a4a kick-off meeting report

28th February to 2nd March, 2012

JRC, Ispra, Italy

1 Introduction

The implementation of the 2009 revision of the DCF[1] generated the obligation to collect a large amount of information for all stocks being subject to fisheries exploitation. Based on the regulation there are 250+ stocks for which some kind of biological information must be collected. Most of these stocks will have in the future, ~2020, time series of exploitation data more than 10 years long, although the information about the biology will most likely be limited due to the logistics of processing all the samples collected. These stocks (will) have a moderate amount of information and won't fit into the "data poor" stock definition. In addition, due to the large number of these stocks it is not logistically feasible to run complex data eager models that require a high level of expertise to run and analyse. What is required is a robust methodology that allows the assessments of a large number of stocks by non-expert modellers.

Having stock assessment and advisory methods to apply to a large number of moderate data stocks, raise interesting challenges and creates opportunities worth exploring. For example, approaching stock assessment as a data generating engine, having a common stock assessment methodology or analysing massive stock assessment results, open the possibility of issuing advise for more species in a multifleet, multispecies framework and promotes comparative advise analysis.

As scientists it is important to think ahead and start developing such methodologies. JRC following it's mission of antecipating policy implementation issues decided to move forward with the "Assessment for All" (a4a) initiative, aiming to:

1. develop an assessment method targeting stocks that have a reduced knowledge base on biology and moderate time series on exploitation and abundance;
2. trigger the discussion about the problem of massive stock assessment;
3. build capacity on stock assessment and fisheries management advise.

The initiative has a web repository where all the presentations, reports, code and data can be found[2].

1.1 Objectives and organization

The kick-off meeting of the initiative took place between 29/February and 02/March of 2012 at the JRC head quarters in Varese, Italy, chaired by Ernesto Jardim (JRC/EC), with the following terms of reference:

1. world wide needs of fisheries advice;
2. available stock assessment methods;
3. ways to make stock assessment in the context of management advise more robust;
4. identify modules to build a MSE;
5. discuss progress of the initiative.

The agenda of the meeting is in the annex.

[1] Data Collection Framework (2008/949/EC)
[2] https://github.com/ejardim/a4a

1.2 Participation

Name	Affiliation
Andrew Cooper	Simon Fraser University (CA)
Chato Osio	Joint Research Center (EC)
Einar Nielsen	Danish Technical University (DK)
Ernesto Jardim (chair)	Joint Research Center (EC)
Finlay Scott	Centre for Environment, Fisheries & Aquaculture Science (UK)
Gary Carvalho	Bangor University (UK)
Iago Mosqueira	Joint Research Center (EC)
Jann Marthinson	Joint Research Center (EC)
Jose de Oliveira	Centre for Environment, Fisheries & Aquaculture Science (UK)
Leire Ibarriaga	AZTI Tecnalia (ES)
Manuela Azevedo	Portuguese Institute for Sea and Atmosphere (PT)
Ruben Roa	AZTI Tecnalia (ES)

1.3 Background information

An introduction to the subject was done by Ernesto Jardim to open the meeting, followed by a set of presentations of reports and other initiatives, that contributed to the progress of the work. Manuela Azevedo presented the recent outcomes of the ICES WKLIFE (), the south hemisphere initiative on MSE report was presented by Iago Mosqueira, the GFCM workshop on Elasmobranchs was presented by Chato Osio and Andrew Cooper presented the management system implemented in the USA after the revision of the Magnuson-Stevens act. All these presentations are available on the a4a repository in github.

2 Outcomes

The ToR and agenda were followed loosely to allow for discussions and brain storming.

The overall objective was to consolidate ideas regarding the initiative's aims, expectations and opeartionalization. It was critical to better define the problem the initiative is attempting to contribute to, discuss the range of solutions available and define which ones the initiative should pursue. In that sense the meeting was succefull and the objectives were achieved.

The discussions gave rise to the definition of a "moderate data stock", a major step to understand where the initiative intends to contribute. The issue of introducing genetics in fisheries management was discussed and several clarifications were made, as well as the identification of promising areas of convergence between fisheries modelling and genetics. Another issue to be grounded was the assessment model(s) to be explored, for which a set of characteristics were defined while leaving open the exact framework to be used. A further step was taken by designing the type of Management Strategies Evaluation the initiative will promote/develop as a standard advise methodology for these kind of stocks. In a more pragmatic setting the group loosely defined a simulation experiment to be carried out and a set of subjects to be tested. Additionally the group discussed the a4a operationalization.

3 Conceptual framework

3.1 Moderate data stock

The group discussed the characteristics of a "moderate data stock" in terms of data availability and concluded on the following definition.

A moderate data stock has at least data on:

- nominal effort,
- volume of catches in weight (which should include landings and discards),
- length information for the catches (based on selectivity studies or direct observations),
- information based maturity ogive (parameters are not educated guesses but based on information),
- information based growth model (parameters are not educated guesses but based on information),
- length-weight relationship,
- index of abundance (the type of index is left open on purpose, it could be a survey or CPUE),
- length information for the index of abundance (based on selectivity studies or direct observations)

The length of the time series is not specified on purpose, it will depend on the species' longevity.

3.2 Genetics

While there is general agreement that genetic approaches can support fisheries management relevant issues, a clear need persists to clarify how and where exactly genetic analysis could contribute to fisheries management advise and stock dynamics modelling, particularly when applied in a routine context.

To start with, a clear distinction must be made between the usage of genetics for control and enforcement, like determining the origin of individuals or species/stock mis-identification, and the usage of genetic indicators or metrics for modelling purposes, which was the aim pursued in this meeting.

The discussions focused on three distinct themes: stock identification, risk indicators, and total biomass/abundance estimation.

Stock identification is the most promising area of convergence, and the application of genetics for this purpose seems most readily available as a routine approach in fisheries management: there exist already a number of examples where genetic stock identification (GSI) is used and the genetic analysis applied is robust and relatively easy to perform. When applying GSI, the major effort arises through the need to establish a baseline, which depends on finding the allele composition that separate the stocks/populations/groups. Better definitions of stock boundaries, estimates of migration rates, Harvest Control Rules (HCRs) based on the percentage of certain groups on the catch, etc, can all be plugged into stock dynamics modelling or management procedures

simulations. Following these ideas the group discussed and suggested a non-exhaustive set of questions that could be tested on a MSE framework:

- What if there are two subpopulations with distinct biological characteristics managed as a single stock;
- Which kind of HCR can be applied to a group of species based on knowledge of their percentage on the catch;
- How robust is the management procedure to departures from the closed population stock assessment assumption.

Risk indicators were the next subject that the group considered promising. If specific indicators, e.g. linked to specific biological functions like reproduction, are monitored over time, this might provide indications, giving an alert that something "wrong" is going on. Genetic diversity and frequency of rare alleles are examples of such indicators, which still require further work and development to fully assess their usage. Such an approach would require on-the-fly analysis and computations.

With regards to estimations or proxies of stock biomass/abundance it became clear that genetics cannot help. The genetic concept of population size, and the so-called “effective population size”, is very distinct and the relation between the genetic population size and abundance (number of individuals in the population) is similar to an exponential decay model where most abundance variability lies in the model's flat bottom (EINER AND ANDREW CAN YOU PLEASE CHECK THIS). For the time being pursuing this path, in the context of a4a, was considered futile, despite of a wide number of potential applications that could be envisioned.

Time resolution is a major problem when using genetic indicators, as in most cases they appear to be stable at a multi-annual scale. For stock and fisheries dynamics modelling this time frame is too wide.

Generally, Single Nucleotide Polymorphisms (SNPs), particular genetic markers, are highly amenable to high throughput analytical techniques, easily comparable between laboratories and produce robust and reproducible results.

3.3 Stock assessment model

To help with the discussions about the possible development of a stock assessment model two essential questions were discussed and clarified.

The stock assessment models were classified with relation to their abundance estimation characteristics as:

1. unscaled - biomass is not well estimated but trends in biomass are relieable enough for management ;
2. scaled - biomass is well estimated but it's not possible to identify where the stock is with relation to the its productivity;
3. referenced - biomass is well estimated as well as the position of biomass relative to its productivity.

Two distinct processes to be carried out using assessment models were considered, each requiring distinct characteristics:

1. conditioning of the operating model - the assessment model must be as precise as possible, make use of all information available and provide estimates of the parameters' uncertainty;
2. within the management procedure - the assessment model is a metric generator for the HCR, as simple and robust as possible, not neccessarely providing estimates of parameters' uncertainty.

Taking into account the descriptions above the group considered that the development of a stock assessment model should aim for a "scaled" model and focus on the conditioning of the operating model as its most relevant outcome. There will be the possibility of using a simplified version to inform the HCR during the management procedure.

Additionaly, the assessment model must allow its rapid application to a wide range of situations. To achieve such objectives the model should be adjusted as automatic and precise as possible to reduce or avoid the need for complex human decisions.

The model should be based on existing models, avoid unneccessary complexity and implemented in FLR. One of the primary tasks of the initiative will be to test the assumptions of the model and derive it's characteristics in terms of robustness ...

3.4 Advise methodology

The group discussed the importance of having an advise methodology based on MSE for data moderated stocks. There was agreement that an MSE to be applied to a large number of stocks would require some sort of standardization, to limit the decisions required to proceed with the analysis and to make it possible to compare results across stocks.

Having a focus on the operating model, the MSE would be targeting the tests of the decisions made during conditioning and the management procedure would be as much as possible a standard process, following a protocol, to test the most relevant components of the operating model. Advise will be a product of that protocol.

In such framework it will be neccessary to define the MSE elements that will be subject to testing and which ones will be subject to assumptions. For example, regarding the assessment model for the HCR the protocol can state that a biomass dynamic model and a statistical catch at age must be used so that some model mis-specification can be dealt with.

The MSE should be developed considering a set of standard procedures to test assumptions and conditions with regards to the robustness of the advise. In that sense the initiative should aim for defining a standard procedure for data moderate stocks by setting protocols for the most important elements of the MSE, like conditioning the operating model, e.g. using LH to fill gaps or define the range of OM based on LH (e.g. LH+ 1 sd etc), defining the HCR that should be tested, defining the assessmentg models that should be considered, defining the minimum elements of the MSE for moderate data stocks, how to present results, etc.

The presentation of results is another area of interest. There were discussions about the development of statistics that reflect the uncertainty of the full system. Two proposals were made:

- $B_{OBS} - B_{TRUE}$ - where B_{OBS} is the biomass estimated by the management procedure assessment model and B_{TRUE} is the operating model biomass, this statistic accounts for observation and estimation error;
- $\frac{C_{TRUE}B_{OBS}}{B_{TRUE}C_{HCR}} = \frac{C_{TRUE}}{C_{HCR}}\left(\frac{B_{TRUE}}{B_{OBS}}\right)^{-1}$ - where C_{HCR} is the catch resulting from the HCR, this statistic could be interpreted as a measure of the trade-off between implementation error and observation-estimation error. Being close to 1 could be interpreted as errors being compensated and being able to manage "well" the system. The clear disadvantage is that it is not symmetric: goes in (0,1) in one side and (1,infinity) on the other.

After the meeting some suggestions on the visual representation of the results were discussed, in particular the usage of dashboards, which allow the representation of distinct levels of detail in the same "plot". Such representation could help stakeholders and scientists to explore and better understand MSE results.

4 Implementation

4.1 Simulation experiment

The group discussed simulation experiments that could be used to test models and algorithms discussed above. The steps are described below:

1. Simulate data that fits the definition of moderate data;
2. Use real data that fits the definition of moderate data;
3. Develop/compile candidate stock assessment models for moderate data stocks (conditioning);
4. Tests:
   (a) When estimating stock dynamics and fishing mortality for data limited stocks, which elements are more difficult to estimate considering distinct exploitation histories and life history parameters;
   (b) How the time series length impacts the estimation of stock dynamics and fishing mortality for data limited stocks;
   (c) How fixed parameters impact the results (sensitivity analysis) considering distinct exploitation histories and life history parameters;
   (d) etc
5. Write MSE using the ICES HCR;
6. Expand tests o include management impact of:
   (a) MP model complexity;
   (b) two subpopulations with distinct biological characteristics being managed as a single stock;
   (c) departures from the closed population stock assessment assumption;
   (d) etc
7. Expand HCR.

4.2 Operational tools

All participants agreed to allocate some of their time to the initiative. In that regard it was discussed the possibility of organizing a new meeting next year and initiating a program of visiting scientists, that would allow more flexibility. For such program to work the JRC team will have to carry out most of the work and plan with visitors the best timing so that the biggest advantage can be taken of the period working together.

It was also agreed to use FLR (http://flr-project.org) as the main framework for development.

There is also a budget for JRC scientists to participate on international forum, which constitutes an important tool to disseminate the initiative and cordinate with other groups.

Annex 01
Agenda

- Wednesday
  - Introduction (E.Jardim)
  - Identify and describe the problem
  - Summary of WKLIFE (M.Azevedo)
  - Summary of south hemisphere initiative report (I.Mosqueira)
  - Summary of GFCM WK on Elasmobranchs (G.Chato)
  - Management of a selection of stocks from N.America (A.Cooper)
  - Discussion
  - Compile a set of possible solutions to the problem
- Thursday
  - Seminar to JRC on Fisheries Modelling (09:30 – 11:00)
    - Welcome message by Alessandra Zampieri (JRC HoU)
    - MSE by Jose de Oliveira (CEFAS)
    - Catch Dynamic Model by Ruben Roa (AZTI)
    - Genetics and quantitative fisheries by Gary Carvalho (B.U.) & Heiner Nielsen (DTU-AQUA)
  - Elaborate on advantages and disadvantages of each solution
  - Revisit the solutions and decide which are the most promising
  - Agree on a framework for testing: MSE, statistical analysis, simulated data, etc.
- Friday
  - Discuss implementation and testing of the best solutions
  - Elaborate on the expected outcome
  - Challenges and opportunities
  - Workplan