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 biological information will most likely be limited due to the high human resources requirements to process 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 on all of them complex data eager models that require a high level of expertise. What is required is a robust methodology that allows the assessments of a large number of stocks by stock assessment experts with distinct backgrounds.

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 analyzing massive[2] stock assessment results, open the possibility of issuing advice for more species in a multifleet, multispecies framework and promotes comparative analysis.

As scientists it is important to think ahead and start developing such methodologies. JRC following it's mission of anticipating 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 advice.

The initiative has a web repository where all the presentations, reports, code and data can be found[3].

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 headquarters in Varese, Italy, chaired by Ernesto Jardim (JRC/EC), with the following terms of reference:

[1] Data Collection Framework (2008/949/EC)

[2] In the sense of analyzing a large number of stock metrics, which will open the possibility of using methods like data mining or other "big data" methods.

[3] https://github.com/ejardim/a4a

1. overview of current worldwide needs for fisheries advice;
2. brief review of available stock assessment methods of relevance to these stocks;
3. possible ways to make stock assessment more robust in the context of providing management advice;
4. identify necessary modules to build a simulation for advice framework;
5. discuss the direction and progress of the initiative.

The agenda of the meeting can be found in Annex I.

1.2 Participants

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 Ibaibarriaga	AZTI Tecnalia (ES)
Manuela Azevedo	Portuguese Institute for Sea and Atmosphere (PT)
Ruben Roa	AZTI Tecnalia (ES)

1.3 Background information

A general introduction to the subject, aims and objectives was carried out by Ernesto Jardim to open the meeting, followed by a set of presentations of reports and other initiatives, that could contribute to the progress of the work[4]. Manuela Azevedo presented the recent outcomes of the ICES WKLIFE, the south hemisphere initiative on Management Strategies Evaluation (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.

[4] All the presentations are available on the a4a repository.

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 operationalization. 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 successful 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 modeling and genetics. Another issue to be grounded was the assessment or population 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 MSE the initiative will promote/develop as a standard advice methodology for these type of stocks. In a more pragmatic setting the group loosely defined an initial simulation experiment to be carried out and a set of issues 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 types and availability, and agreed 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 structure of 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, it could be a scientific survey or a commercial CPUE series),
- length structure of the index of abundance (based on selectivity studies or direct observations)

The length of the time series required is not considered to be of major importance, as 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 advice and stock dynamics modeling, 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 modeling purposes, which was the aim pursued in the discussions taking place during 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 modeling 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 are monitored over time, their analysis may give an alert that something "wrong" is going on. These indicators can be linked to specific biological functions like reproduction, genetic diversity or frequency of rare alleles. In any case, further work and development is still required to fully assess their usage. Such approach would require on-the-fly analysis and computations.

With regards to estimations or proxies of stock biomass/abundance it became clear that genetics can not 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 in number of individuals in the population is similar to an exponential decay model, where most abundance variability lies in the model's flat bottom. 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 modeling 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, in the sense of a population model that attempts to reflect the dynamics of the biological system given the available data, 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 reliable enough for management;
2. scaled - biomass is well estimated but it's not possible to identify where the stock is with relation to 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 necessarily 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.

Additionally, 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 unnecessary 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 Advice methodology

The group discussed the importance of having an advice 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 making it possible to compare results across stocks.

Having a focus on the operating model, the MSE objectives will be to give advice on management, explicitly considering the impacts of decisions made during conditioning. In such framework the MP should be based on standard procedures, following protocols to test the most relevant OM's components. The initiative will concentrate on defining those protocols for data moderate stocks, *e.g.* defining HCR(s) to be tested, which assessment models should be considered by the MP, 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 simultaneously. 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 fit the definition of moderate data;
2. Use real data that fit 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 moderate data 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 moderate data stocks;
   (c) How fixed parameters impact the results (sensitivity analysis) considering distinct exploitation histories and life history parameters;
   (d) ...
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) ...

7. Expand HCRs.

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 a program for visiting scientists.

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

There is a budget for JRC scientists to participate on international forum, which constitutes an important tool to disseminate the initiative and coordinate 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 (C.Osio)
  - 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 Modeling (09:30 – 11:00)
    - Welcome message by Alessandra Zampieri (JRC HoU)
    - MSE by Jose de Oliveira
    - Catch Dynamic Model by Ruben Roa
    - Genetics and quantitative fisheries by Gary Carvalho & Heiner Nielsen
  - 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