ICES WGBIOP REPORT 2015

First Interim Report of the Working Group on Working Group on Biological Parameters (WGBIOP)

7–11 September 2015

Malaga, Spain

International Council for the Exploration of the Sea

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Contents

Executive summary

This was the first interim year for the multi-annual Terms of References (ToRs) for the Working Group on Biological Parameters (WGBIOP). ToR a was the consolidation of the WGBIOP itself, ToRs b, c and e were dealing with the development of a quality assured assessment of new and existing biological parameters for both single-and integrated stock assessment. ToRs d, f and g were the generic ToRs for the group handling the reviewing of calibration exercises on biological parameters, their outcomes and recommendations for such actions, including a continuous development of tools for facilitating such calibrations.

WGBIOP addressed ToR a) both as a general plan for the group but also by agreeing on specific plans for each ToR. In terms of the remits of the WGBIOP, it was concluded that the group will not only focus on existing biological parameters but also on accuracy in derived life-history parameters estimation which may support stock assessment; both single-stock and integrated ecosystem assessments. Given this rather ambitious remit, the group decided to focus the first 3-year period on defining new (for assessments) and existing biological parameters (ToR b) , their quality in terms of sampling and estimation (ToR c) and how these may be integrated in the general benchmark process in ICES (ToR e). Concerning the generic ToRs (d, f and g) it was decided to follow the outlined procedure in the ToRs (i.e. continue the work on quality assurance of biological parameters through workshops and calibrations as previously done in PGCCDBS), and in addition have a developmental side to them. WGBIOP decided to expand the workshop/exchange review to include under the WGBIOP remits also the work performed on ichthyology, fish egg production and ichthyoplankton related issues.

Discussions related to ToR b led to a specification of the broad groups of new and existing biological parameters that are emerging as critical components of state-of-the-art assessment. A descriptive database was initiated including details of the necessary data providing information on the particular parameter, the types of species/ecosystems for which they are most useful, the type of stock/ecosystem models that they are typically used in, and examples of where they have been used before. The discussions on this ToR led to a draft of a "roadmap" that can guide end-users on the data collection, potential usefulness, and typical approaches employed when incorporating this new biological information into assessment.

WGBIOP addressed ToRs c and e in combination and ended up merging these into one single ToR: "Evaluation of quality of biological parameters: issues, quality indicators and guidelines". The discussions under this new ToR were very fruitful and led to a thorough review of the issues regarding biological parameters. Issues put forward by the assessment WGs for benchmark stocks were evaluated ('top–down' approach) and, as an example, the WGNSSK 2015 report was screened for issues ('bottom–up' approach). This evaluation focused on existing biological parameters already included in assessments (e.g. age, maturity, natural mortality). New biological parameters from this review were discussed under ToR b. The development of Quality Indicators was initiated for existing biological parameters.

1   Administrative details

Working Group name
Working Group on Biological Parameters (WGBIOP)
Year of Appointment within the current cycle
Year 1
Reporting year within the current cycle (1, 2 or 3)
Year 1
Chair(s)
Francesca Vitale, Sweden
Lotte Worsøe Clausen, Denmark
Pedro Torres, Spain
Meeting venue
Fuengirola, Malaga, Spain
Meeting dates
07–11 September 2015

2   Terms of References

a) Develop the work plan for WGBIOP; 3-year work plan including specific deliverables and milestones

b) Identify and assess new biological parameters as input to integrated ecosystem assessments and continue the development of methods and guidelines for best practice in the analysis of biological samples providing such parameters meeting end-user needs

c) Provide guidelines for the various steps of the determination of statistically sound biological parameters in relation to: a) sampling protocols, b) sampling design and c) computation facilitating precision and accuracy in estimating existing biological parameters and those defined in ToR b

d) Plan studies, workshops and exchange schemes or other intersessional work related to interpretation and quality assurance of data on stock-related biological variables and review their outcomes

e) Identify and evaluate potential issues in relation to biological parameters in accordance with the Benchmark schedule and provide feedback using quality indicators

f) Address requests for technical and statistical recommendations/advice related to biological parameters and indicators

g) Update and further develop tools for the exchanges and workshops (e.g. WebGR, other statistical tools, age readers/maturity stagers forum)

3 Summary of Work plan

Year 1	Consolidate WGBIOP workplan (ToR a). Initiate the collation of a) information related to potential new biological parameters; b) Benchmark Issue Lists; c) Guidelines. ToR e-g are generic ToRs and will be dealt with on a yearly basis in WGBIOP
Year 2	Implement the quality indicator for current Benchmarks; develop methods/guidelines for best practice for the computation of the new required biological parameters; further develop the Guidelines in ToR c.
Year 3	Review the current status of issues, achievements and developments that falls under the remit of WGBIOP, identify future needs in line with the ICES objectives and Science Plan and the wider marine environmental monitoring and management within Europe and propose a future/alternative work plan

4 List of Outcomes and Achievements of the WG in this delivery period

Given that this year is Year-1 for WGBIOP, the outcomes and achievements of the WG in the delivery period are identical with the progress report on the ToRs.

5 Progress report on ToRs and workplan

5.1 ToR a) Setting the remits of WGBIOP

WGBIOP does not only focus on existing biological parameters but also on accuracy in derived life-history parameters estimation which may support stock assessment; both single-stock and integrated ecosystem assessment. Given this rather ambitious remit, the group decided to focus for the first 3-year period on defining new (for assessment purposes) and existing biological parameters (ToR b), their quality in terms of sampling and estimation (ToR c) and how these may be integrated in the general benchmark process within ICES (ToR e). Concerning the generic ToRs (d, f and g), it was decided to follow the outlined procedure in the ToRs (i.e. continue the work on quality assurance of biological parameters through workshops and calibrations as previously done in PGCCDBS (ICES 2014a)) and in addition have a developmental side to them. WGBIOP decided to expand the workshop/exchange review to include under the WGBIOP remits also the work performed on ichthyology, fish egg production and ichthyoplankton related issues. In the following, the deliverables and milestones discussed for each ToR is outlined, summing up to the 3-year work plan for WGBIOP.

5.1.1 Deliverables for 2016 by ToR

ToR b) Assess and suggest potentially new biological parameters for single-stock and ecosystem models

Workplan: Given the almost limitless number of potentially new biological parameters and assessment methods, let alone their definitions and calculations, WGBIOP will attempt to identify broad sets of new and existing biological parameters that are emerging as critical components of modern assessment. This will be based on a literature review, input from experts, and collaboration with other ICES working groups. A descriptive database will be created, including details of the necessary data providing information on the particular parameter, types of species/ecosystems for which they are most useful, type of stock/ecosystem models where they are typically used in, and

examples of where these have been used before. Instead of making specific recommendations for the use of new methods or parameters, a "roadmap" will be developed that can guide end-users on data collection, potential usefulness, and typical approaches employed when incorporating this new biological information into assessment.

Deliverables for 2016: The structure and preliminary contents of a database detailing important parameters for single-stock and integrated ecosystem models fully integrated with the relevant stock-assessment/integrated assessment methods experts and working groups. Presentation for WGBIOP 2016

ToR c) Provide guidelines for the various steps of the determination of statistically sound biological parameters and ToR e) Identify and evaluate potential issues in relation to biological parameters in accordance with the Benchmark schedule and provide feedback using quality indicators

Due to a very close link between the TORs c and e it was decided to merge and rename them to "Evaluation of quality of biological parameters: issues, quality indicators and guidelines."

Workplan: Issues regarding biological parameters will be evaluated each year for benchmark species in the following year. Responses (advice or action) by WGBIOP will be communicated to the stock coordinators. Based on issues and previous experiences (e.g. WKNARC2, WKMATCH), quality indicators will be formulated. Statistician(s) will be sourced to aid the group in re-tuning the indicators so they can be used in the benchmark assessment procedures. The quality indicators will be tested in two case studies. Finally, the best practices for evaluation of quality of biological parameters will be documented in generic guidelines.

Progress 2015: Issues regarding biological parameters were evaluated both by examining the issue lists put forward for the benchmark stocks in 2016 and by examining the WGNSSK report (ICES 2015). Responses by WGBIOP have been / will be communicated to stock coordinators. Preliminary quality indicators were formulated for existing biological parameters. These quality indicators were linked to the overall issues list. Furthermore, for the benchmark stocks, values for quality indicators of age were given if available through age reading workshops.

Deliverables for 2016: Evaluation of issues put forward by the assessment WGs for benchmark species in 2017. The work related to formulating quality indicators, specifically focusing on statistical indicators, will be continued. Carrying out case studies on two species selected from the benchmark stocks in 2017.

ToR d) Plan studies, workshops and exchange schemes or other intersessional work related to interpretation and quality assurance of data on stock-related biological variables and review their outcomes.

Workplan: Although this is a generic ToR, which will continue the work done in PGCCDBS (ICES 2014a), WGBIOP will aim at changing the procedure in order to pave the way for 'fast-track' exchanges/workshops. The need for a fast estimation of the bias and quality of a certain stock-related biological variable, like age, has been seen to arise during the annual stock-assessment working groups, often with a need for an answer in well time before the next assessment working group. In order to facilitate this, WGBIOP will develop the current guidelines for such exchanges/workshops to include 'fast-track' options. The recommendation flow between stock-specific groups, survey groups, catch-related groups, methodology groups and groups focusing on the integrated approach to assessments, needs to be strengthened. Often the recommendations

only lead to a short reply in the ICES recommendation database and no further work is executed. WGBIOP will work towards getting the linkage between senders and recipients of recommendations strengthened by setting up actual contact between relevant experts, suggesting potential solutions, when replying to recommendations addressed to WGBIOP.

Deliverable for 2016: Presentation at WGCHAIRS 2016 of the updated guidelines including 'fast-track' wk/exchanges and their standardized output.

ToR f) Address requests for technical and statistical recommendations/advice related to biological parameters and indicators

Workplan: This ToR predominantly focuses on reviewing any technical and statistical recommendation/question addressed to WGBIOP from the ICES/GFCM community. The ToR is generic and will be part of the WGBIOP remits much along the lines of what was previously done in PGCCDBS. The nature and clarity of recommendations sent to the group vary quite a bit, and sometimes it is difficult to give a useful and operational reply. To facilitate an operational recommendation-system, WGBIOP will develop a template for categorizing the nature of the recommendations, which in turn will allow operational advice from WGBIOP.

Deliverable 2016 and 2017: A three-year plan for implementation of the template was discussed. In year one (2015), the template would be sent to chairs of upcoming workshops and exchanges. In year two, feedback will be received and the template potentially revised. In year three - full implementation of the template.

ToR g) Update and further develop tools for the exchanges and workshops (e.g. WebGR, other statistical tools, age readers/maturity stagers forum)

Given the current endangered status of the calibration tool WebGR, which will cease to work by the end of 2015 unless appropriate action is taken, the focus of the first work-period of WGBIOP was decided to be the immediate rescue of WebGR and then keeping this tool viable. An immediate rescue of the system is estimated to be rather low budget demanding (in the area of 6000 €). However, in order for ICES to take over the system, which is the only way to ensure its future use, a higher amount of money will be required. WGBIOP will further develop a plan for the continuation and upgrading of WebGR in the format of a proposal for a 2-year project.

Deliverable 2016: Rescue WebGR to ensure the continued existence. Update the system with automatized e-mail contacts (including stock co-ordinators) when a workshop is set up and include guidance on standardized output.

5.2 ToR b) Identifying relevant/novel biological parameters

During the 2015 session, the majority of progress was made in defining more clearly the aim of this ToR. Further progress was made on identifying potential new parameters by recognizing the relevant working groups, reviewing the processes and parameters mentioned in their reports and compiling a contact list for the WG chairs. Finally, several draft e-mails were written to contact the chairs to begin liaising with the relevant assessment groups to aid in populating the envisioned parameter database.

General development of ToR deliverables

The final deliverable for this ToR was initially outlined as providing a list of new and requested biological parameters needed for an integrated ecosystem assessment (IEA) to be delivered to the relevant EGs. Given the great variability of assessment methods

currently used across the range of stocks and ecosystems for which ICES gives advice, detailing a list of new biological parameters that may be of potential use within IEAs is an extremely broad task. Many of these ecosystem models are still under development, and may take many forms (for a review, see FAO 2007), from single-species assessment models with ecosystem predation components (e.g. extended SeaStar model, Tjelmeland and Lindstrøm 2005), to foodweb models of an ecosystem (e.g. the ecosystem mass-balanced model Ecopath, Pauly *et al.,* 2000) and complex, spatially explicit and biogeochemical ocean-coupled models (e.g. the advection-diffusion-reaction model SEAPODYM, Lehodey *et al.,* 2008). Assessment frameworks may be designed to answer specific management questions for a region or species of interest, or may be constructed to examine the sensitivity of an ecosystem as a whole to specific processes.

WGs working towards the development of an ecosystem-approach to assessment and management already exist for a number of regions (WGIAB, WGINOR, WGINOSE etc.), each of which is tasked with identifying the appropriate ecological parameters and modelling approaches for that particular area. Parameters of ecosystem models represent inherently multi-scale processes, and the term biological parameter is less appropriate than for single-species population dynamics models where biological processes such as growth and maturity are critical. Life history or ecological process parameters are more commonly used terms, but here we include these under our remit of listing new biological parameters for use in developing IEAs. These parameters may be wide ranging in ecological scale, from environment-linked species-specific biology through to population processes and interspecific trophic flows.

It is envisioned that this subgroup of WGBIOP will provide not simply an exhaustive list of new biological parameters that may or may not be of use to these emerging IEAs. Rather, a more generic "roadmap" database will be produced, through liaison with these WGs during 2016, detailing these broad ecological parameters that are highlighted as potentially critical components of an IEA. Parameters will be described, alongside the data and methods that can provide a basis for their calculation. This will include the potential parameters that can be calculated from data already collected as part of EU data regulations (e.g. proportion of large fish in population), through to reviewing the possibility of parameterizing more abstract processes such as trophic flow. Brief summaries of their typical use will also be provided as well as examples of where they have been employed in management from European waters and beyond.

This subgroup will form a link between the IEA groups requesting information on the availability of new life-history parameters, and those scientists designing and undertaking data collection. In practice, this means IEA groups will submit information requests for new parameters they have identified as key to improving the representation of a process within their model. This subgroup will then act to provide guidance on computational methods and available datasets and where possible, provide referenced examples. Furthermore, if new datasets are required then guidance on "best practice" for data collection methods will be provided to sampling designers through collaboration with other subgroups within WGBIOP. In the long term, the subgroup will produce a library of IEA relevant parameters, available data and best practices for collection, and their links to the various regional WGs who employ them. More information on the proposed structure of the library is provided below (Figure 5.2.1).
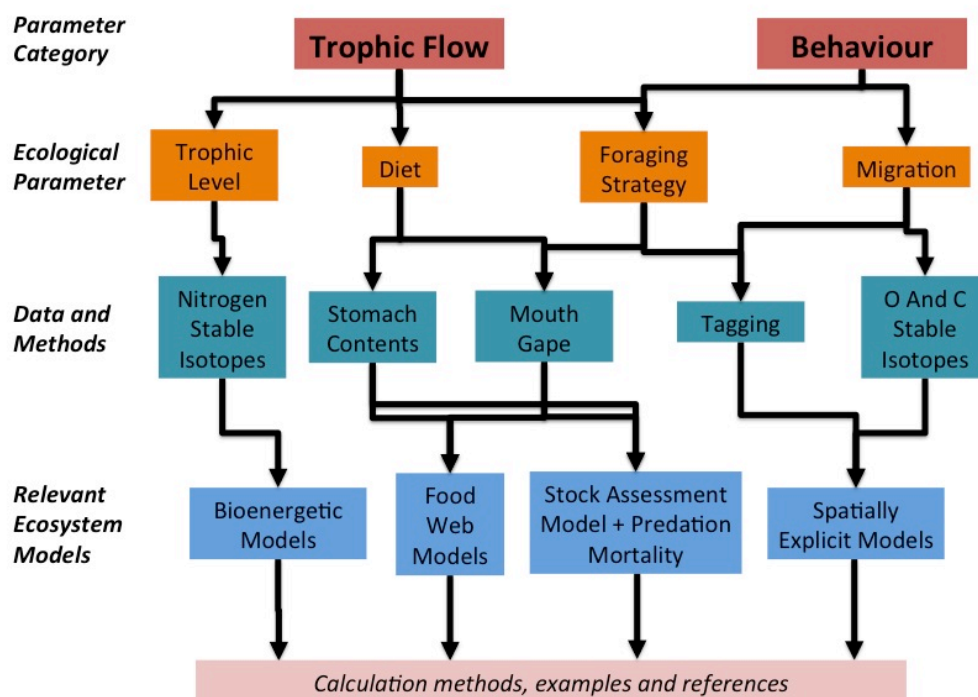
Figure 5.2.1. Proposed structure for the library of IEA (integrated ecosystem assessment) relevant parameters.

Cooperation and expertise required

The focus of this subgroup must remain on new requests for biological parameter information, but summaries of existing assessment parameters and methodologies will provide additional guidance on the sensitive life histories of different stocks.

Cooperation with IEA WGs is implicit in our ToR, and an initial milestone for 2015/2016 is to contact the chairs of these groups with a description of our aims in order to begin a dialogue on sensitive life-history parameters. Furthermore, inviting scientists from groups developing both currently used stock assessment models and future IEAs to give overview presentations on how biological parameters influence their scientific advice may be beneficial to WGBIOP.

Milestones and deliverables for 2015/2016 period

Identify relevant WGs and EGs that require new and emerging life-history parameters for integrated ecosystem assessments.

Contact chairs with outline of our ToR and a request for those parameters that have been identified as critical for review and best practice by their WG.

Using this information, group parameters within broad ecological process categories and summarize data, methods and use within IEAs.

By the 2016 WGBIOP meeting, have identified and compiled an initial draft list of the most important parameters that are emerging as critical or sensitive for IEA WGs.

Identify experts from other WGs who can provide overview presentations on current assessment methods and their links to IEA development.

5.3   ToR c) and ToR e) Evaluation of quality of biological parameters: issues, quality indicators and guidelines

As a first step towards defining quality indicators and general guidelines, issues regarding biological parameters were evaluated. Issues put forward by the assessment WGs for benchmark stocks were collated ("top–down" approach) and the WGNSSK report (ICES, 2015) was screened for issues ("bottom–up" approach). The issues, including a response from WGBIOP, are listed in Table 1 of Annex 6. This list is limited to the existing biological parameters already included in assessments (e.g. age, maturity, natural mortality). "New" biological parameters which came up during this scrutiny were forwarded towards the subgroup dealing with ToR b.

Preliminary quality indicators for existing biological parameters were defined (Table 2 in Annex 6). The choice and formulation of these indicators were based on our experience with biological parameters (e.g. WKNARC2 (ICES, 2013), WKMATCH (ICES, 2012). A link was made between the issue list and quality indicators (last column in Table 1, Annex 6). The quality indicators will be further developed in the following years (see below).

As a first exercise in actually using quality indicators, we provide some quality indicators for the benchmark fish stocks. Table 3 in Annex 6 presents the following quality indicators for age:

- % agreement
- CV
- # countries
- # techniques
- birthdate
- ageing scheme

The data come from the reports of WKNARC1 (ICES, 2011), WKNARC2 (ICES, 2013), PGCCDBS (ICES, 2014a) and the workshops on age reading, or updated data during the WGBIOP 2015 meeting. The specified workplan for this new ToR is outlined below.

We recommend that those involved in creating issue lists and/or stock annexes write in clear and elaborate way so non-involved persons can also understand the content. Furthermore, some issue lists and stock annexes were missing.

Year 1

Following the meeting statistician(s) will be sourced to aid the group in re-tuning the indicators so they can be used in a pre-benchmark data workshop. It would be the understanding that the appointed expert(s) will attend WGBIOP 2016. The group will select two species to be used as case studies in year two (benchmark species for 2017). One species will be mackerel. The second one will be a WGNSSK (ICES, 2015) species.

Year 2

Continuous progress will be made on formulating quality indicators (Table 2). These updated quality indicators will be applied to the reoccurring evaluation of the issue lists put forward by the assessment groups for benchmark stocks (this will be limited to the top–down approach). The expert statistician attending WGBIOP 2016 will work with the group to make the indicators useable for statistical evaluation in benchmark

assessments (by means of e.g. error matrices, bootstrapping, simulation model and sensitivity analyses). These analyses will be carried out for two case studies.

Year 3

Using the information and expertise obtained over the past two years generic guidelines for the evaluation of the quality of biological parameters will be created. However, this will be a continuous development as our knowledge in these fields will increase with time. It will also be an aim of the group to publish one of the case studies created in year two (not a deliverable). Beyond the time frame we could carry out evaluation of quality of new biological parameters (ToR b).

Milestones

- **2015**
    - Evaluation of issues for benchmark species in 2016 (2-way approach)
    - Preliminary formulation of quality indicators and application on benchmark stocks
    - Source expert to join the group to make the indicators useable for assessment working groups
    - The group will select two species to be used as case studies in year two (benchmark species for 2017).
- **2016**
    - Evaluation of issues put forward by the assessment WGs for benchmark species in 2017
    - Continued progress will be made on formulating quality indicators, specifically focusing on statistical indicators
    - Case studies on two species
- **2017**
    - Evaluation of issues put forward by assessment WGs for benchmark species in 2018
    - Consolidate quality indicators for existing biological parameters
    - Generic guidelines

5.3.1 ICES cooperative research report (CRR). Protocols on the ageing of different fish species in the ICES area

Editors: Lotte Worsøe Clausen, Francesca Vitale and Grainne Ni Chonchuir

PGCCDBS 2012 was approached by the ICES Publications Committee (ICES PUBCOM) with a suggestion of combining the existing protocols on the ageing of fish species within the ICES area, and publishing them as an ICES cooperative research report (CRR). This idea was positively received by PGCCDBS. The proposed CRR was discussed further at the WKNARC-2 meeting in 2013, agreement was reached on the general structure of the CRR, the chapter titles, and chapter editors were also appointed. ACOM endorsed this proposal and the CRR is currently submitted and under review since the 1st of September 2015, with the following structure:

Chapter 1. Introduction

Chapter 2. Gadoids: Karin Hüssy and Beatriz Morales-Nin as chairs of the Workshop on Age Validation of Gadoids (WKAVGS; 2013)

Chapter 3. Flatfish: Mark Etherton, Sally Songer, Joanne Morgan and Barbara Bland

Chapter 4. Small and Medium Pelagic Species: Begoña Villamor and Pierluigi Carbonara

Chapter 5. Deep Water Species: Ole Thomas Albert, Christoph Stransky and Rafael Duarte

Chapter 6. Statistical handling uncertainty in age estimations: Lotte Worsøe Clausen and Ernesto Jardim as chairs of the Workshop on Analysis of Biological Calibration Studies (WKSABCAL).

Chapter 7. Acknowledgements

Chapter 6. References

5.4   ToR d) Planning studies, exchanges, workshops

This ToR is a generic ToR for the group and will be part of the WGBIOP remits much along the lines of what was previously done in PGCCDBS and WKNARC. The ToR covers the following points:

a) Update the guidelines for otoliths exchange and for workshops on age reading and maturity staging calibration:

Guidelines for otoliths exchange and for workshops on age reading calibrations were updated according to the recommendation from WKSABCAL (ICES, 2014b).

The usual procedure for starting an exchange/workshop is for WGBIOP to draft the proposal following a recommendation by a specific expert group. This request is subsequently evaluated and decided upon by WGDATA and ACOM/SCICOM. Exchanges and workshops are therefore usually planned at least the year before they are supposed to take place. However, if a stock assessment WG discovers an issue, which needs a sudden action to be taken, it can be necessary to diverge from the normal procedure. In order to be able to promptly react to sudden problems, it will be necessary to have a direct communication between the stock coordinator and WGBIOP, for deciding upon an action. It is important that chairs of previous and suggested workshops/exchanges are included in this communication, as there might be some planning already going on, which can be useful to be aware of.
The guidelines for workshops on maturity staging calibration were also updated and can be found in the Data Quality Assurance Repository as well as in the Maturity Staging Forum (MSF)

b) Update the interactive table:

During WGBIOP the interactive table, including all the workshops and exchanges occurred, ongoing and planned per species, related to both age and maturity, and was updated. This table can be found in the Data Quality Assurance Repository as well as at the Age Readers Forum (ARF).

c) Update the age-reader and maturity-stagers contact lists:

All the national age-readers coordinators were contacted and asked to update the information related to their countries/institutes, thus the age readers contact list was updated accordingly. In addition, all the national maturity stagers' coordinators were contacted and asked to update the information related to their countries/institutes, thus the national maturity stagers contact list was updated accordingly. In cases where no reply was received, the information

was left unchanged. The lists can be found at [Data Quality Assurance Repository](#) or at the Maturity Staging Forum ([MSF](#)).

d) Update the "Review material, techniques and preparation methods by species and areas to fish ageing" table:

Most of the national laboratories did not make any changes for their material, techniques and preparation methods by species and areas because their techniques were up-to-date. Some of them made some changes, for example, in preparation methods (changing the otolith preparation from whole to break and burn or sectioning and staining for a specific species). Lastly, there is some new information added from the National laboratories about their techniques that at first were not on the table.

e) Respond to the recommendations received from other expert groups:

Not unexpectedly, WGBIOP received quite a few recommendations from other ICES groups/workshops and other fora. The group handled a total number of 50 recommendations. In some cases, the recommendations were unclear and prior to the WGBIOP, the expert groups' chairs were asked to clarify such recommendations, which led to some withdrawal. The group discussed options for facilitating a more efficient and clear communication between the senders of the recommendations and WGBIOP and concluded that a thorough review of the recommendations prior to the actual WGBIOP meeting by subgroups would allow time for potentially necessary clarifications. Additionally the group is optimistic for the uptake of the recommendation template developed under ToR f.

All recommendations were discussed and appropriate action was taken, including filling in the 'Final recipient action' column in the Recommendation database.

f) Report results from the WKs occurred the past and current year:

Reports from past exchanges and workshops were reviewed and results were discussed. Recommendations from the outcomes of these reports were evaluated (Annex 4). Resolutions for future Workshops/exchanges recommended by other experts group were drafted when endorsed by WGBIOP. Annex 5 lists those planned exchanges and workshops.

5.4.1 WGBIOP in context of Liaison Meeting and Regional Coordination Meetings

WGBIOP is keen on interfacing with the RCMs and the LM to ensure an information flow between these groups and WGBIOP, thus recommendations and views from these groups were also discussed during the meeting. A general request from the LM 2014 was to develop a procedure for annual interim calibration in National laboratories delivering age data to stock assessment. Such procedures are outlined in the report from WKNARC2 (ICES, 2013) and WGBIOP strongly encourage all laboratories to follow these guidelines. This information will be channelled through to the respective RCMs. The table below provides in-depth feedback to RCM and LM from WGBIOP.

LM 7. QUALITY ASSURANCE – CALIBRATION OF AGE READINGS

RCM Baltic 2014 Recommendation	RCM recommends that WGBIOP develop a procedure for an annually intermediate calibration
Justification	To make sure on a regular basis that age reading is done in a consistent way and that a reference set is available for age readers before the start reading a new season of otoliths. WebGR could be used as a tool for uploading pictures on otoliths. All experts involved in the age reading for the specific stock should participate in the exercise which should be performed annually for all stocks.
Follow-up actions needed	WGBIOP to look into a standard procedure
Responsible persons for follow-up actions	ICES WGBIOP
Time frame (Deadline)	Next WGBIOP meeting to be held in August - September 2015.
LM comments	LM endorses this recommendation
WGBIOP 2015 comments	Two RCMs were held prior to WGBIOP, namely the RCM Baltic and RCM North Sea and Eastern Arctic (NS&EA). At the RCM Baltic (draft report), the following considerations were discussed regarding Eastern Baltic cod: MS are obliged to collect otoliths under the DCF. All MS should continue to perform stock-related sampling according to their NP. However, the RCM Baltic agrees that MS are not obliged to perform the age readings since it is currently not possible to conduct an age-based assessment. This holds until a solution for current age reading problems is found. The RCM NS&EA (draft report) recommends that the Liaison Meeting (LM) discusses and makes a decision on the age determination of Lophius sp. in the upcoming years. Many Member States undertake the task of determining the age of anglerfish (Lophius sp). This task is done though (1) otoliths and (2) illicia. To date, there have been several age determination workshops and otolith/illicia exchanges which have shown there is very little agreement among readers and that there is almost no correlation between the ages reported using one structure vs. the other structure. This task is difficult and more time consuming than the age reading of many other species. The assessment working groups do currently not use ages and conduct the assessment using lengths only. In this respect, a decision should be reached whether the resource-heavy aging should stop in the meantime until another process can be found and agreed. In a similar manner, WGBIOP discussed the lack of agreement in hake (Merluccius sp.) age reading, which appears to be very different from stock to stock. In all cases, WGBIOP strongly encourages that the data end-users (i.e. assessment WGs and Benchmark WKs) stay in dialogue with WGBIOP and the RCMs in order to provide feedback on the usability and feasibility of (deriving) age reading data for these difficult species.

5.4.1.1 Task sharing

PGCCDBS 2012 recognized the increasing need for regional cooperation and task sharing (TS) to provide quality assured data on age compositions and life-history parameters (growth, maturity, fecundity) for a growing number of species and stocks to be included in single and multispecies management advice. In agreement with the PGCCDBS 2012 advice, WKNARC2 (ICES, 2013) recognized TS as an important tool to improve the age data quality and the knowledge of age studies (age determination, validation etc.). However, WKNARC2 highlighted the risks in concentrating the expertise on individual fish species among fewer people and laboratories (Central Laboratories).

The WKNARC2 considered the following points as a good basis to organize TS:

- The TS should be organized by the National Ageing Coordinators.
- The sharing should be organized at Regional level: subregions Atlantic, Mediterranean and Black Sea.
- The exchange should include not only the hard structure but also readers (the mutual exchange of readers among National Institutes (NI's) may promote standardization of methodologies, knowledge sharing and the improvement of the age data quality);
- The revision of DCF (2014–2020) could identify the financial support for the exchanges of hard structures/readers;
- Identification of some key species with high priority for collaborative study and sharing activity.

WGBIOP 2015 agrees that there is a risk of concentrating the expertise on individual fish species among fewer people and of increasing the workload of individuals. However in view of the discard ban and regionalization, both the number of fish and the number of new species requiring ageing will increase, consequently the overall workload will increase.

Furthermore, collaborative studies to standardize age reading and the development of cooperation between national institutes on a regular basis would be an essential tool for improvement of age data quality.

Also WKNARC2 (ICES, 2013) created a table to facilitate the composition of the TS groups, showing the contact person receiving/sending calcified structures/readers by species. Also included in this table is the identification of data used in assessment, if the sender is willing to be trained instead of exchanging structures etc.

WGBIOP 2015 proposed Pierluigi Carbonara and Mark Etherton as responsible for receiving and sending the information regarding the TS from the NI's. WGBIOP chairs will send the table to the RCM members in order to evaluate the need and possibility to establish task sharing.

5.5 ToR f) Technical and statistical recommendations/advice from WGBIOP

The need was identified to standardize the approach to making recommendations to WGBIOP so that 1) the group understands clearly, what was intended and 2) the correct person(s) are identified to take the recommendation forward. In order to solve this issue, a template is required. The template should guide the workshop chair(s) to a description of the issue that allows WGBIOP to reply to it swiftly and effectively.

During the meeting, a template was developed to answer this issue. In developing the template, it was decided that it should be dynamic so that changes to species / stock lists can happen and new parameters added over time to reflect the current situation.

The template consists of an excel spreadsheet with several drop-down menus that allow categorization of the recommendations. The template limits the number of recommendations to five (the upper limit for workshops). The user is first asked to select the biological parameter (age, maturity, other). Then, a second drop-down menu is created that is relevant to the first selection. These are followed by selection requirements for species and stock. These drop-down menus consider the possibility of multiple selections such as "flatfish" and "all Baltic" as well as individual selections such as "cod" and "VIIIa". The next box for entry is a free text box, where the user is asked to describe the particular issue that needs addressing. Guidance notes are available underneath the table to help make this clear and to the point. The next box is to select the relevant group to send the recommendation to (i.e. WGBIOP Chairs). This ends the input from workshop chairs.

Finally, there are boxes for the outcomes of the recommendation: Final recipient action, person responsible and date. These are filled in by the person identified to take the recommendation forward and the action list is the same as the ICES standard list.

5.6 ToR g) Update and further develop tools for the exchanges and workshops

WebGR is a set of Open Source web services developed within an EU tender project in 2008 to support studies of fish growth (age) and reproduction (maturity). This tool assists fisheries scientists in the organization and data analysis of calibration workshops for classification of biological structures and provides means to analyse the results of such exercises. Currently, AZTI is hosting the service in http://webgr.azti.es with no cost to the users. However, AZTI can give no warranties that the tool will be available after 2015 due to security flaws of the old software. Therefore, a rescue plan has been initiated, where several countries have offered to chip in, in order to update the WebGR software. This will be done before the end of 2015 and will ensure further use of the tool but with the original capabilities. A detailed description of the rescue plan can be found in Annex 8.

The tool has not been further developed since 2010. Nevertheless, since 2010 more than 60 workshops and exchanges have used WebGR with variable success. Unanimously, the members of these expert groups saw a great potential in using this software and its tools. However, they experienced different problems while using it and at the same time had several requests on how to improve this tool and obtaining more complex outputs. This feedback highlighted the strong need for further improvement of WebGR and it is the basis for the present study proposal. The objective is to substantially improve the software, which will amend the contribution to improve the quality of growth and reproduction studies, by guaranteeing a consistent application of age reading protocols and maturity scales, ultimately influencing fisheries management advice. Additionally, the use of this tool is not necessarily limited to age and maturity studies. In principle, WebGR can be applied to all situations, where individual scientists need to discuss the interpretation of a protocol, for the identification of the status of biological material.

The desirable upgrading of WebGR is manifold. First, a more user-friendly interface would be beneficial both for workshop managers organizing online exercises and for participants joining them. The arrangement of a workshop is currently troublesome,

consisting of more steps than actually needed, therefore a process consisting of sequential steps and a detailed error report need to be implemented. Furthermore, there is a great need for improvement of the picture uploading mechanism and to enhance exploring tools, in terms of new measuring tools. Concerning the output, the most basic features are currently implemented and the easy export procedure allows users to use the data on a standard statistical package or spreadsheet. At present, an R script has been developed which uses the "all distance" output from WebGR. The analysis uses Linear Mixed Effect Models to examine whether there are consistent differences in growth curves estimated by the different readers. This is then used in conjunction with and to support the age data and corresponding reference images, which have been annotated by the readers. The script also includes computation of the standard accuracy and precision measurements (percentage agreement and CV) plus bias plots. The method was presented at WGBIOP and the group agreed that it would be a very useful tool to include in the proposed WebGR upgrade. The extended statistical output will give a more complete and standardized evaluation of potential differences among readers/stagers.

Currently, the service is freely provided at http://webgr.azti.es, but without any warranties in case of problems, with a high risk of data loss. It would be very beneficial both for ICES and the users, if ICES could host the server. This would guarantee a wider dissemination of this useful tool and ensure a better site management and support. Furthermore, an offline access to the workshop is to be aimed for. This feature needs to be implemented so that all individual users' annotations will be synchronized with the server as soon as one goes online again.

The project objectives will be achieved over 24 months through the realization of a list of tasks classified in five Work Packages (WPs). WP 0: Project Coordination; WP 1: Development and improvement; WP 2: Development of maturity staging; WP 3: Statistical methods; WP 4: Site management; WP 5: Training and dissemination.

A study proposal with a detailed list of improvements can be found in Annex 8. **Budget: €350,000 to be spent over 24 months. WGBIOP strongly supports this initiative and study proposal**

6   Revisions to the work plan and justification

The first year ToR a) was to consolidate WGBIOP and develop a 3-year work plan; this was fulfilled and thus this ToR is removed from the coming meetings. The ToRs were amended during the consolidation of the WGBIOP, merging the original ToR c) and ToR e). Thus, the ToRs for WGBIOP in 2016 are the following:

a) Identify and assess new biological parameters as input to integrated ecosystem assessments and continue the development of methods and guidelines for best practice in the analysis of biological samples providing such parameters meeting end-user needs.

b) Evaluation of quality of biological parameters: issues, quality indicators and guidelines.

c) Plan studies, workshops and exchange schemes or other intersessional work related to interpretation and quality assurance of data on stock-related biological variables and review their outcomes.

d) Address requests for technical and statistical recommendations/advice related to biological parameters and indicators.

e) Update and further develop tools for the exchanges and workshops (e.g. WebGR, other statistical tools, age readers/maturity stagers forum).

The workplan for WGBIOP 2016 and 2017 was updated accordingly to the following:

Year 1	Consolidate WGBIOP workplan (ToR a). Initiate the collation of a) information related to potential new biological parameters; b) Benchmark Issue Lists; c) Guidelines. ToR e-g are generic ToRs and will be dealt with on a yearly basis in WGBIOP
Year 2	Develop methods/guidelines for best practice for the computation of the new required biological parameters with off-set in case studies; further develop the Guidelines in ToR c.
Year 3	Review the current status of issues, achievements and developments that falls under the remit of WGBIOP, identify future needs in line with the ICES objectives and Science Plan and the wider marine environmental monitoring and management within Europe and propose a future/alternative work plan. Implement the quality indicators for Benchmarks

7 Next meetings

WGBIOP 2016 will be chaired by Lotte Worsøe Clausen and Pedro Torres. The meeting will be held in Bari (Italy)/alternatively Lisbon (Portugal) during 5– 9 September 2016.

WGBIOP 2017 will be chaired by Lotte Worsøe Clausen, Francesca Vitale and Pedro Torres. The meeting venue and time is yet to be decided.

8 List of Annexes

Annex 1: List of participants

Annex 2: Recommendations from WGBIOP

Annex 3: Table of biological parameters (ToR b)

Annex 4: Review of past exchanges and workshops (ToR d)

Annex 5: Ongoing and future workshops and exchanges (ToR d)

Annex 6: Review of issues from Issuelists; Table of Quality Indicator; Table of benchmark quality indicators (ToR c and e)

Annex 7: Recommendation template (ToR f)

Annex 8: WebGR rescue plan and proposal for version 2 (ToR g)

Annex 9: References

Annex 1: List of participants

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Annex 2: Recommendations

RECOMMENDATION	ADRESSED TO
1. Stock annexes must be updated and improved with regards to the sampling of biological data.	AWGs, WGCHAIRS, WGNSSK
2. Initiation of Sprat biological data collection (standard parameters: length, weight, maturity, age).	IBTSWG, WGIPS
3. Currently, WebGR is freely provided at http://webgr.azti.es but without any warranties in case of problems, with a high risk of data loss. It would be very beneficial both for ICES and the users, if ICES hosts the server. This would guarantee a wider dissemination of this useful tool and ensure a better site management and support.	ICES Data Centre, WGDIG
4. WGBIOP requests WGIPS to collect and prepare gonad samples from the 2016 herring and sprat surveys for the workshop on maturity staging of herring and sprat (WKMSHS2). WGBIOP endorses the recommendation of WGIPS to have a maturity staging workshop for sprat.	WGIPS
5. WGBIOP urges the use of the template (Annex 7 in WGBIOP 2015 report) for recommendations to WGBIOP.	ICES Chairs (WGCHAIRS)

Annex 3: ToR b) – Example parameter list and WG contact details

Table 1: Example list of new biological parameters and associated information

NAME	PARAMETER CATEGORY	DESCRIPTION	CHARACTERISTIC	DATA REQUIRED	CALCULATION	REFERENCE
Proportion of large fish in the population	Growth	The indicator is the quantitative proportion of the specimens for the entire assemblage that is caught by that particular gear or a subset based on morphology, behaviour or habitat preferences (e.g. bottom-dwelling species only).	quantitative	length / weight	%P>40 cm = W>40 cm / WTotal catch where W>40 cm is the weight of fish greater than 40 cm in length and WTotal is the total weight of all fish in the sample.	WGECO 2012
Mean maximum length of fish	Growth	The indicator is the mean of the maximum length (Lmax) of the specimens for the entire assemblage that is caught by that particular gear or a subset based on morphology, behaviour or habitat preferences (e.g. bottom-dwelling species only). Asymptotic total length (L∞) is preferred to maximum recorded total length if an estimate is available, but it is recognized that such data may not be available for many species.	quantitative	length	mean Lmax= Σj (Lmaxj Nj)/N where Lmax j is the maximum length obtained by species j, Nj is the number of individuals of species j and N is the total number of individuals	WGECO 2012
Simpson evenness index	Population	Simpson's Index calculates the probability that two organisms sampled from a community of will belong to different species (the more even the abundance of individuals across species, the higher the probability that the two individuals sampled will belong to different species). Simpson's Index values range from 0 to 1, with 1 representing perfect evenness (all species present in equal numbers).	quantitative	number of species / abundance index	Ds = 1 - Sum1i [ni*(ni-1)]/[N*(N-1)] ni = the number of individuals in the ith species collected, and N = the total number of organisms in the sample.	Simpson, 1949
Reaction norms	Population	Probabilistic maturation reaction norm (i.e. the probability of maturing) and this is derived from the maturity ogive (i.e. the probability of being mature) and from the mean annual growth at age.	quantitative	estimation of maturity ogives and estimation of growth rates (from ALK)	m (a , s)= (o (a , s)- o (a -1, s -Δ s (a)))/(1- o (a -1, s -Δ s (a))) where a is age, s is length, o (a , s) is the maturity ogive, and Ä s (a) is the length gained from age a -1 to a	Barot *et al.,* 2004

Table 2. Contact details for working groups relating to integrated ecosystem assessments.

WORKING GROUP NAME	FULL TITLE	URL	CHAIR	E-MAIL
WGINOSE	Working Group on Integrated Assessments of the North Sea	http://www.ices.dk/community/groups/Pages/WGINOSE.aspx	Andrew Kenny	andrew.kenny@cefas.co.uk
WGIAB	Working Group on Integrated Assessments of the Baltic Sea	http://www.ices.dk/community/groups/Pages/WGIAB.aspx	Lena Bergström, Laura Uusitalo, Christian Möllmann	lena.bergstrom@slu.se
WGINOR	Working Group on Integrated Assessments of the Norwegian Sea	http://www.ices.dk/community/groups/Pages/WGINOR.aspx	Geir Huse, Gudmundur J. Oskarsson	no e-mail addresses in reports Huse: IMR Norway & Gudmundur Iceland Marine Research Institute
WGIBAR	Working Group on the Integrated Assessments of the Barents Sea	http://www.ices.dk/community/groups/Pages/WGIBAR.aspx	Yury Kovalev, Edda Johannesen	kovalev@pinro.ru ; eddaj@imr.no
WGCOMEDA	Working Group on Comparative Analyses between European Atlantic and Mediterranean Marine Ecosystems to Move Towards an Ecosystem-based Approach to Fisheries	http://www.ices.dk/community/groups/Pages/WGCOMEDA.aspx	Marta Coll, Manuel Hidalgo, Hilmar Hinz	marta.coll@ird.fr ;jm.hidalgo@ba.ieo.es ;hhinz@imedea.uib-csic.es
WGECO	Working Group on the Ecosystem Effects of Fishing Activities	http://www.ices.dk/community/groups/Pages/WGECO.aspx	Anna Rindorf	ar@aqua.dtu.dk
WGSAM	Working Group on Multispecies Assessment Methods	http://www.ices.dk/community/groups/Pages/WGSAM.aspx	Steve Mackinson, Daniel Howell	steve.mackinson@cefas.co.uk ;danielh@imr.no
WKICA	Workshop on Integrated Ecosystem Assessment (IEA) for the Central Arctic Ocean	http://www.ices.dk/community/groups/Pages/WKICA.aspx	Reidar Hindrum, Alexander Klepikov, Phil Mundy, Hein Rune Skjoldal,	reidar.hindrum@miljodir.no; Klep@aari.ru; phil.mundy@noaa.gov; hein.rune.skjoldal@imr.no
WKSPATIAL	Workshop on Spatial Analysis for the Baltic Sea	http://www.ices.dk/community/groups/Pages/WKSPATIAL.aspx	Stefan Neuenfeldt, Michele Casini	stn@aqua.dtu.dk , michele.casini@slu.se

Working Group Name	Full Title	URL	Chair	E-mail
WKSIBCA	Workshop on Scoping for Integrated Baltic Cod Assessment	http://www.ices.dk/community/groups/Pages/WKSIBCA.aspx	Marie Storr-Paulsen, Maciej Tomczak	msp@aqua.dtu.dk ;maciej.tomczak@su.se
WGRFE	Working Group on Recruitment Forecasting in a Variable Environment	http://www.ices.dk/community/groups/Pages/WGRFE.aspx	Elizabeth Brooks Sam Subbey	liz.brooks@noaa.gov ; samuel.subbey@imr.no
WGOOFE	Working Group on Operational Oceanographic Products for Fisheries and Environment	http://www.ices.dk/community/groups/Pages/WGOOFE.aspx	Barbara Berx, Rosa Barciela	b.berx@marlab.ac.uk ; rosa.barciela@metoffice.gov.uk
WGRMES	Working Group on Resilience and Marine Ecosystem Services	http://www.ices.dk/community/groups/Pages/WGRMES.aspx	Gonzalo Macho Rivera, Sabastian Villasante	Newly formed so no contact list
WGISUR	Working Group on Integrating Surveys for the Ecosystem Approach	http://www.ices.dk/community/groups/Pages/WGISUR.aspx	Ingeborg de Boois	Ingeborg.deboois@wur.nl
WGIPEM	Working Group on Integrative Physical-biological and Ecosystem Modelling	http://www.ices.dk/community/groups/Pages/WGIPEM.aspx	Myron Peck, Rubao Ji	myron.peck@uni-hamburg.de ;rji@whoi.edu
WGEAWESS	Working Group on Ecosystem Assessment of Western European Shelf Seas	http://www.ices.dk/community/groups/Pages/WGEAWESS.aspx	Enrique Nogueira, David Reid, Pascal Laffargue, Maria de Fatima Borges	enrique.nogueira@gi.ieo.es ;david.reid@marine.ie ;Pascal.Laffargue@ifremer.fr ;mfborges@ipma.pt
WGNARS	Working Group on the Northwest Atlantic Regional Sea	http://www.ices.dk/community/groups/Pages/WGNARS.aspx	Robin Andersen, Sarah Gaichas	M.Robin.Anderson@dfo-mpo.gc.ca ;Sarah.gaichas@noaa.gov
WGIMM	Working Group on Integrating Ecological and Economic Models	http://www.ices.dk/community/groups/Pages/WGIMM.aspx	Eric Thunberg, Jörn Schmidt, Rasmus J. Nielsen	Eric.Thunberg@noaa.gov ; jschmidt@economics.uni-kiel.de ;rn@aqua.dtu.dk
WGLMEBP	Working Group on Large Marine Ecosystem Programme Best Practices	http://www.ices.dk/community/groups/Pages/WGLMEBP.aspx	Rudolf Hermes, Hein Rune Skjoldal	Rudolf.hermes@boblme.org ; Hein.rune.skjoldal@imr.no

Working Group Name	Full Title	URL	Chair	E-mail
WGMSFDemo	Working Group to Demonstrate a Celtic Seas wide approach to the application of fisheries related science to the implementation of the Marine Strategy Framework Directive	http://www.ices.dk/community/groups/Pages/WGMSFDemo.aspx	Jean Paul Lecomte, Carl O'Brien, Eugene Nixon	jean.paul.lecomte@ifremer.fr ;carl.obrien@cefas.co.uk ;eugene.nixon@marine.ie

Annex 4: Review of past workshops and exchanges during 2014/2015 (Tor d)

4.1   Workshops

The following are summaries of the age reading workshops carried out in 2014 and 2015.

4.1.1   Workshop on the Age Reading of Saithe (*Pollachius virens*) (WKARPV)

The workshop on age reading of Saithe *(Pollachius virens)* (WKARPV) was held in Boulogne-sur-Mer, France, from 26 to 29 May 2015. The meeting was co-chaired by Kélig Mahé (France) and Jane A. Godiksen (Norway), and included eight age readers from four countries.

The objectives of this first workshop were to review, document and make recommendations on current methods of aging saithe.

This workshop was preceded by an otolith exchange in 2013, which was undertaken using WebGR. Participants who hadn't taken part in the exchange were asked to annotate the images in the months prior to the workshop, however, due to problems with accessing WebGR only a limited amount of the readers managed to do this in time. The otolith collection included 298 images from the North Sea and the Barents Sea. The overall agreement with modal age of the pre-workshop exercise was 85.9%, with a precision of 6.2% CV. The images were analysed, the differences discussed, and guidelines were established from this discussion. To test the guidelines a set of 50 otoliths from the Barents Sea was read during the workshop. These were read both with reflected and transmitted light and had an agreement ranging between 79.2% and 82.3% with a precision ranging from 3.7% to 4.6% CV. There was clear bias between the individual readers using the two different light sources. Width measurement analysis of the 50 otoliths was carried out in plenary after agreeing on the ages of 48 of the 50 otoliths to determine the continuity of the position of the growth rings.

In general, the understanding of the annual rings was high between the readers, and there was little disagreement, however, since the otolith preparation is different among institutes, there was discussion especially about the perception of the edge. Readers used to reading broken otoliths found it difficult to read the edges of the image of the slides. Therefore, we recommend that both broken and slides are com-pared during the next saithe exchange along with images on WebGR.

Recommandations	Adressed to
1. WKARPV2 Workshop in 2022	WGBIOP, WGNSSK, NWWG, AFWG, ACOM
2.Otoliths Exchange of P. virens in 2019	WGBIOP, WGNSSK, NWWG, AFWG, ACOM
3. Clarify guideline of ageing criteria for saithe	WGBIOP, WGNSSK, NWWG, AFWG, ACOM
4. Develop the WebGR tool	WGBIOP, ACOM

WGBIOP 2015 acknowledges the work done, and agrees on scheduling the future workshop and exchange in many years from now. In addition, WGBIOP supports the further development of the WebGR tool (see section 5.6)

4.1.2 Workshop on the Age Reading of Sea Bass (*Dicentrarchus labrax*) (WKARDL)

The Workshop on Age reading of Sea bass (*Dicentrarchus labrax*) (WKARDL) was held in Lowestoft, England, UK, from the 15th to 19th June 2015. The meeting was chaired by Kélig Mahé (France) and Mary Brown (England UK), and included seven age readers from three countries.

The objectives of this first workshop were to review, document and make recommendations on current methods of ageing sea bass. This workshop was preceded by otolith exchanges in 2011 and 2013, which were undertaken using WebGR. Participants, who had not taken part in the exchange, were asked to annotate the images in the months prior to the workshop. However, due to problems with accessing WebGR only a limited number of the readers managed to do this in time.

Seven readers participated in a scale calibration exercise during this workshop which showed an overall agreement of 78.2% (ranging between 29 and 100%) with a precision of 5.2% CV (ranging from 0 to 13%). Of the 55 scales, 24 (43%) were read with 100% agreement. The image analysis exercise clarified that the lack of agreement can be due to the difficulty identifying the position of the first annulus, the presence of checks and the dates of sample collection.

The workshop achieved quite a lot in terms of ironing out, through discussion and calibration, some of the major difficulties in ageing otoliths of sea bass. This group recommends use of scales for sea bass ageing. For future exchanges, it would be beneficial to compare unstained otolith sections with transmitted and reflected lights and stained otolith sections, with the scales. For scale exchanges, the group recommends the use of multiple scale images (or videos) for each fish. The group reached agreement on a definition of an ageing guideline and a reference collection presented in this report and the aim is to employ these tools for all laboratories.

RECOMMENDATIONS	ADRESSED TO
1. WKARDL2 Workshop in 2021	WGBIOP, WGCSE, WGBIE, ACOM
2. Otolith and Scale Exchange of *D. labrax* in 2019	WGBIOP, WGCSE, WGBIE, ACOM
3. Clarify the ageing criteria guideline	WGBIOP, WGCSE, WGBIE, ACOM
4. Develop the WebGR tool	WGBIOP, ACOM

WGBIOP 2015 acknowledges the work done, and agrees on scheduling the future workshop and exchange in many years from now. In addition, WGBIOP supports the further development of the WebGR tool (see section 4.6)

4.1.3 Workshop on Statistical Analysis of Biological Calibration Studies (WKSABCAL)

The Workshop on Statistical Analysis of Biological Calibration Studies [WKSABCAL] met in Lisbon in October 2014. The meeting was chaired by Ernesto Jardim (EU) and Lotte Worsøe Clausen (Denmark), and included eighteen participants from eight countries.

The objectives of the workshop were to review applied statistical methods for analysing reader agreement on fish age estimations, in the light of, both, what is warranted from the data suppliers (the readers) and what is required by the data receivers (the

stock assessors). The aim of the workshop was to bridge between the age and maturity-calibration workshops and the stock assessment working groups facilitating a full use of the results and considerations from calibration workshops.

The group reviewed a large number of past workshops and exchanges as well as available literature to outline state-of-the-art of statistical methods for analysing reader agreement. Through discussions, a selection WKSABCAL recommended the following methods/analysis to be run by age calibration workshops:

- To access bias
  - ABP – Age-bias plot
  - TS – Tests of symmetry
- To access precision
  - APE – Average Percentage Error
  - CV – Coefficient of Variation
- As diagnostics for problems found by the previous analysis
  - Analysis of otolith increments, both through image layers and statistically
- As output to stock assessment groups
  - AREM – Age Readings Error Matrix

All the methods were tested on known-dataset to evaluate their performance. The available software able to perform such analysis was evaluated and suggestions for R-packages were given. In this relation, the WKSABCAL outlined potential additions to the prevailing web-application interface for calibration studies (WebGR), which the group highly recommends implemented to facilitate the operational outcomes of calibration workshops.

The group discussed the range of potential recipients of outcomes from calibration workshops and suggested ways to reach the various groups.

RECOMMENDATION	ADRESSED TO
Update workshops guidelines to include recommended outputs and the dissemination framework.	WGBIOP
Explore the solutions identified by the WKSABCAL, or alternatives, for the integration of error on age readings and maturity staging into stock assessment models.	Working Group on Methods for Fish Stock Assessments (MGWG). Also an option as an ICES JMS theme; to be evaluated by PubCom
Update WebGR and FSA to integrate the methods and outputs identified by the WK.	Maintainers of WebGR and FSA (to be addressed by the ICES secretariate)
Analysis of the effects of error/bias in ageing and staging in stock assessment models.	Future Benchmark Workshops (to be addressed by the ICES secretariate)

WGBIOP 2015 acknowledges the work done and updated the workshops guidelines accordingly including the recommended output. Also WGBIOP supports and reinforces the recommendations addressed to other expert groups, including the further development of the WebGR tool (see section 5.6)

4.1.4   Workshop on Scoping for Integrated Baltic Cod Assessment (WKSIBCA)

The ICES Workshop on Scoping for Integrated Baltic Cod Assessment (WKSIBCA), chaired by Marie Storr-Paulsen, Denmark, and Maciej Tomczak, Sweden, met in Gdynia, Poland, 1–3 October 2014 with 42 participants and six countries represented. The objective of WKSIBCA was to review data used in the single-stock assessment, to come up with a timeline for how to improve the assessment and to discuss how an integrated assessment could be implemented for the two Baltic cod stocks; the cod in SD 22–24 and cod in SD 25–32. Participants in the workshop were a large group with diverse background representing the industry, fisheries, NGOs, managers and scientists.

The single-stock analytic assessment of the eastern Baltic stock was not accepted by this year's assessment working group (WGBFAS) due to severe problems with the input data. The advice for the eastern Baltic cod was, therefore, based on the ICES approach for data-limited stocks. As an outcome, ICES decided to establish a benchmark for both cod stocks and to scope an integrated assessment for the Baltic cod stocks. This meeting (WKSIBCA) was therefore meant to introduce the intercessional work conducted since the assessment working group in April 2014, and to reach some conclusions on how to proceed both in the short term (Benchmark in March 2015) and longer term (2–3 years).

It was recognized that four main issues had to be covered during this workshop. Although there was some overlap between the topics, it was decided to have subgroups on: 1) age and stock identification; 2) mortality and growth; 3) recruitment; and 4) on the process of integrated assessment and advice leading to ecosystem-based approach for fisheries management.

Presentations on the progress were made by scientists within these four main topics and on the second and 3rd day of the workshop, four subgroups were formed based on the same topics listed above. In these groups, all participants were asked to produce a timetable with a detailed description on the work that has to be conducted, responsible person(s) and time of deliverable.

The report's structure is in line with the four subgroups and the respective output. Abstracts of all presentation are available the end of the report.

Main outputs from the workshop were

From the age and stock mixing group:

- Analysis of an otolith exchange showed that traditional age reading of the eastern cod stock is subject to substantial bias leading to low accuracy and precision (SD 24–32). WKSIBCA recommends a review process of the documents presented at the meeting. The review should take place before the benchmark to draw conclusions if the current age reading should be abandoned.

- Analysis for alternative assessment independent of age readings should be carried out simultaneously. A data call on historic length-based data (2000-2013) has to be sent out before the benchmark, and as soon as possible after WKSIBCA, to be able to compare length and age-based assessment outputs.

- In SD 24 a large part of the stock is currently belongs to the eastern Baltic cod. It was decided to split the catches and survey data in SD 24 according to the proportion on eastern and western cod found in the area. Different methods for splitting were suggested (see Section 3.1.2).

From the mortality and growth subgroup:

- Infection of cod with the seal associated cod worm and liver worm has been increasing in later years. Analyses are needed to quantify the potential parasite-related mortality and the effects on cod growth (by length class/group) and performance.

- The grey seal population has increased since the beginning of the 2000s. This has likely increased the predation mortality on cod but need to be quantified by size.

- Discards apparently increased in the last years. Further investigation of the effect of gear selection on cod discards is needed.

- Body condition of cod has declined during the last decade. However, the mortality caused by the decrease in condition has to be quantified. The reasons for the decline in condition are currently not fully understood, but is likely a combination of several factors such as density-dependent effects, food availability, anoxic areas and parasites.

From the recruitment subgroup:

- Since the middle of the 2000s, the recruitment of eastern Baltic cod has increased. However, the most recent ichthyoplankton surveys indicate a low larval abundance. Until the benchmark in March 2015 an egg production estimates from ichthyoplankton surveys in 2011–2014 should be prepared. On a longer time-scale, a study relating growth and condition with fecundity and viability of offspring is needed.

From the integrated assessment subgroup:

- There is a need for additional data time-series to explain and understand the development in growth and mortality. These dataset should be spatially disaggregated and include biomass and abundance of species (macro-benthos, marine mammals, fish eating birds) and consumption rates (marine mammals and birds).

- For short-term prediction, a feasibility of an ecosystem-based recruitment model should be investigated, thereby giving indications on new year classes at a much earlier stage than at present.

- For defining reference points in an ecosystem context, regime shift and managements objectives should be considered.

- In the longer term a development of assessment methods ensemble modelling approach (many models are used together) need to be investigated.

- Ways to integrate ecological knowledge into advisory process need to be tested.

Recommendation	Adressed to
1. To establish a workshop under WGBIOP to look into age estimating of Baltic cod	WGBIOP (see proposal)
2. To review the presented data on WKSIBCA on age quality. To detemine if present age data can be used in stock assessment. Two reviewers with the knowledge of; age readings, stock assessment and data quality assurance should be contacted	ICES Secretariat
3. Spatial abundance information on grey seal population in the Baltic Sea, with consumption information (species, amount and size). Information on target distance.	HELCOM seal group

4. Time-series on benthic data in the Baltic?	BEWG

WGBIOP 2015 acknowledges the work done by the group and support the recommendations addressed to the other expert groups. WGBIOP 2015 proposed that a follow up Workshop should be held when appropriate once the decision is made to apply age-based assessments on Baltic cod again. WGBIOP have made tentative ToRs, in section 5.2.1 (WKAEBCod).

4.1.5 Workshop on Growth–increment Chronologies in Marine Fish: climate–ecosystem interactions in the North Atlantic (WKGIC)

Over the past several decades, thousands of otoliths, bivalve shells, and scales have been collected for the purposes of age determination and remain archived in European and North American fisheries laboratories. Advances in digital imaging and computer software combined with techniques developed by tree-ring scientists provide a means by which to extract additional levels of information in these calcified structures and generate annually resolved (one value per year), multidecadal time-series of population-level growth anomalies. Chemical and isotopic properties may also be extracted to provide additional information regarding the environmental conditions these organisms experienced. Given that they are exactly placed in time, chronologies can be directly compared to instrumental climate records, chronologies from other regions or species, or time-series of other biological phenomena. In this way, chronologies may be used to reconstruct historical ranges of environmental variability, identify climatic drivers of growth, establish linkages within and among species, and generate ecosystem-level indicators.

The first workshop on Growth-increment Chronologies in Marine Fish: climate-ecosystem interactions in the North Atlantic (WKGIC) met at the Johann Heinrich von Thünen Institute in Hamburg, Germany, 2–3 December 2014, chaired by Bryan Black (USA) and Christoph Stransky (Germany). Twenty-three participants from eleven different countries attended. Objectives were to i) review the fundamentals of cross-dating and chronology development, ii) review the application of growth-increment widths in marine fish and bivalve species to biochronologies, iii) discuss assumptions and limitations, iv) identify the most promising species and collections for chronology development, and v) initiate cooperative projects or training exercises to commence after the workshop.

The workshop began with an overview of tree-ring techniques of chronology development, including a hands-on exercise in cross-dating. Next, we discussed the applications of fish and bivalve biochronologies and the range of issues that could be addressed with talks from several workshop participants. We then reviewed key assumptions and limitations after which we developed a preliminary inventory of archival holdings that would be most suitable for chronology development, specific to species and regions. In several cases, there is the potential to generate continuous centennial-length time-series of fish growth anomalies. Finally, we agreed that the next step is to hold a hands-on training workshop in 2015. The objective would be to develop a biochronology as a group and in so doing, provide participants the skills with which to apply tree-ring techniques to their otolith collections. Overall, we hope to increase the use of these techniques, and over the long term, develop networks of biochronologies for integrative analyses of ecosystem functioning and relationships to long-term climate variability and fishing pressure.

Recommendation	Adressed to
1.WKGIC2	SCICOM

WGBIOP 2015 acknowledges the work done by the group and proposed a follow up Workshop with ToRs, venue and dates outlined in section 5.2.6

4.2 Exchanges

The following are summaries of the age reading exchanges carried out in 2014 and 2015

4.2.1 Anchovy (*Engraulis encrasicolus*): Full-scale Otolith Exchange 2014

The 2014 ICES Planning Group on Commercial Catch, Discards and Biological Sampling (PGCCDBS) identified the need of a full-scale European Anchovy (*Engraulis encrasicolus*) otolith exchange to take place in 2014 under the coordination of IEO and AZTI (Spain). It was the second exchange after that of 2009 that anchovy otoliths of Atlantic and Mediterranean were included together.

A questionnaire was distributed among anchovy aging institutes before the exchange to get an overview of potential participants and methods used and information of anchovy stocks in different areas (biology, fisheries, etc.). Within the participating institutes, the methods of treatment of the otoliths before reading are relatively well standardized. A total of 576 images of anchovy otoliths were selected and uploaded for analysing using the WebGR application, distributed in 10 sets from different anchovy distribution areas and stocks (English Channel, Bay of Biscay, Portugal coast, Gulf of Cadiz, Alboran Sea, Western Mediterranean, Gulf of Lion, Southern Tyrrhenian, Strait of Sicily, Western Ionian and Aegean Sea).

Eighteen readers from eight institutes and six countries (France, Spain, Portugal, Italy, Slovenia and Greece) were participated. From all readers nine readers have a long time experience reading (>5 years) anchovy otoliths (experts); one was intermediate and eight trainees.

Analyses were performed for the total areas and each area. For each area overall age reading were analysed and three additional analyses were performed: Analysis only with the expert group, analysis referring to intermediate and training group and analysis only with area readers in those areas where there were more than one reader (Bay of Biscay, IXa area, Strait of Sicily, Southern Tyrrhenian, Western Ionian and Aegean Sea).

For the total areas, the average percentage of agreement (66%) and CV (58%) does not seem to be satisfactory. Most of the anchovy otoliths were not well classified by many of the readers during the 2014 exchange. By areas, the agreement with the modal age of all readers was low (between 59 and 74%) and CV was high (between 31 and 127%). In the case of the expert group, agreements and CV are highly variable, depending on the areas, showing the highest agreement in the area VII and VIII, with 80% agreement in both cases, and high variation of CV (73% and 22% respectively). In general, the results of the expert group improved compared to those of intermediate and training group in all areas, except in some areas of the Mediterranean (i.e. Western Mediterranean, Southern Tyrrhenian and Ionian Sea). In addition, the results of the area readers group are better (higher per cent agreement and lower CV) than the other groups of readers (including expert group), except for the area IXa (quite similar with respect expert group). This may mean that there are different criteria reading between areas, so that when comparing only the readers in their expertise area they are more precise

because they all follow the same criteria reading. Analysis only done with the area readers group shows a higher overall agreement and low CV for Aegean Sea and Bay of Biscay readers (91% and 97% of agreement; CV of 11.4% and 6.7%, respectively). Possibly the success of the readers of the Bay of Biscay, compared with the other sets, is because exchanges and workshops have been conducted since 1990 in this area, and there are sufficient criteria for the interpretation of anchovy otoliths. In the case of Aegean readers, which show a great accuracy of its readings, both readers are of the same institute and therefore would have very consistent criteria.

Only 6 readers of the participants in the 2009 exchange and workshop were also participating in the current exchange of 18 participants. However, the results of the recent exchange show no decline of agreement but a slight improvement in all areas, especially in the IXa, and a significant improvement in the CV (lower variability) in all areas.

The age compositions estimated by each age reader for the whole group show that some readers are interpreting the age structure of anchovy distinctly from the majority of readers. There seems to be a difference of criteria among some readers of the Mediterranean and the Atlantic areas.

The reasons that might explain the agreement and discrepancies appearing in the exchange may be: a) Difficulties in differentiating between true annual rings and false rings (or checks), b) Insufficient typical annual growth pattern recognition and insufficient criteria regarding the otolith edge that can be expected to be seen along the year. In addition, it is observed that the different conventional birth dates between areas (in the Atlantic in January and in the Mediterranean in June or July) produces some difficulties for some readers (including expert readers) in determining the ages (mainly at ages 0) when the reader changes the conventional birthday, which is accustomed.

There is analytical assessment for all anchovy stocks, except in the areas VII, IXa and GSA10. In Division IXa and GSA10 no analytical assessment is made yet (trend based in qualitative assessment), but it is presumed that will be made in a short time. The agreements and CVs between the readers contributing to the age structures inputting the assessments and the modal ages from the expert group readers for each stock are variables. Major disagreements between the expert readers and the local area readers for stock assessment could be a matter of concern for the potential of arising from hidden biases impacting the assessments and certainly would deserve further analysis. In general, under a few exceptions in some stock, it seems that the experience of readers determines the interpretation they make of the otolith structure and the level of agreement achieved with the rest of expert readers.

The exchange group recommended:

- To organize an ageing workshop in 2016 to increase the agreement and accuracy of age readings of the laboratories involved in stock assessment of these pelagic species.
- Validation studies could be made and submitted to 2016 workshop, especially studies of progression of length frequency modes throughout time, as is one of the most basic analyses, which can provide reliable information on growth, particularly of young, fast-growing fish. Further, this method is low cost and takes advantage of data routinely obtained in fishery studies (length). Other studies such as on counting of daily growth marks in otoliths or others would be also welcome.

- It is also recommended, as far as possible, that only the age readings of the most expert readers are used for the assessment inputs and second that new readers pass a training processes from validated set of otoliths of the area they have to work with.

WGBIOP 2015 acknowledges the work done by the group and in agreement with these recommendations proposed a follow up Workshop with ToRs, venue and dates outlined in section 5.2.5 (WKARA2)

4.2.2 North East Atlantic Mackerel (*Scomber scombrus*): Small-scale Otolith Exchange 2014

The overall result of the last exchange and workshop exercise in 2010 was that there were significant variations in mackerel age estimates between readers. Low precision, and large relative biases between readers were found, and the older ages (from age 6) were particularly difficult to reach agreement. Following these findings, all participants in the workshop agreed to follow the guidelines of the WKARMAC report for the decided upcoming exchange of images to facilitate an evaluation of the guidelines. An exchange was carried out from December 2013 to April 2014 and coordinated by Jens Ulleweit from Thünen Institute of Sea Fisheries (Hamburg).

A questionnaire was distributed among mackerel aging institutes before the exchange to get an overview of potential participants and methods used. 19 readers of 10 European laboratories in nine countries (Norway, Denmark, Faroe Island, Spain, France, Germany, Netherlands, Ireland and Iceland) were participated. From all participants seven readers have a long time experience to read mackerel otoliths (experts); seven were intermediate and five trainees

A set of altogether 164 images of mackerel otoliths was selected and uploaded for the analysis using the WebGR application. The set consisted of images of otoliths, which were embedded, in transparent raisin between two glass plates laid on a black background. The otoliths were sampled during observer trips and surveys carried out in 2012 in the 1st and 3rd quarter. It was attempted to cover a wide range of fish sizes from different ICES areas.

Overall agreement is 68.2%. Good agreements are reached for age 1 and 2 (93 and 92%, resp.), for age 3 and 4 agreements are between 74 and 76%, agreement for age 5 is 61% and for age 6 and 7 57%. Only very low agreement is found for the older ages 8 to 14 (between 47% for age 8 and 31% for age 13). Two additional analyses were performed: Analysis only done with the expert group shows a higher overall agreement of 75.5%, analysis referring to experts and intermediate (14 readers) shows an overall agreement of 70.4%, still slightly higher than the agreement between all readers.

The analysis including all age readers revealed an overall coefficient of variation (CV) of 15.4%. CV peaked at 24.7% for modal age 1 which was due mostly to two readers who interpreted a number of otoliths as age 0 in opposite to the other readers. Lowest CVs were revealed for modal age-groups 2 and 4, highest CVs for 9, 10 and 12. Overall CV for only the expert group is 9.3%, for the group of experts and intermediate reader 13.9%.

According to WKARMAC 2010 the overall agreement of the last exchange (2009) was 68%, but the agreement on an image reading exercise during the last workshop in 2010 was only 25%. WebGR was not used in 2010. Only 8 readers of the participants of the 2009/2010 exchange and workshop were also participating in the actual exchange with

19 participants. However, the results of the recent exchange show no decline of agreement but a slight improvement with 68.2%. Taking only into account the group of experts, resp. expert and intermediate readers, agreement is better.

Looking at the age compositions estimated by each age reader for the whole group it can be clearly seen that some single readers are interpreting the age structure of mackerel distinctly different from the majority of readers. Furthermore, especially for the age-groups >7 the exchange reveals again higher differences with agreements lower than 50%.

Overall, there is certainly room for improvement both in terms of consistency and agreement between readers. More effort needs to put into the age determination for older mackerel

The exchange group recommended:

- Taking the results of the exchange in account the carrying out of a workshop in 2015/2016 is recommended dealing with the generic terms of references (ICES 2011) for workshops on age calibration in order to increase the agreement between the laboratories involved in stock assessment especially for the older fish.
- Furthermore, growth and validations studies need to be integrated.
- Following a WKARMAC recommendation WGWIDE is again encouraged to look further into a possibility of incorporating the increased variance around the problematic age groups in assessment, e.g. by suggesting studies dealing with this issue.

WGBIOP 2015 acknowledges the work done by the group and in agreement with these recommendations proposed a follow up Workshop with ToRs, venue and dates outlined in section5.2.14 (WKARMAC2)

4.2.3 North Sea and Celtic Sea Sprat (*Sprattus sprattus*): Otolith Exchange 2014

In 2012, PGCCDBS (Planning Group on Commercial Catch, Discards and Biological Sampling) identified the need for a full-scale Sprat exchange to take place for the North Sea area in 2013. In addition, HAWG (Herring Assessment Working Group) 2012 recommended to the PGCCDBS that Sprat in the Celtic Seas (Subarea VI and VII) be included in this exchange. The above-mentioned exchanges were organized and coordinated by DTU AQUA. Due to technical difficulties, only the otoliths from the North Sea area were analysed.

A total of 18 readers with varying levels of expertise from 10 institutes and 8 countries (Denmark, Norway, France, Netherlands, Sweden, UK, Ireland and Germany) participated in the exchange.

A set of altogether 150 images of sprat otoliths were selected and uploaded for analysing using the WebGR application and measurements were made combined using ImageJ and measurements from WebGR.

The overall percentage Agreement for all Readers was 62% with overall Co-efficient of Variation (CV) of 44%. Based on expert readers alone this improved the percentage Agreement, up to 78% but with little change in the CV of 45%. A very large proportion of the individual otolith CV falls between 41% and 60%.

Based on the results from the age data alone it is apparent that the level of disagreement between Readers is very high and that the level of precision is very poor. Based on experts alone the results improved as would be expected, as these are the Readers who have experience in reading Sprat otoliths from the North Sea area. The other Readers are trainees, most of which read Sprat otoliths from other areas.

For this exchange, we decided to move away from the traditional use of the modal age for a large part of the analyses. We tested a method which utilizes the measurement data from WebGR and thus allows for a more descriptive analyses of where the problems lie. In this exchange, the problem is threefold with disagreement on the overall age, the identification of annuli and the position of the first annulus. It is a combination of these three factors that result in the poor level of agreement and varying precision between readers.

The Celtic Sea image set was not included in the exchange following the crash of WebGR due to technical reasons. The image set was compared visually with the image set from the North Sea to see if any or what differences may exist. The comparison showed the two otolith sets to be both similar in appearance and readability.

The results point to a number of unresolved issues, most importantly, the identification of the first winter ring and the identification of the subsequent annuli. These issues should be addressed collectively as part of a Sprat age reading workshop by; a) expanding the WKSPRAT pilot study on first annulus identification and b) compiling microstructure measurement data for subsequent annuli. By including samples and age Readers from a range of ecoregions, a higher level of agreement could be attained across areas.

The exchange group recommended:

- A calibration workshop to be held on basis of the exchange; first a re-reading of the calibration set using set lines for annotation purposes
- Validation of the first annulus
- Application of microstructure data to provide guidelines for identification of subsequent annuli
- Expansion of the workshop to include samples from other ecoregions

WGBIOP 2015 acknowledges the work done by the group and in agreement with these recommendations proposed a follow up Workshop with ToRs, venue and dates outlined in section 5.2.7 (WKARSPRAT)

4.2.4   Norwegian spring–spawning herring (*Clupea harengus*): Otolith and Scale Exchange 2014

The Planning Group on Commercial Catch, Discards and Biological Sampling (PGCCDBS), recommended that a small-scale exchange could be circulated to confirm the age reading criteria of the age readers. An exchange was carried out in 2014 and coordinated by Jane A. Godiksen from Institute of Marine Research (Bergen, Norway).

As Norwegian spring-spawning herring is aged based on scales or otoliths, depending on the institute reading, this small-scale exchange aimed to determine the agreement between the two age-reading methods. Therefore, otoliths and scales were chosen from the same fish to be included in the exchange. Readers were allowed to read both structures, and it was taken into account which structure they were used to read.

Readers from eight different research institutes (IMR, MRI, Cefas, PINRO, Ifremer, Swedish Institute of Marine Research, Faroe Marine Research Institute and Johann

Heinrich von Thünen Institute) participated in the exchange. The majority of the readers contribute with age data to stock assessment of NSS herring. Many readers participated in both the scale and otolith reading, although only one of them is their read at their institute. 17 readers participated in the exchange, ten reading otoliths and seven reading scales.

In this exchange, 127 otoliths and scales from herring captured in ICES area IIa were annotated using WebGR.

Results otoliths and scales combined shown a percentage agreement ranged from 24 to 100% with an average of 67.6%. Of the 127 structures, 53 were read with at least 80% agreement and one of these was read with 100% agreement. The precision CV ranged from 0% (corresponding to 100% agreement in readings) to 44%, with an average of 11.5%. When including only readers reading for assessment, percent agreement increased to 69.1% and CV decreased to 9.4%. There is a trend by most readers in underestimating the otoliths older than 9 years modal age, while scale readings tend to overestimate these age classes, though more variation is found here.

16 readers participated in the otolith exchange, of these ten are used to reading otoliths, while six have variable experience with otolith reading of NSS herring. Modal age is calculated from those normally reading otoliths, excluding the trainee. Percentage agreement ranged from 27 to 100% with an average of 72.2%. Of the 127 structures, 73 were read with at least 80% agreement and two of these was read with 100% agreement. The precision CV ranged from 0% (corresponding to 100% agreement in readings) to 31%, with an average of 10.0%.

10 readers participated in the scale exchange, of these seven are used to reading scales, while three have variable experience with scale reading of NSS herring. Modal age is calculated from those normally reading scales. Percentage agreement ranged from 30 to 100% with an average of 76.7%. Of the 127 structures, 73 were read with at least 80% agreement and 35 of these were read with 100% agreement. The precision CV ranged from 0% (corresponding to 100% agreement in readings) to 37%, with an average of 6.1%.

Using the ATAQCS comparison sheet produced by Cefas (Mark Etherton) modal age of otolith readings (made by those normally reading otoliths) was compared to modal age of scale readings (made by those normally reading scales). This was done in order to see the overall differences between the two groups of readers. The agreement reached 64.1%, with a CV of 6.0%. The lowest agreement was found among fish captured on October/November, with an agreement between 42.9 and 44.4%, while percent agreement in February was 74.0% and in 70.7% in July. There was a slight tendency of reaching higher ages when reading scales compared to otoliths. The majority of the disagreeing scales were read to be one or two years older than the otolith age.

The percentage agreement in all the comparisons in the exchange was quite low compared to what could be expected. The results comparing age readings of the readers usually reading the structures showed an agreement of only 67.4%. Agreements were higher in readings containing only one structure – even when readers not used to the structure participated, than the agreement found combining both structures in one EFAN-sheet, while only including the readers used to the structures. The ATAQCS-sheet comparing otoliths and scales showed a high percentage of disagreeing otoliths/scales, and up to six years difference between the modal ages of the two structures.

The exchange group recommended:

- These results are quite disturbing and it is important to continue this small-scale exchange with a large-scale exchange including both images and the real structures. It was mentioned by several that it was too difficult to interpret nine of the images, and therefore it will be interesting to use the same structures in a large-scale exchange.
- Since few institutes collect both structures by default, it would be a good idea if a request were made for institutes to collect a sample for next exchange, especially in areas outside IIa.

WGBIOP 2015 acknowledges the work done by the group and agrees with these recommendations. In addition, WGBIOP 2015 proposed a mini-workshop with ToRs, venue and dates outlined in section 5.2.9 (WKNSSAGE)

4.2.5 Whiting (*Merlangius merlangus*): Full–scale Otolith Exchange 2015

Sixteen individuals from eight countries participated in the exchange coordinated by Cefas in 2015. A set of 134 whiting otoliths was compiled. In total 134 whiting, otoliths/photos were used in the exchange collected from areas IVb, VIIe, VIIg, throughout quarter 1 and 4.

The readers used the otoliths and photos to estimate an age and then annotated them on WEBGR. Each otolith had associated data including; length, sex, maturity and date of capture. Experts as well as beginners participated in the exchange.

The overall agreement of all age readings was 74% (precision CV=14%). Out of the 135 otoliths, 63 were read with at least 80% agreement, with only one read at 100% agreement. This does not vary too much when a reader whom uses a different technique (whole/burnt) is removed. However, there percentage agreement was very low (46%) and this may have been because the reader was unfamiliar with using slides. Another reader with low agreement (33%) seemed to be underestimating most of the otoliths by 1 year (possibly missing the first year growth).

Of the sixteen individuals, thirteen were experienced readers and three were being trained in this species. This was maybe apparent in one of the trainees (47%) but not with the other two trainees (10 and 12), whom had fairly high agreement (69, 76%).

The overall percentage agreement was lower than in the 2005 exchange (80%) and there were a number of disagreements between readers. Therefore, WGBIOP recommends that there is an otolith workshop to address these problems. It was also highlighted that a calibration exercise (within the workshop) should be carried out for area IIIa to improve the age estimation of this difficult stock, as this was an issue for the benchmark for this stock. It was agreed that the workshop would be hosted at Cefas, Lowestoft in 2016 (date to be confirmed) (Chair Jo Smith, UK Co-chair Lotte Worsøe Clausen, DK).

WGBIOP 2015 acknowledges the results from the exchange and agrees with these recommendations. WGBIOP 2015 proposed workshop with ToRs, venue and dates outlined in section 5.2.9 (WKARWHG2).

4.2.6 Horse Mackerel, Mediterranean Horse Mackerel and Blue Jack Mackerel (*Trachurus trachurus*, *T. mediterreaneus* and *T. picturatus*): Otolith Exchange 2015

The Planning Group on Commercial Catch, Discards and Biological Sampling (PGCCDBS) meeting in February 2014 recommended a large exchange in 2014 and a workshop for 2015 (ICES, 2014) under the Ifremer institute France (Kelig Mahé) and the COISPA Tecnologia & Ricerca Italy (Pierluigi Carbonara), coordinated this exchange. There were 3 age reading workshops (1999, 2006 and 2012) which were preceded by one exchange.

19 readers from eight countries (Spain, Portugal, Italy, France, Germany, Norway, Ireland, and Netherlands) participated at this exchange. A total of 550 fish was sampled from both Atlantic (Channel, Celtic Sea, Bay of Biscay, Azores, Portuguese waters and Tenerife) and Mediterranean area ((Alboran Sea, South Adriatic Sea and Ligurian Sea): 95 *Trachurus mediterraneus*; 134 *Trachuru spicturatus*; 321 *Trachurus trachurus*. The otolith sections and whole otoliths were used during this exchange but only *Trachurus trachurus* was sampled with both techniques. Images of otoliths were uploaded for analysing using the WebGR application.

Among three *Trachurus* species, all data showed the very low precision with the percent agreement 47, 49 and 56% and the CV 44, 69 and 29% respectively for the *T. mediterraneus*, *T. picturatus*, and *T. trachurus*. The precision analysis showed the same level of precision between otolith sections and whole otoliths from the Ligurian Sea for the *T. trachurus*.

These results will be one of the ToR in the scheduled ageing workshop in the October 2015 in Tenerife (Spain). WGBIOP will evaluate the results from this workshop during the 2016 WGBIOP meeting.

Annex 5: Workshops and exchanges during 2015–2017 (ToR d)

5.1   Work plan 2015

The following age reading workshops and exchanges will take place in 2015/2016:

- WKMSMAC2 – Workshop on Maturity Staging of Mackerel and Horse Mackerel (*Scomber scombrus* and *Trachurus trachurus*) Lisbon (Portugal) 28 September-2 October 2015, co-chaired by Cindy van Damme (The Netherlands) and Pierluigi Carbonara (Italy). (PGCCDBS 2014 recommendations)

- WKARHOM2 – Workshop on Age Reading of Horse Mackerel, Mediterranean Horse Mackerel and Blue Jack Mackerel (*Trachurus trachurus, T. mediterreaneus and T. pictatus*), Sta. Cruz de Tenerife, Canary Islands (Spain), 26-30 October 2015, co-chaired by Pierluigi Carbonara (Italy) and Kélig Mahé (France). (PGCCDBS 2014 recommendations)

- WKARCM – Workshop on Age Reading of Chub mackerel (*Scomber colias*), Lisbon (Portugal), 2-6 November 2015, co-chaired by Andreia Silva (Portugal) and Maria Rosario Navarro (Spain). (PGCCDBS 2014 recommendations)

- WKFATHOM – Workshop on Egg staging, Fecundity and Atresia in Horse Mackerel (*Trachurus trachurus)* and mackerel (*Scomber scombrus*), Hamburg (Germany) 12–16 October 2015 and Bergen (Norway), 9–13 November 2015, chaired by Cindy van Damme (the Netherlands).

- WKARDAB2 – Workshop on Age reading of Dab (*Limanda limanda*), Hamburg (Germany) 17-20 November 2015, co-chaired by Holger Haslob (Germany) and Loes Bolle (the Netherlands).

- Otolith Exchange 2015 – Chub mackerel (*Scomber colias*). Coordinators: Andreia Silva (Portugal) and Maria Rosario Navarro (Spain) Ongoing

- Otolith Exchange 2015 – Megrim (*Lepidorhombus spp*). Coordinator: Gordon Henderson (Scotland): Ongoing.

- Otolith Exchange 2015 – Sole (*Solea solea*). Coordinator: Loes Bolle (The Netherlands). Ongoing.

- Otolith Exchange 2015 – Dab (*Limanda limanda*). Coordinators: Holger Haslob (Germany) and Loes Bolle (The Netherlands). Ongoing

- Otolith Exchange 2015 – Herring (*Clupea harengus*) in Baltic Sea. Coordinator: Jari Raitaniemi (Finland). Ongoing

- Otolith Exchange 2015 – Herring (*Clupea harengus*) in North Sea, Irish Sea, Celtic Sea and VIa areas. Coordinator: Julie Coad (Denmark). Ongoing

5.2 Workshops proposals 2015–2017

5.2.1 ICES_NAFO Workshop on Age Reading of Greenland Halibut (*Reinhardtius hippoglossoides*) (WKARGH)

A **Workshop on Age Reading of Greenland Halibut** (*Reinhardtius hippoglossoides)* (WKARGH2), chaired by Karen Dwyer, Canada, and Gróa Pétursdottír, Iceland, will be established and take place in Reykjavik, Iceland 22–26 August 2016 to:

a) Review information on age estimations, otolith exchanges, workshops and validation work done so far.

b) Evaluate all available information on individual growth patterns in order to achieve a general consensus about the most probable levels of longevity and growth rates for the different stocks.

c) Report on ageing protocols currently in use and their compliances with available validation results.

d) Join international experts on growth, age estimation and assessment in order to progress towards a recommended procedure for future age determination of Greenland halibut.

e) Address the generic ToRs adopted for workshops on age calibration (see 'WGBIOP Guidelines for Workshops on Age Calibration')

WKARGH2 will report by 1 October 2016 for attention to ACOM and SCICOM.

Supporting information

Priority:	Essential. Age determination is an essential feature in fish stock assessment to estimate the rates of mortalities and growth. Assessment of Greenland halibut stocks using age structured models has proved useful in establishing a diagnosis on stock status. However, the approach has several limitations and shortcomings such as stock structure, natural mortality and growth. Age data is provided by different countries and are estimated using different ageing criteria which have not always been validated. Therefore, a WK should be carried out in order to evaluate available information on otolith growth patterns, age determination issues and the current situation of age estimation of Greenland halibut which has been subject of concern of ICES AFWG and NWWG and make progress towards a solution.
Scientific justification:	The previous WKARGH (Vigo, 2011) concluded that the traditional ageing method for Greenland halibut severely underestimates age of fish older than age 5. The workshop demonstrated a common understanding of the underlying growth patterns of the species and evaluated two new age reading methods as promising but there was no common agreement as to which method is most accurate. Since then several institutions have continued tagging programs, ageing structure comparisons, and other work in order to validate seasonal zones in otoliths.

The workshop should be the forum to present and discuss the results of these investigations in relation to the previous findings.

For the purpose of inter-calibration between ageing labs an appropriate exchange programme, to be carried out after the meeting, will be planned and designed during the workshop.. This will include a set of otoliths images collected partially from chemically tagged fish.

The aim of the workshop is to identify the state of art of age estimation of Greenland halibut after validation studies conducted so far. |

Resource requirements:	The scientific institutions should make a concerted effort to compile the existing tagging material as well as sectioned otoliths (digital otolith images), that can be used as a reference collection.
Participants::	In view of its relevance to the ICES quality assurance , ICES NWWG and AFWG, and NAFO, the Workshop should try to include age readers and experts on fish growth and age determination working on Greenland Halibut
Secretariat facilities:	None
Financial:	None
Linkages to advisory committee:	ACOM
Linkages to other committees or groups:	PGCCDBS, NWWG, AFWG, SSGEIOM, SCICOM and NAFO
Linkages to other organizations:	

5.2.2 Workshop on Age reading of Whiting (*Merlangius merlangus*) (WKARWHG 2016)

A **Workshop on Age estimation of Whiting (*Merlangius merlangus)* (**WKARWHG2), chaired by Joanne Smith, United Kingdom and Lotte Worsøe Clausen, Denmark, will be established and take place in Lowestoft, UK, XX November 2016 to:

a) Review information on age estimations and validation work done so far;

b) Analyse the results of exchange programme between ageing labs, using a set of otoliths (images) collection;

c) Clarify the interpretation of annual rings;

d) Improve the current age reading protocol;

e) Create a reference collection of agreed age otoliths;

f) Address the generic ToRs adopted for workshops on age calibration (see 'WGBIOP Guidelines for Workshops on Age Calibration').

WKARWHG2 will report by (**date to be confirmed**) for the attention of ACOM, SCICOM, and WGBIOP.

Supporting Information

Priority:	Age determination is an essential feature in fish stock assessment to estimate the rates of moralities and growth. In order to arrive at appropriate management advice ageing procedures must be reliable.
	Otolith processing methods and age reading methods might differ considerably between countries. Therefore, otolith exchanges should be carried out on a regular basis, and if serious problems exist age reading workshops should be organised to solve these problems.

Scientific justification and relation to action plan:	The aim of the workshop is to review the available information on age determination, and validation for whiting, to identify the present problems in age determination for this species, improve the accuracy and precision of age determinations and spread information of the methods and procedures used in different ageing laboratories.

A number of samples (otoliths or/and images) of otoliths were circulated among different laboratories to assess the precision of age readers during 2015. At the workshop, in 2016, results from the otoliths circulation will be presented and discussed. |
Resource requirements:	Age stratified otolith set from Division IIIa consisting of 100-150 otoliths should supplement the already existing workshop-set of otoliths from the North Sea.
Participants:	Age reader experts working on whiting stocks. Experts in whiting biology and stock assessment.
Secretariat facilities:	None.
Financial:	Additional funding will be required for facilitate the attendance of the scientists and technicians.
Linkages to advisory committees:	ACOM
Linkages to other committees or groups:	WGBIOP, SCICOM , RCMs
Linkages to other organisations:	None.

5.2.3 Workshop on Age estimation of Blue Whiting (*Micromesistius poutassou*) (WKARBLUE2)

A **Workshop on Age estimation of Blue Whiting (*Micromesistius poutassou*)** *(WKARBLUE2)*, chaired by Patrícia Gonçalves, Portugal, and Jane A. Godiksen, Norway, will be established and will meet in Lisbon, Portugal, 5–9 June 2017 to:

a) Review information on age estimations and validation work done so far;

b) Analyse the results of exchange programme between ageing labs, using a set of otoliths (images);

c) Clarify the interpretation of annual rings;

d) Improve the age reading protocols produced during WKARBLUE1;

e) Present and evaluate the results from age validation studies;

f) Create a reference collection of agreed age otoliths;

g) Address the generic ToRs for workshops on age calibration (see WGBIOP Guidelines for Workshops on Age Calibration').

WKARBLUE2 will report by 5 July 2017 for the attention of ACOM, SCICOM, and WGBIOP.

Supporting Information

Priority:	Age determination is an essential feature in fish stock assessment to estimate the rates of moralities and growth. In order to arrive at appropriate management advice ageing procedures must be reliable.
	Otolith processing methods and age reading methods might differ considerably between countries. Therefore, otolith exchanges should be carried out on a regular basis, and if serious problems exist age reading workshops should be organised to solve these problems.
Scientific justification and relation to action plan:	The aim of the workshop is to review the available information on age determination, and validation for blue whiting, to identify the present problems in age determination for this species, improve the accuracy and precision of age determinations and spread information of the methods and procedures used in different ageing laboratories.
	A number of samples (otoliths or/and images) of otoliths should be circulated among different laboratories to assess the precision of age readers during 2016. Before the workshop, results from the otoliths circulation/exchange will be presented in 2016. Based on the exchange results, in 2016, age validation studies will be stablished to be conducted by the participants until the workshop. At the workshop, in 2017, results from the exchange and from the age validation studies wil be presented and discussed.
Resource requirements:	No specific resource requirements beyond the need for members to prepare for and participate in the exchange and in the meeting.
Participants:	Age readers experts working on blue whiting
Secretariat facilities:	None.
Financial:	
Linkages to advisory committees:	ACOM
Linkages to other committees or groups:	WGWIDE,WGBIOP, SCICOM, RCMs,
Linkages to other organisations:	None.

5.2.4 Workshop on Age reading of European anchovy (*Engraulis encrasicolus*) (WKARA2)

A **Workshop on Age estimation of European anchovy** (*Engraulis encrasicolus)* (WKARA2), chaired by Andres Uriarte, Spain, Begoña Villamor, Spain, and Gualtiero Basilone, Italy, will be established and will meet in San Sebastian (Spain), 24–28 October 2016 to:

a) Review information on anchovy age estimations, otolith exchanges, workshops and validation work done so far;
b) Analyse growth increment patterns in anchovy otoliths and continue to improve the guidelines for their interpretation;
c) Analyse the results of the exchanges carried out in 2014 and the potential source of discrepancies, in light of ToRs a) and b);
d) Increase existing reference collections of agreed aged otoliths.
e) Address the generic ToRs adopted for workshops on age calibration (see 'WGBIOP Guidelines for Workshops on Age Calibration')

WKARA2 will report by 1 December 2016 for the attention of WGBIOP, SCICOM and ACOM.

Supporting Information

Priority:	Essential. Age determination is an essential feature in fish stock assessment to estimate the rates of mortality and growth. In order to arrive at appropriate management advice ageing procedures must be reliable. Age data are provided by different laboratories and countries using internationally agreed ageing criteria. It is necessary to continue to clarify the guideline of age interpretation. Therefore, otolith exchanges should be carried out on a regular basis, and if serious problems exist age reading workshops should be organised to solve these problems.
Scientific justification and relation to action plan:	The aim of the workshop is to identify potential problems in *Engraulis encrasicolus* age determination, assess variability of growth patterns among different ecosystems, improve the accuracy and precision of age determination, and share the methods and procedures used between different ageing laboratories.
	An otolith exchange was made in 2014 and at WKARA2results from this otolith exchange will be presented and discussed. In view of the poor precision of age determination resulting from the exchange, for the workshop presentation of validation studies will be encouraged.
Resource requirements:	No specific resource requirements beyond the need for members to prepare for and participate in the meeting.
Participants:	In view of its relevance to the ICES quality assurance, the Workshop is expected to attract wide interest from both Mediterranean and Atlantic areas, ICES and GFCM. The Workshop tries to bring together international experts on anchovy age reading and fish growth and scientists involved in stock assessment to assess the accuracy and precision of the age determination.
Secretariat facilities:	None.
Financial:	
Linkages to advisory committees:	ACOM , GFCM
Linkages to other committees or groups:	SCICOM, WGBIOP, WGCOMEDA and WGHANSA
Linkages to other organisations:	WGSASP from GFCM

5.2.5 Workshop on Growth-increment Chronologies in Marine Fish: climate-ecosystem interactions in the North Atlantic (WKGIC2)

A **Workshop on Growth-increment Chronologies in Marine Fish: climate-ecosystem interactions in the North Atlantic** (WKGIC2), chaired by Bryan Black, USA, Christoph Stransky, Germany and Beatriz Morales-Nin, Spain, will meet in Palma de Mallorca, Spain in 18–22 April 2016.

This will be a hands-on training exercise in which participants will work as a group to develop an otolith growth-increment chronology, including all phases of data collection, analysis, and interpretation. The chronology will be developed from one of the North Atlantic collections identified during WKGIC in December 2014. The 2016 workshop will involve learning:

a) Fundamental dendrochronology (tree-ring analysis) technique, with particular emphasis on visual cross dating followed by statistical verification using programs such as COFECHA.

b) How to prepare and photograph otolith samples, then measure growth-increment widths using image analysis software (i.e. Image Pro Premier).

c) Statistical techniques for generating biochronologies from growth-increment width measurements. Topics will include the removal of age effects, issues of minimum sample size, and maximizing signal-to-noise ratio. Special consideration will be given to datasets for chronologies developed using archival collections of short-lived individuals.

d) Correlation and regression techniques for relating the biochronology to instrumental climate records, principally through the use of the KNMI Climate Explorer.

A new otolith chronology based on candidate species and collections and their relationships to climate will be established over the course of the workshop.

WKGIC2 will report by 1 June 2016 for the attention of WGBIOP, SCICOM and ACOM.

Supporting Information

Priority:	Over the past several decades, thousands of otoliths, bivalve shells, and scales have been collected for the purposes of age determination and remain archived in European and North American fisheries laboratories. Advances in digital imaging and computer software combined with techniques developed by tree-ring scientists provide a mean to extract additional levels of information in these calcified structures and generate annually-resolved (one value per year), multidecadal time series of population-level growth anomalies. Given that they are exactly placed in time, chronologies can be directly compared to instrumental climate records, chronologies from other regions or species, or time series of other biological phenomena. In this way, chronologies may be used to reconstruct historical ranges of environmental variability, identify climatic drivers of growth, establish linkages within and among species, and generate ecosystem-level indicators.
	The first workshop on Growth-increment Chronologies in Marine Fish: climate-ecosystem interactions in the North Atlantic (WKGIC) met in2014. WKGIC identified that the greatest limitation to developing biochronologies in the North Atlantic is lack of training in the specialized crossdating and statistical apporoaches involved. WKGIC2 will be a longer training workshop in which participants will learn these techniques (i.e. Crossdating and detrending, including common dendrochronology programs ARSTAN and COFECHA.) by developing a biochronology using otoliths from the North Atlantic region.

Scientific justification and relation to action plan:	A large and growing network of chronology datasets has been developed from annual growth-increment widths in marine fish and bivalves in the North Pacific. These chronologies have been integrated across species, marine regions, and other biological time series to develop indicators and identify climate drivers of productivity and functioning at the ecosystem level. For example, chronologies of rockfish (*Sebastes* spp.) and salmon (*Oncorhynchus* spp.) have been integrated with indices of seabird reproductive success to demonstrate that winter upwelling is critical to ecosystem functioning in the California Current. This winter upwelling pattern is driven by broad-scale atmospheric pressure systems that facilitate or block onshore flows of precipitation. Due to their drought sensitivity, tree-ring chronologies can be used to hind-cast this biologically important winter pattern over the past six centuries, documenting that variance in the system has risen to unusually high levels over the past 100 years driven by a series of winters with anomalously low upwelling. Moreover, these California Current chronologies have been compared to those developed in the Gulf of Alaska, showing that the two ocean domains co-vary out of phase. Robust growth in the north is associated with poor growth in the south and vice versa, a pattern largely driven by winter El Niño Southern Oscillation activity. Such approaches have also been applied in fish chronologies off New Zealand and along the Australia west coast.
	A number of exactly dated chronologies have also been developed for the extremely long-lived bivalve species *Arctica islandica* and *Glycymeris glycymeris* in the North Sea and North Atlantic for the purposes of reconstructing ocean circulation and climate. However, the "tree-ring" approach for chronology development has not yet been applied to fish or to address ecological or management issues. The first workshop on Growth-increment Chronologies in Marine Fish: climate-ecosystem interactions in the North Atlantic (WKGIC) met at the Johann Heinrich von Thünen Institute in Hamburg, Germany, from 2–3 December 2014, chaired by Bryan Black (USA) and Christoph Stransky (Germany). During this meeting, we identified several pilot studies have generated strong preliminary chronologies for Atlantic cod, plaice, and the greater Argentine. However, the greatest impediment to expanding this work remains a lack of knowledge as to suitable species and collections available for chronology development in the Atlantic, North Sea, and Baltic region. To this end, we propose a training workshop (WKGIC2) in which participants will learn these techniques and foster new collaborations by developing an otolith biochronology.
Resource requirements:	All necessary samples, images, and meeting space will be provided by the chairs and other members.
Participants:	We anticipate 10-20 participants from leading age labs and universities.
Secretariat facilities:	None.
Financial:	No financial implications.
Linkages to advisory committees:	ACOM
Linkages to other committees or groups:	SCICOM , WGBIOP
Linkages to other organisations:	None.

5.2.6 Workshop on Age estimation of Sprat (*Sprattus sprattus*) (WKARSPRAT)

A **Workshop on Age estimation of Sprat (*Sprattus sprattus)* (WKARSPRAT), chaired by Julie Coad Davies, Denmark and Claire Moore, Ireland, will be established and will meet in Galway, Ireland, 25–28 October 2016 to:

a) Analyse the results of the rerun of the WebGR North and Celtic Sea Sprat Exchange;

b) Follow the development of age estimation and validation studies being undertaken;

c) Analyse growth increment patterns in sprat and compile guidelines for the interpretation of sprat otoliths;

d) Create a reference collection of agreed aged otoliths;

e) Address the generic ToRs adopted for workshops on age calibration (see WGBIOP's Guidelines for Workshops on Age Calibration).

WKARSPRAT will report by 1 December 2016 for the attention of ACOM, SCICOM and WGBIOP.

Supporting Information

Priority:	Age determination is an essential feature in fish stock assessment to estimate the rates of morality and growth. In order to arrive at appropriate management advice ageing procedures must be reliable.
	Otolith processing methods and age reading methods might differ considerably between countries and laboratories. Therefore, otolith exchanges should be carried out on a regular basis, and if serious problems exist age reading workshops should be organised to solve these problems.
Scientific justification and relation to action plan:	The aim of the workshop is to review the available information on age determination, and validation for sprat, to identify current problems in age determination for this species, improve the accuracy and precision of age determinations and and share the methods and procedures used in different ageing laboratories. A number of samples (otoliths or/and images of otoliths) should be circulated among different laboratories to assess the precision of age readers during the first half of 2016. At the workshop results from the otoliths circulation will be presented and discussed.
Resource requirements:	No specific resource requirements beyond the need for members to prepare for and participate in the meeting.
Participants:	Age readers experts working on sprat.
Secretariat facilities:	None.
Financial:	None.
Linkages to advisory committees:	ACOM
Linkages to other committees or groups:	WGBIOP, SCICOM, RCMs
Linkages to other organisations:	

5.2.7 Workshop on Fish Condition (WKFICON)

A **Workshop on Fish Condition** (WKFICON), chaired by Josep Lloret, Spain, Claire Saraux, France and Pierluigi Carbonara, Italy, will be established and will meet at Girona, Spain in xx July 2016 to:

a) Review information on condition indicators of exploited fish;

b) Data collection: species, condition indicators and sampling strategy;

c) Possibilities of inclusion of fish condition in stock assessments;

d) Consideration of fish condition as a measure of ecosystem status (ecosystem based approach).

WKFICOI will report by 1 October 2016 for the attention of ACOM, SCICOM and WGBIOP.

Supporting Information

Priority:	Body condition is defined as the quantity of nutrient reserves, which represent the quantity of metabolizable tissues exceeding those required for daily nutritional demands. Condition indices thus inform on the quantity of energy extracted from the environment and can give important insights on foraging behavior or prey distribution for instance. Body condition indices are also used as indicators of an individual's well-being which can affect its survival and reproductive capacity. Measuring body condition is thus of outmost importance for physiologists and ecologists to understand population dynamics affected by mortality and reproduction
Scientific justification and relation to action plan:	This workshop will provide the opportunity to regroup the ICES/GFCM community working on this field, in order to review the condition indices from the literature and discuss their applicability. As such metric could serve to measure habitat quality and the health of stocks, it is a promising biological parameter to be included in an ecossystem approach for fisheries management. The workshop will provide an arena to discuss how it could help refining stock status and whether it can be included in management advice.
Resource requirements:	None.
Participants:	In view of its relevance to the ICES quality assurance, the Workshop is expected to attract interest from Mediterranean and Atlantic areas, ICES and GFCM.
	Participants will be experts from leading labs and universities working in fish condition.
Secretariat facilities:	None.
Financial:	None.
Linkages to advisory committees:	ACOM
Linkages to other committees or groups:	WGBIOP, SCICOM, RCMs, WGCOMEDA.
Linkages to other organisations:	GFCM.

5.2.8 Workshop on Age estimation of Norwegian Spring Spawning Herring between Norway, Denmark, Iceland and the Faroe Islands (WKNSSAGE)

A **Workshop on Age estimation of Norwegian Spring Spawning Herring** (WKNSSAGE), chaired by Jane A Godiksen, Norway will be established and will meet in Copenhagen, Denmark, 9–10 November 2015, to:

a) Review the technical problems regarding age-reading of Norwegian spring spawning herring between Denmark and Norway regarding the discrepancy in interpretation of the otolith/scale edge in the May-survey.

b) Analyse the edge structures (otoliths/scales) from the IESNS-surveys (May-surveys) described by WGWIDE.

c) Clarify the interpretation of annual rings in particular during spring/summer.

d) Improve the guidelines on age estimation for each of the applied structures (otolith or scale).

WKNSSAGE will report by 1 December 2015 for the attention of WGWIDE, SCICOM, ACOM, and WGBIOP.

Supporting Information

Priority:	Age determination is an essential feature in fish stock assessment to estimate the rates of morality and growth. In order to arrive at appropriate management advice ageing procedures must be reliable.
	Otolith processing methods and age reading methods might differ considerably between countries and laboratories. Therefore, otolith exchanges should be carried out on a regular basis, and if serious problems exist age reading workshops should be organised to solve these problems.
Scientific justification and relation to action plan:	The aim of the workshop is to review the technical problems regarding age-reading of Norwegian Spring Spawning herring between Denmark and Norway in particular in relation to the dicrepancy in interpretation of the edge strucutres in samples from the May survey. Readers are not agreeing on when summergrowth is visible on the structures used for age determination. This results in unclear cohort-tracking of the NSS.
Resource requirements:	Otoliths and scales from the May-surveys will be brought to the WK and discussed.
Participants:	Age readers working on Norwegian spring spawning herring.
Secretariat facilities:	None.
Financial:	None
Linkages to advisory committees:	ACOM
Linkages to other committees or groups:	WGBIOP, WGWIDE, SCICOM, SSGIEOM, RCMs.
Linkages to other organisations:	None.

5.2.9 Workshop on Age estimation of Norwegian Spring Spawning Herring (*Clupea harengus*) (WKARNSSH)

A **Workshop on Age estimation of Norwegian Spring Spawning Herring (*Clupea harengus*)** (WKARNSSH), chaired by Jane A Godiksen, Norway and NN, XX will be established and will meet in Bergen, Norway, XX 2017 to:

a) Review information on age estimations and validation work done so far;

b) Analysis of the results of the exchange programme between ageing labs, using a collection of otoliths and scales (images);

c) Clarify the interpretation of annual rings in particular during summer:

d) Improve the guidelines on age estimation for both of the applied structures (otolith or scale);

e) Create a reference collection of agreed aged otoliths and scales;

f) Address the generic ToRs adopted for workshops on age calibration (see 'WGBIOP Guidelines for Workshops on Age Calibration').

WKARNSSH will report by **date month 2017** for the attention of ACOM, SCICOM and WGBIOP.

Supporting Information

Priority:	Age determination is an essential feature in fish stock assessment to estimate the rates of morality and growth. In order to arrive at appropriate management advice ageing procedures must be reliable.
	Otolith processing methods and age reading methods might differ considerably between countries and laboratories. Therefore, otolith exchanges should be carried out on a regular basis, and if serious problems exist age reading workshops should be organised to solve these problems.
Scientific justification and relation to action plan:	The aim of the workshop is to review the available information on age determination, and validation for Norwegian Spring Spawning herring, to identify potential problems in age determination for this species, improve the accuracy and precision of age determinations and and and share the methods and procedures used in different ageing laboratories.
	150 samples of images of otoliths and scales will be uploaded to WebGR and annotated by the different laboratories to assess the precision of age readers during 2015 (WKNSSAGE). The otoliths and scales will also be excahnged among the readers in 2016. Readers will only read the struture they usually read at their laboratory. At the workshop, in 2017, results from the exchange will be presented and discussed.
Resource requirements:	150 samples of images of otoliths and scales will be uploaded to WebGR None.
Participants:	Age readers experts working on Spring Spawning Herring.
Secretariat facilities:	None.
Financial:	
Linkages to advisory committees:	ACOM
Linkages to other committees or groups:	WGBIOP, WGWIDE, SCICOM, RCM

Linkages to other organisations:	None.

5.2.10 Workshop on Micro increment daily growth in European Anchovy (*Engraulis encrasicolus*) and Sardine (*Sardina pilchardus*) (WKMIAS2)

A **Workshop on Micro increment daily growth in European Anchovy** (*Engraulis encrasicolus)* **and Sardine** (*Sardina pilchardus)* (WKMIAS2), chaired by Carmen Piñeiro, Spain and XX, XX) will meet at Vigo/Málaga (Spain) in October-November 2017 to:

a) Review the validation work done, based on daily ring formation;

b) Define and standardize the daily age reading criteria among areas;

c) Validate methods for the identification of the first annulus in young of the year anchovy and sardine in different areas;

d) Estimate precision and accuracy of age estimates by micro-increment counts;

e) Improve the reference collection of otoliths created in the WKMIAS and start a new collection of age-known otolith images;

f) Evaluate the reliability of new age assignment techniques (i.e. discriminant functions analysis).

WKMIAS2 will report by December 2017 to the attention of ACOM, SCICOM and WGBIOP.

Supporting information

Priority:	Daily growth studies are used to analyze the effects of environmental parameters on growth and survival, and thus can understand the recruitment processes. Also are used as validaton method of the annual growth. In order to arrive at appropriate management advice ageing procedures must be reliable. Daily age determinantion is thus of outmost importance to understand population dynamics. . Consequently, these activities are considered to have a very high priority.

Scientific justification and relation to action plan:	Based on the main results from previous ICES workshops on ageing adult anchovy and sardine and otolith exchanges (WKARA 2009, WKARAS 2011, Anchovy Exchange 2014), to correctly identify the right position of the first ring (annulus) on sagittal otoliths of these species has been one of the main sources of error affecting ageing precision. Improving precision in age reading is extremely important in general, even more in short-lived species such as anchovy and sardine. One of the most common methods to validate the timing and position of the first ring consists of counting of otolith microincrements (daily rings) in juveniles (young-of-the-year). Daily growth studies of anchovy and sardine are currently carried out in different European laboratories, principally to analyze the effects of environmental parameters on growth and survival, and thus to understand the influence of some environmental factors in the recruitment processes of these species. However, given the wide span of methodologies already existing within laboratories, ageing data are often difficult to compare, actually masking the contribution of environmental variables to the observed growth rate patterns in the different areas. The aim of the workshop is to collate the existent different protocols on microincrement counting as starting point to produce a single validated and agreed protocol to better standardize age estimates, either on a daily ring or a an annual ring basis.
Resource requirements:	None.
Participants:	Participants will be experts in microincrement daily growth.
Secretariat facilities:	None.
Financial:	None.
Linkages to advisory committee:	ACOM
Linkages to other committees or groups:	WGBIOP, WGHANSA, SCICOM
Linkages to other organizations cost:	None.

5.2.11 Workshop on Age estimation of Mackerel (*Scomber scombrus*) (WKAR-MAC2)

A **Workshop on Age Estimation of Atlantic Mackerel (*Scomber scombrus)*** (WKAR-MAC2), chaired by Mark Etherton, UK, will be established and take place in San Sebastian, Spain, XXXXX 2017 to:

a) Review information and results on age estimations and recent otolith exchanges, follow up on the previous workshop in 2010 (WKARMAC) and validate the work done so far.

b) Summarize the ageing protocols currently in use and improve them where possible.

c) Address the low agreement between age readers of this species, particularly in fish over the age of 6 years, with group exercises and reading sample sets.

d) Create a reference collection of agreed age otoliths.

e) Address the generic ToRs adopted for workshops on age calibration (see 'WGBIOP Guidelines for Workshops on Age Calibration')

WKARMAC2 will report by XXXX 2017 for attention to ACOM, SCICOM and WGBIOP.

Supporting information:

Priority:	Essential. Age determination is an essential feature in fish stock assessment to estimate the rates of mortality and growth. In order to arrive at appropriate management advice ageing procedures must be reliable.
	Otolith processing methods and age reading methods might differ considerably between countries and laboratories. Therefore, otolith exchanges should be carried out on a regular basis, and if serious problems exist age reading workshops should be organised to solve these problems.
Scientific justification:	To identify the present problems in age determination for this species (i.e. low agreement between age readers particularly for fish over the age of 6 years), to improve the accuracy and precision of age determinations and to share information of the methods and procedures used between different ageing laboratories.
Resource requirements:	Institutes to supply otolith samples for potential inclusion in a reference set.
Participants::	The Workshop will include international experts on growth and age estimation In view of its relevance to the ICES quality assurance, the Workshop is expected to attract interest from ICES Member Countries.
Secretariat facilities:	None
Financial:	None
Linkages to advisory committee:	ACOM
Linkages to other committees or groups:	WGBIOP, SCICOM, RCM
Linkages to other organizations cost:	None.

5.2.12 Workshop on Sexual Maturity Staging of Herring (*Clupea harengus*) and Sprat (*Sprattus sprattus*) (WKMSHS2)

A **Workshop on Sexual Maturity Staging of Herring (*Clupea harengus)* and Sprat (*Sprattus sprattus)* (WKMSHS2), chaired by Cindy van Damme, The Netherlands and Joanne Smith, United Kingdom, will be established and take place in Lysekil, Sweden, 13–17 March 2017 to:

a) has the goal of assessing the usefulnes of the maturity scale agreed in 2011and the conversion to and from other scales used in the different labs/institutes;

b) to validate the criteria and descriptions to classify maturity stages of the 2011 scale which takes into account the difficulties and / or inconsistencies of the maturity scales in use in different labs;

c) to calibrate staging of herring and sprat using fresh fish between the different laboratories;

d) to calibrate staging of herring and sprat following the pattern of trial-dis-cussion-retrial using photographs, following the pattern of trial-discussion-retrial;

e) to validate with histological analysis the macroscopic maturity stage, mainly the resting stages that are incorrectly classified as immature;

f) to address the generic ToRs adopted for maturity staging workshops (see 'WGBIOP Guidelines for Workshops on Maturity Staging').

WKMSHS2 will report by 1 May 2017 for the attention of ACOM, SCICOM and WGBIOP.

Supporting Information

Priority:	The maturity stage is an important biological parameter to be used in the calculation of maturity ogives (and therefore of Spawning Stock Biomass), for the definition of the spawning season of a species and for the monitoring of long-term changes in the spawning cycle. Moreover these parameters are essential input data for the model of fish stocks-assessment ussualy used to establish a diagnosis on stock status.
Scientific justification and relation to action plan:	During the 2011 workshop a common maturity scale with the objective of defining common criteria was proposed for herring and sprat. Laboratories involved in the collection of maturity data agreed to use the common scale for reporting.
Resource requirements:	Before the Workshop the chairs will setup a sampling plan for collecting samples for to be used during workshop. The sampling will be carried out during 2016.
	For the two species, the sampling parameters are: total length; gonad visual inspection - maturity stage by the new common maturity scale; total weight; gonad weight; liver weight; gutted weight; gonad photo; age; histological maturity stage; microscopic preparation photo.
	This workshop will be based on the analysis of both digital photos of gonads and fresh gonads. Therefore facilities suitable to examine fresh biological material must be available during the workshop. It would be necessary to have a web server for storage and easy access to the photos collected by the participants before the workshop.
Participants:	In view of its relevance to the ICES data assurance, the Workshop is expected to attract interest from ICES Member Countries.
	The Workshop will include international experts on maturity staging.
Secretariat facilities:	None.
Financial:	None.
Linkages to advisory committees:	ACOM
Linkages to other committees or groups:	WGBIOP, SCICOM, RCM, HAWG, WGIPS, IBTSWG
Linkages to other organisations:	None.

5.3   Otolith Exchanges proposals for 2016/2017

- Otolith exchange 2016 – Sandeel (*Ammodytes marinus)*. Coordinator: Julie Coad Davies (Denmark)

- Otolith exchange 2016 – Sardine (*Sardina pilchardus*) in Areas VII, VIII, IXa and Mediterranean. Coordinator: Isabel Riveiro (Spain), Eduardo Soares (Portugal) and Pedro Torres (Spain).

- Otolith exchange 2016 – Brill (*Scophthalmus rhombus)* and Turbot (*Psetta maxima*). Coordinator: LoesBolle (the Netherlands)

- Otolith exchange 2016 – Plaice (*Pleuronectes platessa*) in Baltic Sea. Coordinator: Julie Coad Davies (Denmark)

- Otolith exchange 2016 – Blue whiting (*Micromesistius poutassou*). Coordinators: Patrícia Gonçalves (Portugal) and Jane Godiksen (Norway)

- Otolith exchange 2016 – Striped red mullet (*Mullus surmuletus*) and Red mullet (*Mullus Barbatus*): Coordinators: Kélig Mahé (France) and Xisco Ordines (Spain)

- Otolith exchange 2016 – Deep water species. Coordinators: Gróa Petursdotter (Iceland) and Kélig Mahé (France)

- Otolith exchange 2016 – Norway Pout (*Trisopterus esmarkii*). Coordinator: Mark Etherton (UK)

- Otolith exchange 2016 – Pouting (*Trisopterus luscus*). Informal exchange between Spain and Portugal. Coordinator: Sandra Dores (Portugal).

- Otolith exchange 2016 – Pollack (*Pollachius pollachius*). Informal exchange between Spain and France. Coordinator: Kélig Mahé (France)

- Otolith exchange 2016 – Haddock (*Melanogrammus aeglefinus*) from Rockall and North Sea. Communication has been made with Marine Lab Scotland to find a coordinator for this exchange.

- Otolith exchange 2017 – Lemon sole (*Microstomus kitt*) using three different preparation methods. Coordinators: Joanne Smith (UK) and Loes Bolle (the Netherlands)

Annex 6: Review of issues from Issue lists; Table of Quality Indicator; Table of benchmark quality indicators (ToRs c and e)

See link:

http://www.ices.dk/community/_layouts/15/xlviewer.aspx?id=/community/Documents/PGCCDBS/WGBIOP%202015_Annex%20%206%20Review%20of%20Issues%20and%20Quality%20Indicators.xlsx

Annex 7: Recommendation template (ToR f)

See link:

http://www.ices.dk/community/_layouts/15/xlviewer.aspx?id=/community/Documents/PGCCDBS/WGBIOP%202015_Annex%207%20RecommendationTemplate.xlsx

Annex 8: WebGR rescue plan and proposal for version 2 (ToR g)

WebGR is a set of web services, which support fisheries scientists in the organization and data analysis of calibration studies of biological parameters, and provide means to analyse the results of such exercises.

These standard calibration exercises of age and maturity have been conducted among EU Members States (MS) under the Data Collection Framework umbrella and for the routine work of age and Maturity quality assurance within a MS.

Currently WebGR 1.0 has 281 registered experts from 31 countries in Europe (six of them on the Mediterranean coasts) and from 26 institutes. Studies using WebGR have been carried out on 41 species, across 61 workshops, resulting in 7195 images and 57412 annotations now stored on the database.

Unfortunately, there has been no team of developers available to update the open source code of WebGR. Therefore, after seven years a cybersecurity auditory at the hosting institute revealed that the WebGR server was presenting a large security weakness, and concluded that the system should be shut down by the end of 2015.

To avoid the loss of important ageing and maturity calibration exercises and to aid in greater internationalize of the system, the following "Rescue Plan" has been proposed.

Rescue Plan

The final aim of the Rescue Plan is to have a virtual machine on a GNU/Linux Debian LAMP server with all the latest security updates and with an updated (not upgraded) WebGR server running on it. The total cost is estimated to be 5 800€ excl VAT, and the transfer will be performed by the SME created by the original developer of WebGR (Rauthe IT) with the help of AZTI and ICES IT specialists.

In any case, following the original spirit of WebGR, the code and virtual machine will be publicly available through the typical Open Source Repositories (SourceForge) in order to be used by any user.

Detailed work plan

Update ZendFramework 1.9 to 1.12.

The Zend Framework is an open source, web application framework implemented in the programming language PHP 5. The update fixes security issues, bugs and performance issues of this framework.

Update PHPIDS

This is an open source PHP Web Application Intrusion Detection System. The main goal is to give the ability of finding intrusion data coming from client/hacker to php web application and stop it. The update includes the latest filter description for new kinds of attacks.

Publishing the new source code to sourceforge.com

Sourceforge is a platform for hosting Open Source projects like Berlios. Berlios was used for WebGR but it was closed last year, therefore, the project needs a new home for further developing.

Making WebGR a virtual machine and deploying to the ICES server

Make the WebGR application work on the ICES server.

Update Database

The MySQL database server have to be updated to the latest version to make the application secure. For this reason the WebGR database, with all the data, need an update to be compatible with the new database server.

Check WebGR Source code for deprecated functions and security issues and refractor deprecated functions

The source code which was written by the BLE needs to be checked, whether old and outdated functions from PHP (because the new Version 5.4 of PHP will be used) or the ZendFramework are to be used. If so, the functions have to be replaced or rewritten.

Testing the new version

We must check all functions of the WebGR UI whether they work as expected with all the changes and new components of the WebGR application.

WebGR 2.0 proposal and improvements

TITLE OF STUDY :
WebGR 2 - Improvements on the Web application interface and technical infrastructure for supporting Growth and Reproduction Studies

APPROXIMATE COST : 350000 €	DURATION :24 Months

DESCRIPTION OF WORK PROGRAMME

OBJECTIVES AND OUTLINE OF THE STUDY

The objective of this study is to substantially improve the first version of WebGRdeveloped within an EU tender project in 2008 [FISH/2007/07]. WebGRis a web application interface linked to a GUI and a database developed to support fisheries scientists in the organization of calibration studies for biological structures classification providing means to analyse the results of such exercises. Those studies could be the standard age and maturity calibration exercises conducted among EU Member States (MS) under the Data Collection Framework umbrella and also the routine work of age and Maturity quality assurance within a MS.

The project aims to improve the Open Source software previously developed to support studies of fish growth and reproduction. This will facilitate the improvement of the quality of growth and reproduction studies, by guaranteeing a consistent application of age reading protocols and maturity scales, ultimately influencing fisheries management advice. However, the use of this tool is not necessarily limited to age and maturity studies. In principle **WebGR can be applied to all situations,**

where individual scientists need to discuss the interpretation of a protocol, for the identification of the status of biological material.

Presently, one WebGR consortium member provides the Internet service in http://webgr.azti.es, and the service is provided without cost to users. However, AZTI can give no warranties that the tool will be available after 2015 due to security flaws of the old software. Therefore, a rescue plan has been initiated, where several countries has offered to chip in, in order to update WebGR software. This will be done before the end of 2015 and will ensure further use of the tool but with the original capabilities. The WebGRtool has not been developed since 2010. Nevertheless, since 2010 61age and maturity workshops and exchanges on 41 different species have used WebGR with variable success. In total, 31 countries, including six from around the Mediterranean coast, have participated in calibration exercises in WebGR.Unanimously, the members of these expert groupssaw a great potential in using this software and its tools. However, they experienced different problems while using it and at the same time had several requests on how to improve this tool and obtaining more complex outputs.

This feedback highlighted the strong need for further improvement of WebGR and is the basis for this study proposal.

The desirable improvement of WebGR is 2-fold. On the one hand it is necessary to upgrade the user interface, improve picture uploading and enhance exploring tools, in terms of new measuring tools. Moreover, developing an extended statistical output will givea more complete evaluation of potential differences among readers/stagers. At the moment the most basic features are implemented and the easy export procedure allows users to use the data on a standard statistical package or spreadsheet. The intentionis to develop anR package and implement a set of statistical methods.

As WebGR is such an important tool used in quality insurance of age readings and maturity staging of species important for the advisory process within ICES, it would be beneficial both for ICES and the WebGR-users, if ICES could both host and maintain the WebGR application service. This would guarantee a wider availability of the tool and ensure a robust platform management. Having WebGR under the supervision of an international organization, such as ICES, is an important step in the future maintenance of this key tool to assess the quality of biological parameters collected under the Data Collection Framework.

WebGR is used as a pan-European tool. The objective of moving the WebGR platform, and its maintenance, to ICES is to ensure the longevity of this tool. Access to WebGR will be granted to all the scientific community. It is undoubtedly a key tool on the regional and cross-European cooperation,and essential for data quality assurance. Using the same tool across all EU MS will facilitate alignment of the methods used to estimate biological parameters across stocks and national institutes.

The study should consist of 6 Work packages:

WP 0: Coordination

WP 1: Improving WebGR for age calibration workshops

WP 2: Develop WebGR for maturity staging calibration workshops

WP 3: Implementation of statistical methods

WP4: Software development and testing of the WebGR 2.0

WP 5: Training and dissemination

WP 1, WP2, and WP3 will feed into WP4 through an iterative process, in which the software is developed concurrently with the emerging results from the first WPs to match the new demands of the web application interface.

SPECIFIC WORK PACKAGES AND SUB-TASKS

Work Package0.Coordination

Tasks

This WP has the objective to keep track of the study development between all partners and to prepare interim and final reports. WP0 will have a close relationship with WP1, 2 and 3 and WP leaders in order to coordinate the different necessities from ageing and maturity staging and will work as the transmission chain between "user-developers" working in WP1 and 2 and the software developers working in WP3.

Work Package 1. Improving WebGR for age calibration workshops

This WP has the objectives to develop and improve the user interface of WebGR for age calibration workshops. Furthermore, the WP will advise in the ways to correct and improve the currently detected flaws and bugs of the system. The three main objectives of this work package are:

WP 1.1. Implementation of new features.

Otoliths come in many different sizes and ages and different life stages of one individual fish may need to be handled differently, however, WebGR is currently unable to deal with such variability. In several cases it has been very difficult for the reader to annotate correctly due to i.e. too large magnification, size of the symbol marks, too low resolution of images and lack of double ageing fields for diadrome fish. The possibility to group several images would also be an advantage for some species. Implementation of new features to make WebGR more diverse and user friendly for the reader and fix all the problems identified above is therefore much needed.

WP 1.2. Improvement of current features of WebGR and correction of bugs

There are several identified features in the current version of WebGR in relation to e.g. uploading images, handling workshops, etc. which need major improvements in user friendliness. Further a list of bugs has been compiled during the past years and these need to be corrected in order to have a better experience with WebGR.

WP 1.3. Developing new measuring procedures

It is recommended to perform an analysis of distances between annotated growth structures in age calibration workshops. Currently it is not possible to compare the distance between marked growth increments in WebGR given the non-guided marking procedure among readers. To facilitate this, a tool enabling the insertion of a line going from the centre of the otolith to the edge will allow annotation on a common axis for all readers.

Work Package 2. Develop WebGR for maturity staging workshops

The objective of this work package is to expand and adapt the tool to cope with maturity calibration exercises. Even if the input data from maturity calibration exercises is the same as for ageing (images) the output data and the way the input data may differ from the one for ageing. For example, when staging the output data will be a categorical variable for a given identified stage and sometimes it is possible to have images of a gonad and of histological preparations of the same gonad, which needs to be presented together. Since in WebGR 1.0, the interface for ageing was adapted to maturity studies changing mainly the name of the buttons but not creating a specific interface, it is necessary to develop a new interface only for maturity staging. The other thing necessary is to have a way to input a correspondence between maturity stages and the binomial classification (mature/immature) in order to integrate the maturity analysis that is expected to be standardized by future ICES workshops

Work Package 3. Implementation of Statistical methods

This WP has the objective to extend and improve the present statistical analysis implemented in WebGRand it is divided into the following subtasks

- WP3.1 Define suitable statistical outputs from WebGR as inferred from the state-of-the-art recommend by the Workshop on Statistical Analysis of Biological Calibration Studies [WKSABCAL]

- WP3.2 Test methods with *R* and develop a *R* package or alternatively link existing *R*-packages with the set-up of input data in WebGR and define a suitable output format

- WP3.3 Implement statistical analysis in WebGR

- WP3.4 Test statistical analysis on categorized maturity data

Work Package 4. Software development and testing of the WebGR 2.0

This is a continuous WP as developing and testing will be needed during the whole duration of the project. Moreover, when a beta version is available, a workshop for reproduction and another for ageing will be organised where all partners and "power users" of WebGR 2.0 will participate in order to test the new application and provide feedback. Subsequently a fine tuning of the new software will be performed by the subcontracted IT company after the final testing to be done by selected users.

Work Package 5. Training and dissemination.

The objective for WP5 is to disseminate WebGR, train users and channel feedback.

It will divided into the following two subtasks:

- **WP 5.1.Training by the means of a widely used web conferencing tool (i.e.Webex). This will include at least three online meetings, one for coordinators and two open trainings.**

- WP 5.2.Dissemination through flyers to be distributed to different fora and through the Age Readers Forum (ARF).

Timeline for WebGR 2.0

		2016				2017				2018
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1 (1 month)
WP0	Coordination	kick-off				Interim (report/meetin)				Final report
WP1	Development									
WP2	Maturity									
WP3	Stats									
WP4	Test of system			WKs				WKs		
WP5	Trainin and diss									

Responsible institutions

		DTU	SLU	IMR	AZTI	ICES		Coordination
WP0	Coordination	X	X					
WP1	Development			X	X			
WP2	Maturity		X					
WP3	Stats	X			X			
WP4	Test of system				X	X		
WP5	Trainin and diss	X	X	X	X	X		

Budget for WebGR 2.0

Work package	Cost (€)
WP 0: Coordination	50000
WP 1: Improving WebGR for age calibration workshops	50000
WP 2: Develop WbGR for maturity staging calibration workshops	50000
WP 3: Implementation of statistical methods	55000
WP 4: Software development and testing of WebGR 2.0 (might cha	120000
WP 5: Traning and dissemination	25000
Total	**350000**

Improvements

Task 2.1 Implementation of new features.

Interface improvement

The interface needs to be more user-friendly with login frame visible on the first page appearing at the visual part of the screen. At present, the login frame is hidden at the bottom, which can be a bit confusing. Furthermore, a clear downwards sequence of steps needed to create a workshop (e.g. as in Intercatch and Fishframe) is desirable. SQL could be used as model for improving WebGR interface.

Additional tools

- The possibility of annotating in WebGR without internet access, with subsequent synchronization.

- Availability and optional selection of different types and sizes of annotation symbols. E.g. micro-increments annotation (smaller symbol size) for species with very narrow zones.

- Possibility of double field aging, which is necessary for some species like salmon to mark separately years spent at sea and in fresh water.

- Inclusion of a field to note the readability (WKNARC 2011, 3 point scale) of the otolith.

- Inclusion of a field to note spawning checks in the otolith. Spawning checks are often used in assessment and it may be important to ensure the quality in these readings as well.

- The possibility of grouping of 2-3 images belonging to the same individual, as this is required for the examination of maturity stages. When annotating one image, all images of the same individual will automatically get the same result. This is also needed for micro-increments annotation in certain parts of otoliths, and it will be a huge advantage when dealing with species where both otolith and scale from the same fish is represented.

- Output enabling the comparison of age resulting from two or more structures of the same individual (e.g. otolith and scale).

- Statistical output combining current WebGR output and an Eltink spreadsheet improved format.

- Adjustment of the statistics (and EltinkSpreadSheet) with sensitivity for short-lived and long-lived species ageing respectively.

- An option to hide a calibration exercise once the exchange is finished, analysed and reported
- The possibility to make a comment on a specific annotation and to have it appear on the image when in "Browse Annotation" mode

Task 2.2. Improvement of available tools

- It should be possible to choose "all images" by one click when selecting images for a calibration exercise. At the moment, one has to click on every single image.
- It would be advantageous to enable simultaneous invitation of several participants to a workshop by clicking all names at once from the WebGR users list.
- The workshop manager should have permission to add new institute names and species to the attribute list, a right currently given only to WebGR administrator.
- When creating a workshop, an email should be sent to the stock coordinators of the species to inform of the action.
- Only the workshop manager should have access to the statistical output during a calibration exercise. Right now, all readers can check other readers chosen ages and change their own ages according to that.
- Some notification visible on the screen which clearly allows the readers to see if they are using "Annotation mode" or "Browse Annotation mode"

Task 2.3 Resolving issues with the detected bugs

- The workshop manager should have the possibility to delete images uploaded by one-self.
- Need of sequential steps with a function preventing access to the next step if the previous step is not properly completed.
- Error messages have to include explanations on what is wrong and how to proceed.
- Together with the template, it should be possible to download an example showing how to fill out a csv-file correctly.
- A list of requirements concerning e.g. image size and format is needed

Task 2.4 Developing new measuring tools

- Uploading of larger size/mosaic images, as those used e.g. for micro-increments count.
- A tool for calibrating images directly in the programme if a known relationship between pixel ratio and actual measure was known, or the possibility to mark an actual value in mm or micrometers on the image. The programme will use that for calibrating distances. A tool for inserting a line through the otoliths (centre to edge) in order to show the readers which direction to annotate. That way all readers will have the annotations along the same axis.

- A tool that corrects for when the annotations are not in a straight line. This is particularly necessary for annotation of micro-increments in different sections of mosaic images where rings are more clearly visible (function available in TNPC).

Task 2.5 Development of an R package for measuring procedures

- A script has been developed which uses the "all distance" output from WebGR and examines differences in growth curves estimated by the different readers. This package can be developed to provide the statistical output required for exchanges. The extended statistical output will give a more complete and standardized evaluation of potential differences among readers/stagers.

Task 2.6 Developing new reporting procedures

- It is envisioned that a standardized report can be compiled by WebGR which will provide both the results of the above-mentioned growth curve analysis and the supporting statistical output.

Annex 9: References

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