Theme Session N: Quality and precision of basic data underlying fish stock assessment and implications for fisheries management advice

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WebGR – storing images of biological material and creating a framework to promote the implementation of sound statistical analysis in age calibration

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1. Abstract:

The objective of the WebGR project is to develop a set of web services to support the organisation and data analysis of calibration workshops, both for age and maturity information, implemented in a coherent tool installable as a website.

The website consists of a repository of images, a set of web forms to run a calibration exercise online, a reporting module with the most common statistical analysis and import/export modules to manage images and results. The software has a creative commons license (Open Source) to promote transparency, technology transfer and peer review; and will allow the scientific community to get involved in further developments, like linkage to statistical analysis engines, or any other specific features.

The usage of WebGR to carry out calibration workshops will promote the application of sound statistical analysis to design the experiment and compute workshop results. The results are extracted in a standard format that can be easily sent to scientists doing assessments.

2. Introduction:

Scientists use age and maturity data to build growth and reproduction models which are used, e.g. for stock assessment. Uncertainties on these models come from the usual statistical procedures, like sampling and modelling, but also from the interpretation of calcified structures and classification of gonads, the cornerstone of in-laboratory sample processing. Due to the wide spread of fish populations and the increasing work share among scientists, agreement between analysts is paramount to avoid large inconsistencies and reduce the variability introduced by the laboratory processing. To increase the agreement on the interpretation of calcified structures and the classification of gonads, calibration workshops are organized to promote group discussions and achieve general conclusions about these tasks. Calibration Workshops and Exchanges improve data precision and are the preferred mechanism for understanding and reconciling the differences among scientists, in the interpretation of fish age or maturity stage. Consequently scientists focus on improving the precision of their age readings and on the continuous refinement of written criteria for the interpretation of CS. Calcified structures with a known reference date within their growth pattern, e.g. sagittae (otoliths) obtained from marked/recapture experiments, are becoming increasingly available, but are still relatively uncommon for many fish species. Where they are available, these valuable materials are used to further refine age interpretation criteria and improve the precision of fish age readings. WebGR will provide online services for support of Growth and Reproduction Studies, including the storage of images of biological material and will create a framework that will promote the implementation of sound statistical analysis in age calibration.

3. Objectives and Background:

The objective of this study is to develop a set of web services, implemented in a coherent tool installable as a website, to support the organisation and data analysis of calibration workshops, for both age and maturity information of fish and to implement procedures for training purposes. The most common exercises carried out during these workshops are counting growth rings in sagittae (otoliths) (Figure 1), or classifying gonads (Figure 2), with subsequent analysis of the results in order to build age-length keys or maturity ogives. WebGR will enable the provision of online services for the management of calibration workshops including the generation and promulgation of statistical reports. In addition, WebGR will implement procedures for training purposes, such as browsing images, reading experts' annotations and simulating a calibration exercise.
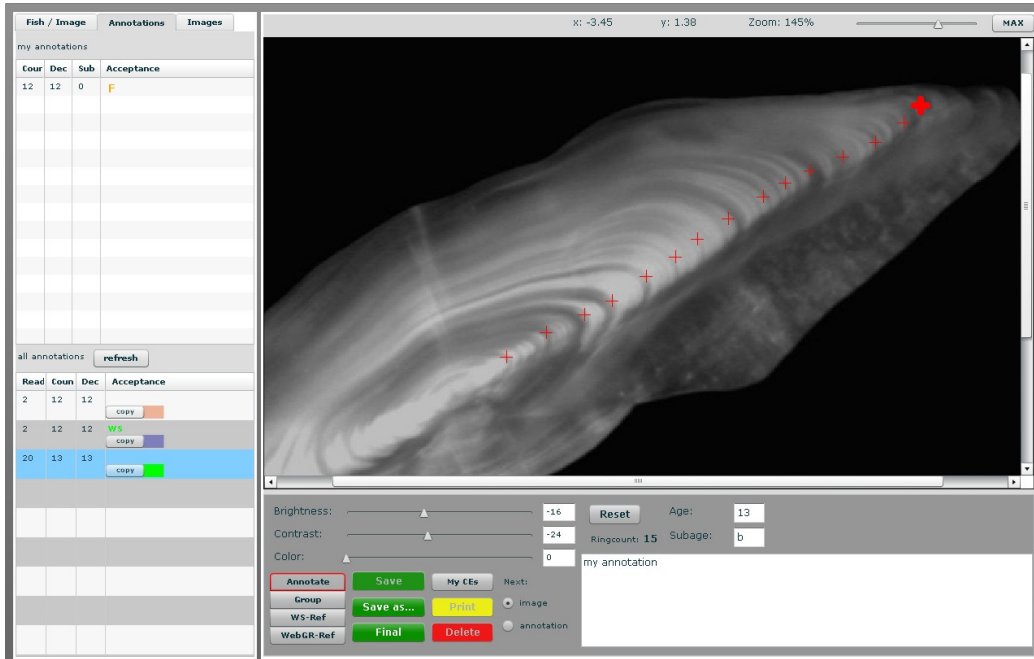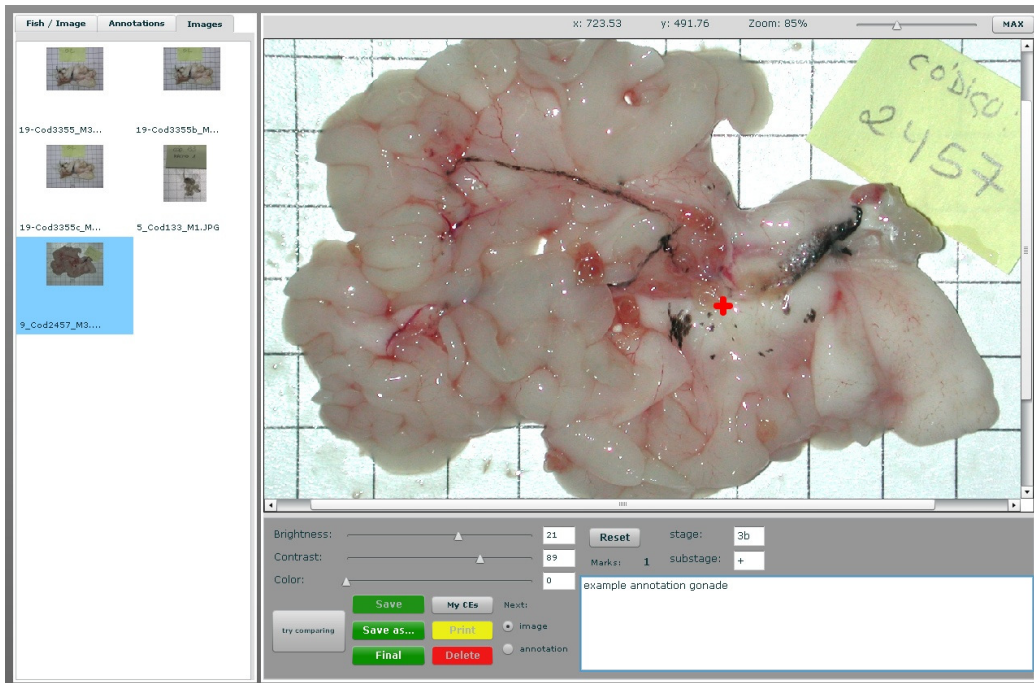
Figure 1: Annotating an otolith in WebGR

Figure 2: Annotating a gonad in WebGR

Quality control and validation of age and maturity data collected under the Data Collection Framework (DCF), is of particular importance and it is an essential element of quality assuring the biological advice issued by stock assessment expert groups. WebGR will

facilitate the generation and more rapid distribution of statistical information on the precision of fish age data and it is anticipated that this will have a direct impact on the estimation of uncertainty in the catch-at-age, weight-at-age data and abundance estimates. WebGR is financed by the EC-DGMARE tender FISH/2007/07 Lot 1. The WebGR development website is http://webgr.berlios.de

3. Concepts:

Historically, workshops on age readings have been used for several different purposes, although there is a common objective of coordinating the interpretation of the criteria used for age classification among age readers. More recently, this idea was extended to maturity staging and it is likely to be extended to other similar analysis, e.g. fish egg stage and larval classification.

In practice, the process starts with the identification of a stock, a semi-discrete group of fish with some definable attributes of interest to managers (Begg *et. al.* 1999), typically a combination of species and area, that may have problems, or simply needs a standardisation process regarding the interpretation of structures for age or gonad classification. Following this decision, there is an exchange of otoliths to be read by all participants individually. The coordinator analyses these results and declares whether there is a problem or not. If there is no problem, the exercise stops and a report is published. If there is a problem, a call for a workshop is issued and a group exercise is organised. During the workshop, both group discussions and individual classifications are carried out providing the material for statistical analysis. The maturity staging workshops differ from the age calibration workshops, by not having an exchange prior to the workshop.

The WebGR website consists of a repository of images, a set of web forms to run a calibration exercise online and a reporting module with the most common statistical analysis and import/export modules, to manage images and results. The software has a creative commons license (Open Source) to promote transparency, technology transfer and peer review. This will allow the scientific community to get involved in further developments, such as linkage to statistical analysis engines, or any other specific features.

Individual scientists will upload images and metadata that are representative of the materials used for stock assessment, as these are encountered in day to day work (Figure 3). Images in the WebGR repository are grouped or classified by workshop (species, date, area, etc.) and the images selected for inclusion in a workshop are accessible to all the participants, within the calibration exercises set for that workshop. Each image is annotated by several scientists. The annotations include fields for the classification (age x or maturity stage y, *etc.*), observations, scientist identity, etc. This information is stored in a database so that the statistical analysis of the results can be automated as far as possible and made public as online reports.
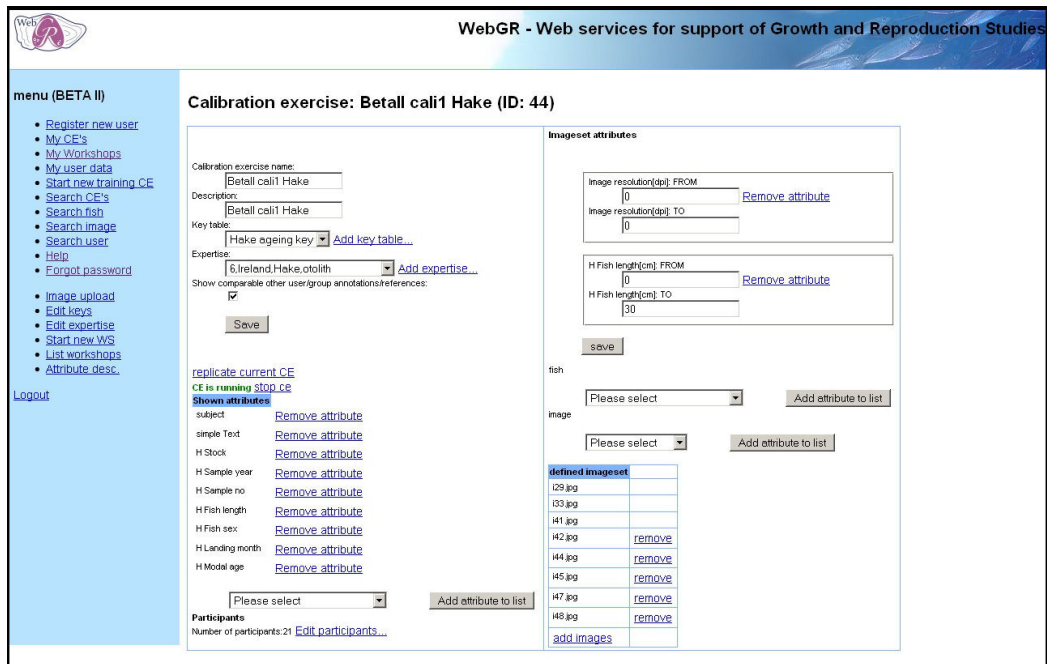
Figure 3: The WebGR User Interface

The core of the WebGR workshop paradigm is based on the hierarchical structure of the workshop, seen as an operational unit, where several objectives like age or gonad calibration of several stocks may exist simultaneously and require the comparison of readers at distinct levels (e.g. institute, experts, stock assessment input providers, etc.). Each objective must be clearly identified and defined and a specific calibration exercise is then carried out following a statistically sound design. Each calibration exercise is organized in a sequence of individual and group classifications that can be carried out for as long as necessary. In some cases, the first individual exercise is sufficient, as is the case for stocks without problems regarding criteria interpretation, or the workshop may be very complex and require several group discussions followed by individual exercises to make sure that the interpretation is correct. Under the scope of WebGR, a workshop contains several calibration exercises and each calibration exercise contains individual and group calibrations that are carried out in a loop until the objectives are achieved (Figure 4).
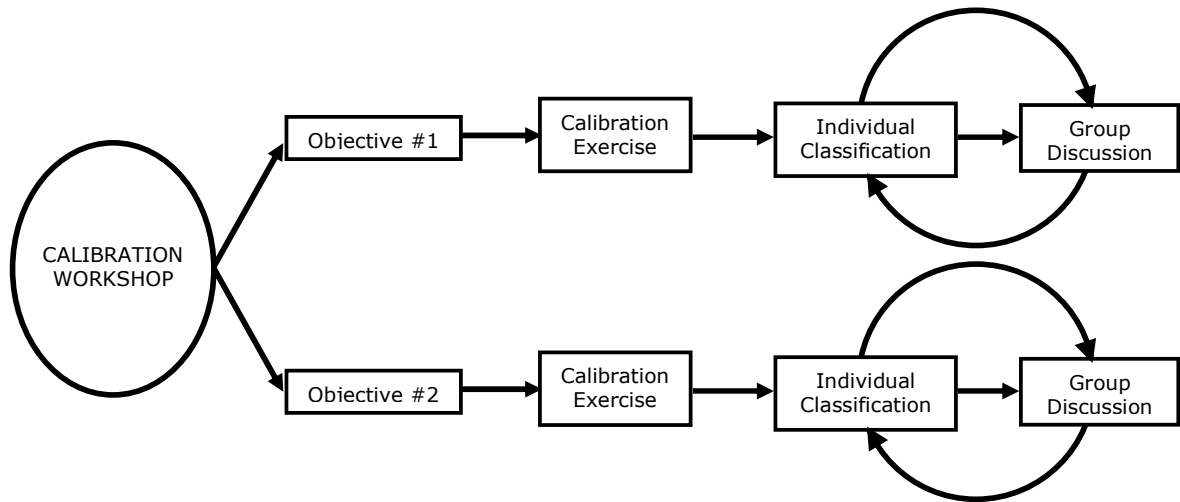
Figure 4: WebGR Calibration Workshop

In order to use WebGR, the institutions will have to download the software packages and install these in their own servers. Large organisations like ICES are the primary target, but smaller individual organisations or national institutes may also download and install WebGR for their internal work. The aim of the project is to develop the software, not to host it.

4. Functionality:

WebGR is an open source, web browser based Intranet application and can be accessed using FireFox© Version 3.0 or higher. Only authorised access is permitted and WebGR provides self-registration with e-mail confirmation. Users choose their level of expertise, beginner, intermediate or expert, e.g. experts are defined as users who produce age data for stock assessment. Registered users upload images and linked metadata to the database. Workshop coordinators set up workshops and calibration exercises using selected images within the database. Users then annotate the images within a calibration exchange and the workshop coordinator or workshop manager will generate a report with images and analysis. Users compare, annotations, discuss annotations and produce results. Users also set reference annotations to provide a training resource and further calibration exercises are organised where this is necessary. When a workshop is complete, the statistical analysis, reporting and export functions of WebGR are used to create and disseminate reports.

5. Discussion:

WebGR offers the advantages of a web-based solution including more rapid dissemination of results and ease of access to results and online reports. Using WebGR is less time consuming for scientists who organise workshops and it is possible to have some workshops without circulating physical material. WebGR also provides better anonymity for individual age workers. Facilities for training and other uses such as public information on fish ages and the lower level of access required for this can also be provided. WebGR can be used to manage collections of images at individual institutes if installed locally. Local and online training exercises can be carried out without administrative overheads. Local institutes need to be encouraged to upload images on a regular basis to maintain the effectiveness of the WebGR database. The use of Open Source software will allow the scientific community to get involved in further developments and there is considerable potential for alternative applications, i.e. other processes where data are derived from

human observations, such fish egg or larvae identification and underwater TV shellfish surveys.

A design meeting to specify WebGR features and characteristics in detail was organized in Lisbon during December 2008 and these concepts were refined at a further meeting in Montpellier in March 2009. Testing of the WebGR Beta II version is nearing completion at the consortium members' Institutes and a series of live calibration exercises will take place during a workshop in Athens in October 2009. Project milestones are shown in Figure 5.
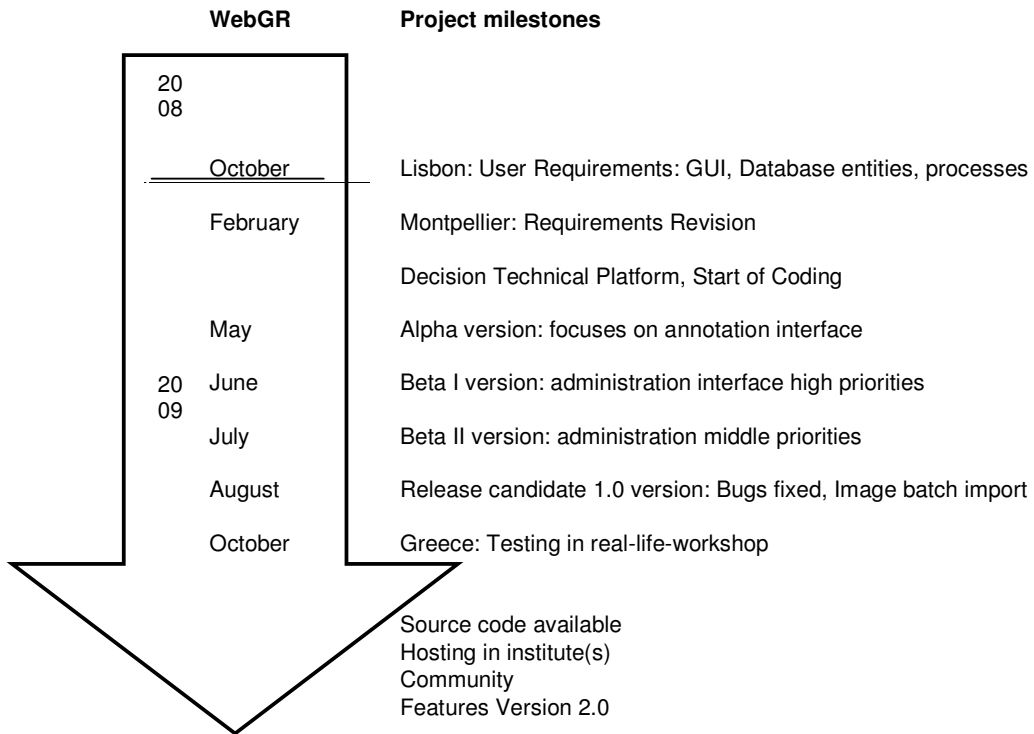
WebGR	Project milestones
20 08	
October	Lisbon: User Requirements: GUI, Database entities, processes
February	Montpellier: Requirements Revision
	Decision Technical Platform, Start of Coding
May	Alpha version: focuses on annotation interface
20 09 June	Beta I version: administration interface high priorities
July	Beta II version: administration middle priorities
August	Release candidate 1.0 version: Bugs fixed, Image batch import
October	Greece: Testing in real-life-workshop

Source code available
Hosting in institute(s)
Community
Features Version 2.0

Figure 5: WebGR Project Milestones

6. Conclusions:

WebGR's ability to run calibration exercises online will make the organisation of Workshops more efficient and economic. WebGR will promote sound statistical analysis in age calibration and generate reports with images and results. WebGR will facilitate the generation and more rapid distribution of statistical information on the precision of fish age data and it is anticipated that this will have a direct impact on the estimation of uncertainty in the catch-at-age, weight-at-age data and abundance estimates. Hence WebGR is potentially part of a solution to the persistent problem of uncertainty in biological data.

Bibliography:

Begg, G.A., Friedland, K.D. & Pearce, J.B. (1999) Stock identification and its role in stock assessment and fisheries management: an overview. Fisheries Research 43:1-8