO secretariat for the EC prior to 2005 referred to unspecified jack mackerel taken in unknown areas. Until confirmation is obtained that these catches refer to Chilean jack mackerel taken in the southeastern Pacific, these catches are not taken into account in the assessment,

Landing data were grouped by the four fleets specified in section 4 (Chile North, Chile South and Central+older internacional fleet off Chile, Peru + international fleet off Peru+Ecuador, International fleet off Chile in recent years). The results obtained are presented in tables 2a-d. Some remarks about the landing data per fleet are presented below.

a) Fleet 1 (northern Chile)
SPRFMO data for the Chilean fishery could not be split into a central + southern component, and a northern component. Hence the more detailed catch data provided Chilean scientists had to be used to split the Chilean catches and estimated the catches by Chile in the northern zone.

b) Fleet 2 (central and southern Chile)
In the absence of SPRFMO data for this area, the catch data provided by Chilean scientists were used to estimate Chilean catches in the central and southern zone.

In the years prior to 2001, fleets from Russia, Ukraine, Japan and Cuba were fishing off Chile and Peru. The SPRFMO data do not distinguish between the two zones. However, Chilean scientists had information on the spatial distribution of Russian catches in this period. This information was used to divide the Russian catches between the waters off Chile (fleet 2) and the waters off Peru (fleet 3). The ratio between Russian taken in both areas was also used to divide the other foreign catches (Ukraine and Cuba) between the two fleets; Japanese catch was assumed to be taken off south-central Chile.

c) Fleet 3 (Peru)
The Peruvian Ministry provided un updated series of Peruvian landing data to the meeting. This series was used instead of the older series provided by SPRFMO. An estimate for the international catches taken by Russia, Ukraine and Cuba off Peru in the years prior to 2001 was provided by Chilean scientists (see point (b) above).

Catches reported by Ecuador to SPRFMO were also included in fleet 3.

d) Fleet 4 (international fleet off Chile)
Only SPRFMO data from 2001 onwards were assigned to this fleet. Catches taken by foreign vessels in FAO area 87 in earlier years were divided between fleet 2 and 3 (see point (b) above).

6.3 Catches in numbers per age group
Preliminary data on catches per age in the different fisheries were provided for the Chilean catches in the northern and central + southern zone. For the Peruvian fleet, only length compositions were available plus a set of growth parameters. Finally, length data were provided for the EU fleet in the offshore waters in in 2006 – 2009.

The Peruvian age/length relationship is rather different from the one used in Chile, and also from the one published by Russian scientists (Kochkin 1994). The difference is related to the fact that Peruvian scientists assume that the fish lay down two rings per year, whereas Chilean and Russian scientists assume that only one ring per year is added. The ASTT considered that it did not have the competence to decide which of the two assumptions was most realistic, and it therefore decided to use both options in the model runs.

The EU length distributions for the years 2006 – 2009 were converted into number per age using Chilean age/length keys. The computed numbers were then raised to the total international catch in the years 2006 – 2009. For the international catches in the years 2001 – 2005, no length or age data were available, hence, only the landing weights were used in the model.

As the compiled age distributions are still of a provisional nature, the numbers are not presented in this report. The final numbers will be made available by the SPRFMO secretariat at least two weeks prior to the JMSG meeting in October 2010.

6.4 Index series
The index series listed in section (4) on model development are presented in table 3

7. Other topics

7.1 Outline for assessment document

It is proposed that future assessments by the JMSG will follow some standard procedure to ensure that elements of the assessment are complete. This can also to provide a means to be responsive to the comments of the SWG. An outline of a proposed standard assessment documents is presented in Annex 3.

7.2 Training in use of JJM model

The result of this meeting provided the guidelines for the workshop planned for the week of Aug 23rd -29th 2010. It is planned that the report of progress from this training will be provided in an annex.

8. References

ASTT 2010a. Report from the assessment simulation task team on Chilean jack mackerel stock assessments, April 6-9th 2010, IMARPE, Lima, Peru.

ASTT 2010b. Report from the assessment simulation task team workshop on using the joint jack mackerel assessment model (JJM), Seattle, August 23-27th, 2010.

Kochkin, P.N., 1994. Age determination and estimate of growth rate for the Peruvian jack mackerels, Trachurus symmetricus murphyi. J. of Ichthyol. 34(3): 39-50.

SPRFMO 2009. Eighth International Meeting, Report of the Science Working Group, Auckland, New Zealand, 2 – 6 November 2009

INPUT DATA FOR THE CHILEAN JACK MACKEREL STOCK ASSESSMENT

	Type	Belize	Chile	China	EU	Faroe Island	Korea	Perú	Russia	Russia	Ukraine	Vanuatu
									(off Chile)	(off Peru)		
Removals	Catch biomass	2005-2008	1970-2009	2001-2009	2005-2009	2007-2009	2003-2009	1970-2009	1979-1992; 2003-2005	1978-1992	1978-1992	2003-2009
	Catch at age		1975-2009									
	Catch at length				2007-2009			1980-2009	1979-1992			
	By fleet (fisheries)		Yes									
Abundance	CPUE		1981-2005					1997-2009				
	Acoustic Survey		1997-2009					1983-2009				
	Egg survey		1999-2008									
	Trawl survey											
Biology	Natural mortality		0.23					0.33				
	Growth function		Yes					Yes	Yes			
	Maturity at age		Yes									
	Maturity at size							Yes				
	Aging		Yes					Yes				
	Age-length key		1975-2009					2001-2006				
	Weigth at age		1975-2009									
	Weight at length							1993-2009				
	L-w relationship		1975-2009					1993-2009				
	Maps of catch distribution				Yes			Yes				

Table 1. Inventory of data available at the Seattle meeting

fleet 1 (northern Chile)

Year	Chilean catches northern area (1)
1970	175208
1971	164838
1972	62634
1973	71762
1974	163396
1975	186890
1976	237876
1977	225907
1978	367762
1979	311682
1980	266697
1981	435061
1982	756484
1983	259128
1984	663695
1985	471599
1986	42536
1987	280594
1988	278701
1989	265861
1990	258233
1991	282817
1992	285387
1993	359947
1994	197414
1995	211594
1996	264631
1997	88276
1998	19278
1999	44582
2000	107769
2001	244019
2002	108727
2003	142016
2004	157647
2005	165552
2006	154524
2007	170220
2008	167258
2009	133994

1) data provided by Chilean scientists

Table 2a. Catches by fleet 1

fleet 2 (central + southern Chile)

Year	Chilean catches central + south (1)	Russia (2)	Ukraine (2)	Japan (2)	Cuba (2)	total catch fleet 2
1970	7938					7938
1971	21934					21934
1972	7100	5500				12600
1973	8904					8904
1974	12678					12678
1975	34951					34951
1976	65570					65570
1977	75585			2273		77858
1978	150319		0	1667	0	151986
1979	203269	269500	45762		0	518531
1980	215528	325300	35025		32409	608262
1981	440935	420300	46580		27741	935557
1982	643821	679700	76323		56356	1456200
1983	541696	866500	140185		45981	1594362
1984	677910	877000	134898		20276	1710084
1985	923042	739100	88639	5229	37309	1793319
1986	1103200	731200	75705		40413	1950518
1987	1416781	818628	89116		34226	2358751
1988	1703037	811713	89976		10671	2615396
1989	2031058	856910	85742		11555	2985266
1990	2150956	852363	87378	157	23580	3114433
1991	2649828	539816	59405		5262	3254311
1992	2796812	32000	2736		0	2831548
1993	2745099					2745099
1994	3596904					3596904
1995	3984244					3984244
1996	3017165					3017165
1997	2541981					2541981
1998	1546704					1546704
1999	1130488					1130488
2000	1135082					1135082
2001	1216754					1216754
2002	1357185					1357185
2003	1272302					1272302
2004	1289820					1289820
2005	1248971					1248971
2006	1215738					1215738
2007	1119713					1119713
2008	728850					728850
2009	690610					690610

1) data provided by Chilean scientists

2) fraction of catches reported to SPRFMO that was assigned by working group to fleet 2

Table 2b. Catches by fleet 2

fleet 3 (Peru)

Year	Peru (1)	Ecuador (2)	Russia (2)	Ukraine (2)	Cuba (2)	Total fleet 3
1970	4711					4711
1971	9189					9189
1972	18782					18782
1973	42781					42781
1974	129211					129211
1975	37899					37899
1976	54154					54154
1977	504992					504992
1978	386793		49220	4783	0	440796
1979	151591		262709	44609	0	458909
1980	123380		219670	23652	21885	388587
1981	37875		351330	38937	23189	451331
1982	50013		56198	6310	4660	117181
1983	76825			0	0	76825
1984	188893		179600	27626	4152	400271
1985	79370		98600	11825	4977	194772
1986	44292		53800	5570	2973	106636
1987	38099			0	0	38099
1988	113743		126575	14030	1664	256012
1989	133671		239382	23953	3228	400234
1990	224684	4144	269934	27671	7467	533901
1991	234110	45313	51984	5721	507	337634
1992	93065	15022		0	0	108087
1993	121309	2673				123982
1994	213220	36575				249795
1995	386748	174393				561141
1996	357953	56782				414735
1997	371485	30302				401787
1998	314123	25900				340023
1999	82541	19072				101613
2000	240881	7122				248003
2001	774603	133969				908572
2002	92470	604				93074
2003	134975					134975
2004	106270					106270
2005	46769					46769
2006	256318					256318
2007	188450	927				189377
2008	120749					120749
2009	25472					25472

1) data provided by Peruvian Ministry of Fisheries

2) fraction of catches reported to SPRFMO that was assigned by working group to fleet 3

Table 2c. Catches by fleet 3

fleet 4 (international fleet off Chile)

Year	Belize	China	EU	Faroe I.	Korea	Russia (1)	Vanuatu	total fleet 4
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977								
1978								
1979								
1980								
1981								
1982								
1983								
1984								
1985								
1986								
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1990								
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1992								
1993								
1994								
1995								
1996								
1997								
1998								
1999								
2000								
2001		20090						20090
2002		76261						76261
2003		94690			2010	7540	53959	158199
2004		131020			7438	62300	94685	295443
2005	867	143000	6179		9126	7040	77356	243568
2006	481	160000	62137		10470		129535	362623
2007	12585	140582	123511	38700	10940		112501	438819
2008	15245	143182	106665	22919	12600	4800	100066	405477
2009		117963	112231	20213	13759		79942	344108

1) catches prior to 2001 assigned to fleet 2 and 3

Table 4d. Catches by fleet 4.

index	Chilean acoustic surveys central + southern area	Chilean acoustic surveys northern area	Chilean cpue central + southern area	Chilean egg surveys	Peruvian acoustic surveys	Peru cpue	EU cpue
unit	tons	tons	tons/day	tons	tons	tons/hour	tons/fishing day
associated fleet	Chile central + south	Chile north	Chile central + south	Chile central + south	Peru	Peru	international fleet
1970							
1971							
1972							
1973							
1974							
1975							
1976							
1977							
1978							
1979							
1980							
1981							
1982							
1983					8512674		
1984					8511022		
1985					7493286		
1986					4329874		
1987					6472042		
1988					6065754		
1989					4302930		
1990					5971710		
1991					5915250		
1992					6099278		
1993					8471096		
1994					6414607		
1995			467		5131333		
1996			460		3080749	8.84	
1997	3530000		385		3375866	5.70	
1998	3200000		318		200972	3.13	
1999	4100000		311	5723933	176613	4.01	
2000	5600000		270	4688208	1350804	4.69	
2001	5950000		311	5626963	1998823	5.27	
2002	5600000	1800000	344		837319	4.42	
2003	3521000	1759000		1387804	850092	3.40	
2004	4240000	3160000		3287439	448580	3.47	
2005	4620000	3600000		1042706	261092	1.06	
2006	7220200	2595600		3282628	1512408	3.44	
2007	3231000	3049000		626425	442731	3.82	308
2008	1009265	486500		1934723	207100	4.10	256
2009	862547	328013			70074	0.48	217

Table 3. Index series

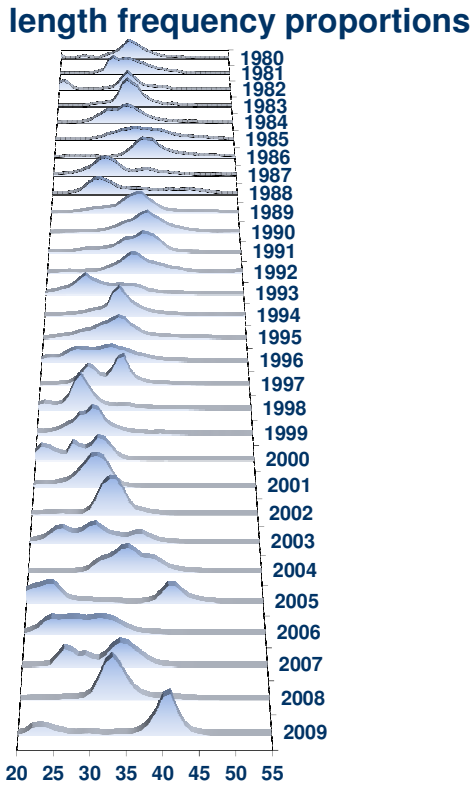

Figure 1. Peruvian fishery length frequency data, 1980-2009.

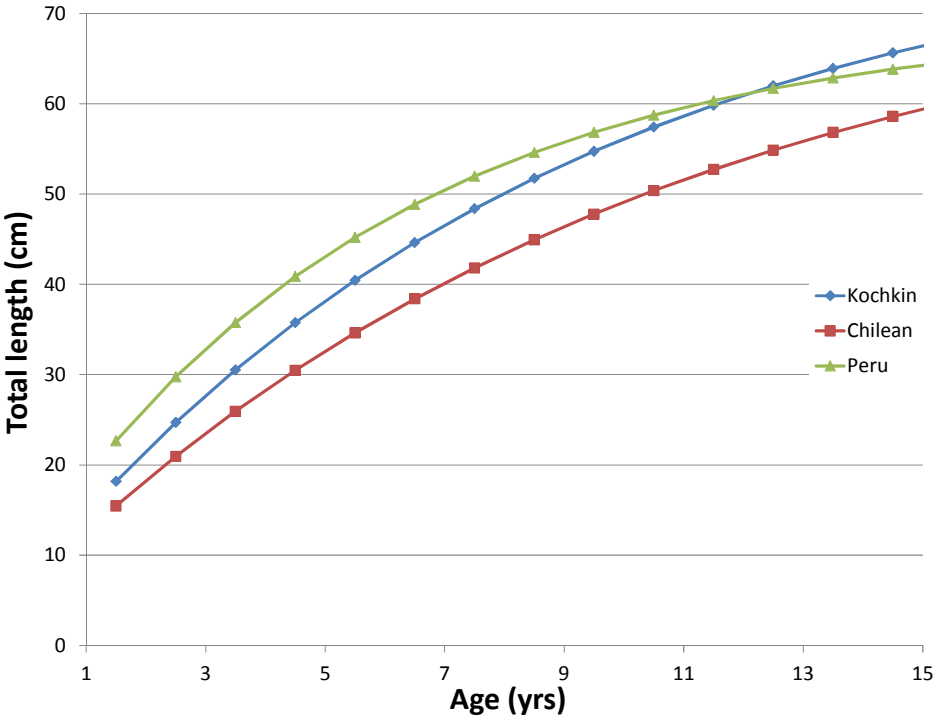

Figure 2. Comparison of different mean length at age relationships considered for application to the Peruvian length frequency data.

Annex 1. Agenda

1. Opening
2. Terms of reference
3. Adopt agenda
4. Review ASTT Results, previous SWG reports
5. Real data overview
   a. Catch series
   b. Biological parameters
   c. Fishery dependent indices
   d. Survey indices
   e. Treatment of missing data
6. SCA model update
7. Model output and projections
8. Management objectives—biological reference points
9. Alternative model scenarios and hypothesis
10. Other issues
11. Report writing for SWG

Timeline of activities

Monday Aug 16	Opening of the meeting Agenda for the meeting Review terms of reference
Tuesday Aug 17	Comparison of different SCA models Agree to Joint Jack Mackerel model approach (JJM) Compile data from other sources
Wednesday Aug 18	Review Peruvian data Incorporation of data components to JJM Develop output routines for diagnostics from JJM Outline for assessment document
Thursday Aug 19	Biological reference points for generating outputs Projection methods Data exchange
Friday Aug 20	Report writing Adopt Report

Annex 2. List of participants

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Annex 3. Proposed outline for assessment documents

1) Executive Summary
    a. Summary of major changes
    b. Summary of results
    c. Response to SWG comments

2) Introduction
    a. Fishery description/ characteristics
    b. Fisheries Management

3) Data
    a. Fishery
        i. Catch
        ii. Length/Age composition
    b. Resource surveys and indices

4) Analytic approach
    a. The assessment model
    b. Parameters estimated independently; e.g.,:
        i. Natural mortality and maturity at age
        ii. Length and Weight at Age
    c. Parameters estimated conditionally

5) Model evaluation
    a. Data sensitivity
    b. Alternative configurations

6) Results
    a. Abundance and exploitation trends
    b. Recruitment outlook
    c. Projections and harvest alternatives
    d. Future Catch Recommendation

7) Other considerations