WORKING GROUP ON BIOLOGICAL PARAMETERS (WGBIOP)

VOLUME 2 | ISSUE 117

ICES SCIENTIFIC REPORTS

RAPPORTS
SCIENTIFIQUES DU CIEM

ICES INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA
CIEM CONSEIL INTERNATIONAL POUR L'EXPLORATION DE LA MER

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

ISSN number: 2618-1371 I

ICES Scientific Reports

Volume 2 | Issue 117

WORKING GROUP ON BIOLOGICAL PARAMETERS (WGBIOP)

Recommended format for purpose of citation:

ICES. 2020. Working Group on Biological Parameters (WGBIOP).
ICES Scientific Reports. 2:117. 150 pp. http://doi.org/10.17895/ices.pub.7651

Editors

Pierluigi Carbonara • Julie Coad Davies • Cindy van Damme

Authors

Jane Aanestad Godiksen • Wim Allegaert • Ulrika Beier • Karen Bekaert • Ângela Canha • Pierluigi Carbonara • Julie Coad Davies • Inês Farias • Maria Cristina Follesa • Mandy Gault • Ruadhán Gillespie-Mules • Stephanie Haase • Annelie Hilvarsson • Karin Hüssy • Maria Korta • Maria Krüger-Johnsen Uwe Krumme • Jorge Landa • Kélig Mahé • David Maxwell • Helen McCormick • Zuzanna Mirny Cristina Nunes • Konstantina Ofridopoulou • Alfonso Pérez Rodríguez • Carmen Gloria Piñeiro • Tiit Raid • Jari Raitaniemi • Argyris Sapounidis • Carine Sauger • Joanne Smith • Christoph Stransky • Jonna Tomkiewicz • Els Torreele • Pedro Torres • Jens Ulleweit • Cindy van Damme • Valerio Visconti Francesca Vitale

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

Contents

i Executive summary

The main objective of the Working Group on Biological Parameters (WGBIOP) is to review the status, issues, developments, and quality assurance of biological parameters for use in assessments and management that are in line with the requirements of end-users. In this final year of the three-year term, WGBIOP operated under challenging circumstances due to COVID-19 measures. The initial action plan was replaced by a more flexible one, where online plenary and subgroup meetings were spread over the year with intersessional work to finalize the proposed deliverables.

WGBIOP continued the review of past exchanges and workshops under the remit of the working group. Since 2019, these calibrations on age, maturity, and larvae identification have been carried out in SmartDots, an online platform for sharing images and facilitating the reading of otoliths, staging of gonads, and identification of early life stages. Developments are underway to include an improved calculation of modal age and error matrices in the SmartDots standard report. WGBIOP investigated ways to incorporate error matrices into assessments and studied the effect of this inclusion together with stock assessors.

Requests for new exchanges and workshops were reviewed, with a focus on stocks to be benchmarked in the coming years. Issue lists were scrutinized, problems identified, and information provided to stock coordinators via regular channels and through the Stock Identification Database (SID).

Despite close cooperation with stock assessors and continued efforts, it has not been possible to further streamline the WGBIOP workflow with the benchmark process. This will be addressed with the Advisory Committee.

The need for validation studies was stressed by the repeated low levels of agreement between readers of some stocks and recurring issues and recommendations to WGBIOP. Lack of resources is the main obstacle. As a first step for measures to prioritize validation studies, WGBIOP identified precision, trueness, and feasibility of validation methods (as well as the urgency for the assessment).

WGBIOP continued investigations into new life-history parameters for integrated assessment and advice in cooperation with end-users (Working Group on Integrative, Physical-biological and Ecosystem Modelling-WGIPEM and Regional Coordination Groups-RCGs). This included a standardization and quality assurance action plan for stomach sampling. Efforts have also been taken to streamline data and workflows across databases and groups.

A step has been taken in the standardization of quality assurance procedures at the regional level. Institute-level overviews of methods and quality assurance protocols used for ageing and maturity are now available. Also, a new method for quality grading was developed, tested, and implemented in SmartDots.

ii Expert group information

Expert group name	Working Group on Biological Parameters (WGBIOP)
Expert group cycle	Multiannual fixed term
Year cycle started	2018
Reporting year in cycle	3/3
Chairs	Julie Coad Davies, Denmark
	Cindy van Damme, The Netherlands
	Pierluigi Carbonara, Italy
Meeting venues and dates	1–5 October 2018, Ghent, Belgium, 32 participants
	7–10 October 2019, Lisbon, Portugal, 40 participants
	18 June, 7–8 October, and 12 November 2020, Webex, 40 participants

1 Terms of reference

a) Plan studies, workshops, and exchange schemes on the interpretation of fisheries data on stock-related biological variables, and review the output.
b) Improve training and quality assurance of age reading and maturity staging. Identify the need for validation studies and assign priorities.
c) Evaluate the quality of biological parameters: issues and guidelines.
d) Investigate and develop data availability, documentation, and methods to improve identified biological parameter estimates as input to assessment models.
e) Address requests for technical and statistical recommendations/advice related to biological parameters and indicators.
f) Update and further develop tools for the exchanges and workshops (e.g. SmartDots and statistical tools).

2 Summary of work plan

Year 1	Continue the collation of ToR d) information related to biological parameters; ToR c) benchmark issue lists and guidelines; ToR a), b), e), and f) are generic tors and will be dealt with on a yearly basis in WGBIOP. Begin the process of re-aligning the scheduling of WGBIOP exchanges/WKs with the benchmark cycle.
Year 2	Continue the collation of ToR d) information related to biological parameters; ToR c) benchmark issue lists and guidelines; ToR a), b), e), and f) are generic tors and will be dealt with on a yearly basis in WGBIOP. Devise and implement best practice guidelines for quality assurance on a regional level under ToR b).
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.

3 Summary of achievements of WGBIOP during 2018–2020

3.1 ToR a

This ToR is a generic ToR for the working group covering the following points:

1. Draft resolutions for workshops and exchanges to be approved for each current year and onwards.
2. Report and review results from workshops and exchanges, which occurred in the past and current year.
3. Annually update a series of files: the interactive table of historic workshops and exchanges by species and the age-reader and maturity-stager contact lists. The contact list is transferred to SmartDots.

The interactive table of historic workshops and exchanges "WK, Ex, SG History Master Table" has been updated every year (http://ices.dk/community/Pages/PGCCDBS-doc-repository.aspx). In cooperation with the ICES Secretariat, efforts have been made to improve the structure of the layout of the repository so that WGBIOP related tables, reports, and guidelines are easily accessible. The table was examined in detail and its utility was reviewed. An additional column was added to include the assessment category for each stock. It became clear during the review of the history table that there were some issues with the historical links for previous years. The links to exchange and workshop reports were updated as far back as 2015, which corresponds with the beginning of WGBIOP. An additional table was also created during the first year's meeting. The intension behind the creation of the "Species–Stock Quality Status" Table was to more clearly link the outputs from the exchanges, workshops, and validation studies with the stocks being subject benchmark review in the coming years (2019–2021). This table was merged with the "WK, Ex, SG History Master Table" in 2019 because of overlap and to have all information stored in one place. Hence, the master table now also includes information on when stocks are subject for benchmark review (if the information is available). The subgroup also reported and critically reviewed results from Workshops and Exchanges which took place in previous years and the summaries are reported in the relative annexes. The proper channel to include an exchange/workshop in the ICES planning process is for WGBIOP to include a proposal in its annual report. This proposal then goes to the EOSG (Ecosystem Observation Steering Group) and ACOM-SCICOM for consideration. Exchanges and workshops are therefore usually planned more than a year before they are due to take place. The ToR a subgroup reviewed each year the suggestions for exchanges and workshops in relation to the needs of the data end-users, paying special attention to those stocks, which have been included in the benchmark schedule for the coming years.

3.2 ToR b

This ToR is a generic ToR for WGBIOP, focussing on improving training and quality assurance of age reading and maturity staging. As part of this ToR, work was initiated on identifying stocks in need of validation studies and assignment of priorities, this was done in cooperation with the subgroups of ToRs a and c, and the work will continue into the next 3-year term of WGBIOP.

The work on this ToR has been carried out in a number of ways:

- Annual update of information on national laboratories readers, materials and methods for age reading. In the final year of this term, the group has worked to integrate this information into the SmartDots database, ensuring vocabularies are in line with ICES vocabularies. For maturity staging, this work was initiated at the beginning of the term as no such overviews were available. As with the age reader, materials and methods information the maturity staging information will be integrated into SmartDots by the end of 2021.
- Update guidelines for age reading and maturity staging calibration exchanges and workshops. The guidelines originated under the PGCCDBS (Planning Group on Commercial Catches, Discards and Biological Sampling) and WGBIOP updates them annually. In 2018 these underwent a major revision in line with the development of SmartDots. Updates included; the alignment of the exchange/workshop cycle with the benchmark system; stock-specific calibration exercises enabling the delivery of AEM's (age error matrices) and stock-specific levels of precision and agreement to the stock assessor; the need to publish the events and reports via SmartDots so that results are publically available and easily accessible and finally, the need to consider results and recommendations from previous calibration exercises when planning these events. For maturity staging, these guidelines were developed in line with those for ageing, highlights include; a sampling at sea protocol for maturity staging; the need to follow the internationally agreed SMSF (Sexual Maturity Scale for all Fish) scale when reporting maturity data to ICES and GFCM; the use of SmartDots for carrying out and reporting of maturity calibration exercises and references to the validated manuals for maturity staging (Follesa and Carbonara, 2019 and the ICES CRR which is in progress).
- Information on national laboratory quality assurance procedures was received and reviewed, and in the final year, those completing the table were asked to evaluate their internal quality management. The information will serve as a basis to compile guidelines on quality assurance for age and maturity during the following WGBIOP period.
- Implementation of the internationally agreed readability/AQ scores in cooperation with WGSMART (https://vocab.ices.dk/?ref=1395).
- Prioritization of validation studies was initiated in collaboration with ToR a and ToR c.

3.3 ToR c

The essence of this ToR is the link between WGBIOP and the stock assessment EGs. In the first 3-year term 2015–2017, quality indicators for biological parameters were formulated with the ultimate goal to incorporate these indicators in the assessment process. The Quality Indicator Table has been further extended and improved, with input from assessment groups. It now covers the entire workflow from the data collection to the stock assessment model runs.

A case study on mackerel was carried out in 2018 (Workshop on Mackerel biological parameter Quality Indicators, WKMACQI) to test the sensitivity of the assessment model for the use of age and maturity error matrices. Further testing and analysing has been done in cooperation with ToR d and during the Working Group on Widely Distributed Stocks (WGWIDE) 2020 meeting.

Annually the issue lists put forward for benchmark assessments are evaluated and, where necessary, action was undertaken by WGBIOP. The work of the subgroup also focussed on scrutinizing results from previous age and maturity calibration exercises in order to detect gaps in the quality assurance of biological parameters in stocks for which a benchmark was planned during the period 2019–2021. This resulted in proposals for additional exchanges in 2019 to 2021. All stock coordinators of upcoming benchmarks were contacted and WGBIOP responses to issues on biological parameters plus information on previous, ongoing and planned exchanges and workshop on ageing and maturity were communicated.

3.4 ToR d

The overall task for this ToR is to document current sources of life-history parameter estimates identified by ICES/GFCM EG's as critical components and relevant to the improvement of modern assessment for ICES/GFCM stocks. In addition, some actions were taken to facilitate closer links between data providers and data end-users.

In this perspective, WGBIOP outlined steps towards implementing AEMs from age reading exchanges into stock assessment. The two main age-based stock assessment models used are Stock Synthesis (SS) and SAM (state-space assessment model) and the possibility to incorporate times series of AEMs in those models were explored.

Age and maturity information sheets are proposed to improve the level of knowledge, within age and maturity workshops and exchanges, of the stock assessment's requirements.

WGBIOP organized the Workshop on Better Coordinated Stomach Sampling (WKBECOSS) in 2019 (ICES 2020a) and has been responsible for proposing and organizing a follow on Workshop on Operational Implementation of Stomach Sampling (WKOISS). The aim is to ensure knowledge sharing and coordination following the work done by WKBECOSS and the Workshop on Sampling, Processing and analysing the stomach contents (WKSTCON, 2019) conducted in the Mediterranean context.

In the WGBIOP context, investigations into the use of single-fish data already present in the Regional Databases (RDBs) and DATRAS, to obtain new biological parameters and indices of fish condition were carried out with the perspective to obtain synthetic ecological data useful for integration into the current stock-assessment models.

The activities in this subgroup have been developed in cooperation with ICES Expert Groups on Integrated, Physical-biological and Ecosystem Models (WGIPEM) and The Workshop on Development of Quantitative Assessment Methodologies based on LIFE-history traits, exploitation characteristics, and other relevant parameters for data-limited stocks (WKLIFE).

3.5 ToR e

Each technical and statistical recommendation addressed to WGBIOP in the period 2017–2020 was addressed and actions planned. Some of these recommendations have been communicated to the ToR a subgroup and considered in the list of age and maturity exchanges and workshops. Where possible, recommendations were taken up in the work plan of WGBIOP.

A list of all stocks currently assessed by ICES, with the indication of the type of information used in the assessment (age, age plus group, maturity ogive) plus the periodicity for age and maturity data collection used in assessment has been prepared. This information is used by ToR a for the prioritization of exchanges and workshops. Based on this table a suggested list of parameters to be included in the Stock Information Database (SID) has been provided to the ICES secretariat.

3.6 ToR f

Under this ToR, WGBIOP has focussed on the development of the SmartDots platform (http://ices.dk/data/tools/Pages/smartdots.aspx) to make it suitable for both age reading and maturity staging exchanges and workshops. In 2017 the group officially adopted the SmartDots platform as the tool for age reading exchanges and workshops from 2018 onwards and in cooperation with the Working Group on SmartDots Governance (WGSMART) received, reviewed,

and prioritised the feedback from the users (mostly members of WGBIOP) to continuously improve and develop the platform. Within the three years of this term; information on age and maturity readers expertise and their contact information has been integrated into the database; an updated list of sample type, preparation and observation methods used in national laboratories across ICES and GFCM areas was compiled for future integration (in cooperation with ToR b); an improved reader ranking system tested; improved overviews of events; a library of published reports produced using a standard analysis run via an R-script hosted on the ICES TAF GitHub (https://github.com/ices-taf/SmartDotsReport_template); and the development of a maturity staging module. Each year at WGBIOP a presentation has been given to demonstrate the new features of the software and web application updates implemented following the feedback from WGBIOP. In addition, there have been updates to the reporting module, most notably the testing and implementation of the multistage approach for the calculation of modal age. A script has also been developed to produce a standardised report template for maturity staging exchanges and workshops. In 2020, an egg and larva module was developed in cooperation with WGSMART in support of the second Workshop on the Identification of Clupeid Larvae (WKIDCLUP2) which took place as an online meeting.

3.7 Other achievements

- Continuous intersessional work with the Working Group on SmartDots Governance (WGSMART) on the further development of the platform as a quality assurance tool for age reading and maturity staging in the ICES and GFCM areas.
- Intersessional work with the Regional Coordination Groups (RCGs) subgroups on end-user needs and Fisheries Overviews.
- Developed a work plan for the CRR handbook on maturity staging
- Looked into possible further use of otoliths in biological parameters besides ageing
- Providing Age Error Matrices to WGWIDE for incorporating in assessment models.

3.8 Pros and cons of WGBIOP online meeting

In 2020 WGBIOP met online due to the COVID-19 restrictions on travel and meetings. WGBIOP always carries out a lot of hands-on work during its physical meeting. In order to continue this work in 2020, the online meeting was split into multiple ones, rather than having a single four-day meeting. On June 18 2020, a meeting was held with the chairs and heads of the ToR-subgroups to agree on the tasks to be carried out and divide the work amongst the subgroups. Between June and October WGBIOP members carried out the planned work and multiple meetings were held for each of the ToR-subgroups to discuss the work and progress in-depth. On October 7 and 8 the work carried out was presented and discussed in plenary, as well as the presentations of the workshops and exchanges results. Also, a first discussion on ToRs and work plan for the new term of WGBIOP was discussed. After these two days, members worked on getting the text for the report and the work for 2020 finalized. On 12 November 2020 WGBIOP had another plenary online meeting to finalize the report text and new resolutions.

In general, this setup worked well for WGBIOP because by spreading the subgroup meetings participants could come more prepared to the plenary meetings and they had more time to carry out the work. But this also took extra time to catch up again where the previous meeting left off. Also, the work in remote subgroups meant there was a risk of duplicating work. If in future WGBIOP should meet again online, it should be considered if it is more beneficial to have the plenary meetings closer together. Overall, most participants were positive about the WGBIOP 2020 online meeting, but there are some pros and cons of this.

The pros most mentioned are:

+ Saves travel time and costs and better for the environment.
+ Easy access.
+ More people can easily attend.
+ Easier to fit private and professional life without all the travel.
+ Webex worked well.
+ The Webex chat function was well used and many found this a good tool.
+ It is easier to see and hear the presentations compared to in a large room, where there might also be distracting noises.
+ Short presentations with summaries of workshops and work carried out.

The cons most mentioned are:

– Missing social interactions and face-to-face catch-up.
– Lack of eye contact.
– Tight schedule with short breaks.
– Because of time differences, it is difficult to schedule lunch and coffee breaks that suit everyone.
– More tiring.
– Probably shorter discussions and less interaction compared to a physical meeting.
– There should have been more time for questions after each presentation.
– Less opportunity to catch up on wider developments.
– Less opportunity to generate new ideas.
– Not all participants had good earphones and microphones, which made it difficult to hear people at times.
– No parallel subgroup meetings.

4 Final report on ToRs progress and work plan

4.1 ToR a: Plan studies, workshops, and exchange schemes on stock related biological variables and review their outcomes

4.1.1 Progress during WGBIOP 2020 (ToR a)

During this year's meeting, progress has been made under ToR a as follows:

- The interactive table of workshops and exchanges "Wk, Ex, SG History Master Table" was updated for the current year (http://ices.dk/community/Pages/PGCCDBS-doc-repository.aspx).
- The subgroup also reported results from Workshops and Exchanges which took place in 2019 and 2020, and the summaries are available in Annex 3 below.
- Drafted resolutions for workshops and exchanges endorsed by WGBIOP, and to be approved by ICES, for 2020 and beyond which can be found in Annex 3 below.

A full list of exchanges has been proposed this year for 2021 and beyond with associated coordinators. Several of these exchanges have a reporting deadline of the first week of October 2021, to ensure the results are available for the benchmark process. Exchanges for species that are not up for benchmark should be finished by the end of 2021. Coordinators will be contacted six months after WGBIOP to ensure that exchanges are progressing as scheduled. WGBIOP will receive reports on the progress and the outcomes of these exchanges before its 2021/2022 meetings so that a presentation including all exchanges can be compiled ahead of the WGBIOP meetings, and WGBIOP will critically assess any recommendation for further work at this time.

WGBIOP will also track the progress of proposed workshops, facilitating the agreement of chairs, dates and locations for workshops to convene. Results will be presented to the WGBIOP meetings in 2021/2022 for consideration.

4.1.2 Progress during WGBIOP 2018–2020 (ToR a)

During the three-year cycle within ToR a the main objectives were:

- Draft resolutions for workshops and exchanges to be approved for 2018 and onwards.
- Report and review results from workshops and exchanges, which occurred in the past and current year.
- Annually update a series of files: the interactive table of historic workshops and exchanges by species.

It was recognized that the planning of the workshops and exchanges should follow the stock assessment benchmark needs in terms of updating of biological parameters. The proper channel to include an exchange/workshop in the ICES planning process is for WGBIOP to include a proposal in its annual report. This proposal then goes to the EOSG (Ecosystem Observation Steering Group) and ACOM/SCICOM for consideration. Exchanges and workshops are therefore usually planned more than a year before they are supposed to take place. WGBIOP reviews the suggestions for exchanges and workshops in relation to the needs of the data end-users, paying special attention to those stocks which have been included in the benchmark schedule for the coming years.

During the three-year cycle, the exchange and workshop reports were annually reviewed and the results reported. The results were presented and discussed during the annual meeting in plenary in order to receive feedback and suggestions from the entire group.

The interactive table of workshops and exchanges "WK, Ex, SG History Master Table" was updated yearly (http://ices.dk/community/Pages/PGCCDBS-doc-repository.aspx). This table is an important overview of the activities for each stock in terms of biological parameters (e.g. age, maturity, etc.) and analysis standardization. In the first year of the present three-year cycle, this activity was particularly complicated as this table was not updated for several years and the links provided by the ICES secretariat were not working. The activity of the subgroup has thus made it possible to have an updated database with links to the exchange and workshop reports updated as far back as 2015. Also the "WK, Ex, SG History Master Table" has been changed, adding an additional column to include the assessment category for each stock. As mentioned above, it became clear during the review of the history table, that there were some issues with the historical links for previous years.

It was decided to merge the table "Species–Stock Quality Status" with the "Wk, Ex, SG History Master Table" so that all relevant information is kept in the "Wk, Ex, SG History Master Table". This table now also includes information on when stocks are subject for benchmark review (if the information is available).

4.1.3 New terms of reference for 2020–2023 (ToR a)

Plan and prioritise validation studies, workshops and exchange schemes on stock-related biological variables and review the results.

Background information for the ToR: Reviewing and prioritising many incoming suggestions for workshops and exchanges from EGs, WKs and other ICES related groups, e.g. planned benchmarks. It is essential to streamline this work with the ICES benchmark schedule.

4.1.4 Work plan for 2020–2021 (ToR a)

Due to the COVID-19 pandemic, several exchanges and workshops planned for 2020 have been delayed or postponed to a later date. The full list of exchanges and workshops for 2020-2022 can be found in Annex 3 below.

- There are three exchanges ongoing or pending analyses and six exchanges that are starting during 2020 Q4 and finishing in 2021.
- For 2021, five age calibration exchanges and two maturity staging exchange exercises are planned.
- For 2022, one age calibration exchange is planned.
- There are eight workshops planned for 2021 and one for 2022 dealing with age and biological parameters such as eggs, larvae and stomach contents.
- Update and restructure the Quality assurance repository with ICES and WGQUALITY.
- Prepare a work plan for adding outcomes of workshops/exchanges and linking these to SID and/or SmartDots.
- Prepare a work plan for a calendar of planned workshops/exchanges in SmartDots to be provided to WGSMART.
- Work with ICES SID developers to include workshop and validation study information in SID, and to make this information available to the wider ICES community.

4.1.5 Deliverables for 2021–2023 (ToR a)

- Update the annual prioritized overview of planned studies, workshops and exchanges.
- Update and restructure of Data Quality Assurance Repository with WGQUALITY.
- Adding outcomes of, and links to workshops/exchanges to SID and/or SmartDots.
- Prepare a calendar of planned workshops/exchanges in SmartDots to be provided to WGSMART.

4.2 ToR b: Improve training and quality assurance of age reading and maturity staging

4.2.1 Progress during WGBIOP 2020 (ToR b)

Following tasks were assigned to ToR b during the 3-year period:

1. Update "material techniques and methods" for maturity table and integration into SmartDots

It was decided to compile a short version of the "material techniques and methods" maturity table. Only information that could not be transferred to SmartDots was kept. This means that only information on the different maturity scales used in each country and on the availability of a conversion table between these national scales and the "WKMATCH 2012 maturity scale revised" are present. In the present table, the "WKMATCH 2012 maturity scale revised" approved in the WKASMSF as mandatory maturity scale for the ICES database has been renamed as "SMSF (Sexual Maturity Scale for all Fish)" to avoid it being confused with other scales previously used within ICES. Data going into ICES databases should always be in the SMSF scale. The name of the table was changed into "Maturity Scales used at Institutes".

Furthermore, a list was compiled with the different sample types, preservation, preparation and observation methods which should go into SmartDots (Annex 4; Table 1). During the next WGSMART meeting in October, it will be discussed with ICES how this information is best inserted into SmartDots.

2. Update "material techniques and methods" for ageing table and integration with SmartDots

It was decided that the "material techniques and methods" for the ageing table will not be kept and updated any more. All information in the table is to be transferred into SmartDots. A list was compiled with the different sample types, preparation and observation methods which should go into SmartDots (Annex 4: Table 2). During the next WGSMART meeting in October, it will be discussed with ICES how this information is best inserted into SmartDots.

3. Update guidelines for age reading exchanges and workshops

The guidelines were reviewed to especially highlight that previous exchanges and workshops and the lessons learned from these should be reviewed before setting up a new event. Some text related to this was added in the guidelines.

4. Update guidelines for maturity staging exchanges and workshops

The guidelines were updated and finalized. References to SmartDots were inserted where necessary. Images of the gonad in situ, out of the abdominal cavity and cut open have been inserted as a useful example to better identify the macroscopic stage.

5. Identify and prioritise the need for validation studies (with ToR a and c)—2020

Validation studies in age determination

This work was initiated in 2018 when WGBIOP proposed the WKVALPEL (Workshop on age validation studies of small pelagic species) which took place in 2019 and was reported in 2020 (ICES 2020b). In 2019 WGBIOP held a scientific session on "Age and Maturity Validation Studies" at its annual meeting where a number of age and maturity experts were invited to present their work. A number of validation techniques implemented in several contexts and regions were presented and discussed, mostly in light of their applicability. An overview of the studies by species, area, method and validated age group can be found in the WGBIOP 2019 report (Table 2.7, ICES 2019). Also, a work plan will be outlined for the ICES CRR Handbook on maturity staging of marine species.

The task for WGBIOP 2020 was to initiate the work needed to identify a list of key species/stocks in need of age validation studies and assign a priority level. This work was a joint effort by ToR a, b and c, each one tackling the issue from a different perspective.

Before proceeding with the identification of validation needs the group decided to compile the available state-of-the-art knowledge of validation studies. Hence, the first step was to produce a table including all the species/stocks where a validation study has already been implemented (; Table 3). Besides setting the ground for future needs this step was deemed necessary in order to create awareness within the stock assessment process of the existence of validation and consequently to advise stock assessors to consider validation outcomes and assess the different stocks in light of those validations. Hence, table 3 in Annex 4 below includes information on a stock basis about existing validation studies, the method applied, the complete reference and when publicly available the link to the study.

For an exhaustive explanation on different validation methods by group of species please, refer to the handbook of fish age estimation protocols and validation methods (Vitale *et al.*, 2019). This publication provides a comprehensive manual on the methodology of age estimation and validation and represents a collation of the state-of-the-art scientific work on the methods and validated age estimation of commercially exploited fish species across Europe. The process of incorporating the information included in the ICES CRR 2019 was initiated in 2020 and, given the extent of this work, will continue intersessionally and during the next term of WGBIOP. The idea behind the table (Annex 4; Table 3) is to produce a living document that is continually edited and updated by WGBIOP. The plan is to eventually incorporate this information into SID (http://stockdatabase.ices.dk/default.aspx) in order to make it readily available.

The second and main step of this task was to produce another living table (Table 4.1) incorporating identified species/stocks in need of age validation studies which can be used as a basis for assigning a priority level.

ToR a and c focussed on benchmarked species during the period 2015–2021. The approach taken was to scrutinize all the issue lists associated with each benchmark in the attempt to find recurring issues that could help when setting a priority level. The table includes the year of the planned benchmark, information about the last benchmark and the last calibration and identified issue/solutions (if any). Also noted is the working group dealing with the stock, potential comments noted in their report and the model used in stock assessment.

Table 4.1. Example of the overview table of species/stocks in need of age validation studies.

STOCK	LAST BENCHMARK	IDENTIFIED ISSUE (Benchmark)	PROPOSED SOLUTION (Benchmark)	LAST WK/Ex	IDENTIFIED ISSUE (WK/Ex)	WG comments	Assessment Model	Last exchange /WK agreement	PRIORITY
NSS herring	WKPELA 2016	Ageing differences using different techniques.	–	Otolith and Scale Exchange Norwegian Spring-Spawning Herring: Coordinator: Jane A. Godiksen. (Initiated in 2016, reported in WGBIOP 2018, Annex 3, p 46.)	The main issue is not yet identified. IMR (Norway) will do some analysis to verify if the disagreement is due to the structure. Before this there is no need for another calibration.	**WGWIDE 2020**: For some years there have been issues with age reading of herring. These issues were raised around 2010, and since then two scale/otolith exchanges and a workshop have been held; and a final work-shop was planned after the second exchange. There were, however, concerns with the second scale/otolith exchange and the final workshop was postponed indefinitely. It is therefore **recommended to organise a new scale/otolith exchange and a follow up workshop. age-error matrices are needed as input to the stock-assessment, to evaluate sensitivity to ageing errors, and such age-error matrices are an output of age-reading inter-calibrations.**	Age based		
dab-nsea	WKNSEA 2016	Ageing differences using different techniques.	–	Otolith Exchange Dab (Limanda limanda) North Sea Coordinator: Loes Bolle. SmartDots event 244 (2019)	High uncertainty especially in Q3. Bias stained section vs. whole. Recommends Validation study (whole	WGNSSK 2020. Only the beam trawl surveys provide data on age and weight for dab. No problem with age are	Age-based survey index		
witch	WKNSEA 2018	Ageing differences using different techniques	Inter-calibration among readers	None	–	WGNSSK 2020. No issues highlighted	Age based		
had-rock	WKROCK 2019	Low degree of age-reading agreement by international experts. Ageing differences using different techniques. Results of age-reading of the identical otoliths differ.	Standardization of methods	Otolith Exchange Haddock (Melanogrammus aeglefinus) Barents Sea, Rockall and North Sea Coordinator: Mandy Gault	ongoing	WGCSE 2020: No issues highlighted	Age based		

The last column of the table is the suggested priority. As mentioned above, this table was initiated during WGBIOP 2020 and it will be finalised during the next term, including the assignment of priority. However, the group had a wide-ranging discussion trying to delineate general rules for setting priority. According to the group, the priority level should be based on the importance of each stock/species from a commercial point of view as well as from an ecological point of view, including for the elasmobranches, the IUCN judgement on the endangered status of each stock/species. The use of an age-based model in stock assessment was also one of the criteria for setting a priority level.

The rationale behind the assignment of priority level should be in general as follows:

1. If a stock has no age-based assessment it should be assigned a low priority.
2. If a stock has not been recently calibrated it should be assigned a low priority and if necessary, a calibration should be planned.
3. If the stock has been recently calibrated, the report and recommendations from the WK/Ex will be scrutinized to ascertain if the causes behind potential discrepancies between readers have been identified. The stock will be assigned priority accordingly.

Within ToR b, the results from the ICES WKVALPEL (ICES, 2020b) were used as part of a tool to identify and prioritise the need for validation studies. WKVALPEL focussed on age validation in small pelagic species (*E. encrasicolus*, *S. pilchardus*, *C. harengus*, *S. sprattus*, *S. scombrus*, *S. colias*, *T. trachurus*, *T. mediterraneus*, *T. picturatus* and *M. potassou*) and highlighted all the existing validation methods and created an overview of preferred methods for the different small pelagic species/stocks based on the scientific output and the feasibility of the suggested method. This work is summarized here and will be used for extending Table 4.1 in the new term of WGBIOP.

An ageing process follows a number of typical steps. First, an ageing methodology has to be established, based on scientific information, in order to obtain age data for a particular species. Once age results are available some analysis are recommended to improve precision among different readers and/or readings. The next step is to perform other studies that offer independent results used to support, or not, the accepted ageing methodology. Several matching and independent results help to corroborate certain ageing criterion. Each study nature determines how precision and/or trueness are enhanced, usually increasing both at different levels. In general, these methods are included in indirect or semi-direct validation categories, as true ages are not known in any of them. Some other methodologies, usually more complex and costly, are considered strictly validation experiments, as results approach real ages. Tagging-recapture experiments and rearing in captivity are included within this category.

The workshop aimed to review information on age estimations, otolith exchanges, workshops, and validation works done for each pelagic species than to propose the appropriate validation methods to recognise the growth checks. In order to answer these questions, several steps have been taken:

- A synthesis table of the last annual growth workshops and exchanges by species was realized. The goal, for each species, was to add information on the exchange or workshop and to present the major difficulties that caused low Percentage of Agreement between the age readers of those expert groups as well as to recommend some guidelines to overcome those difficulties.
- Identify existing methods for validation of age readings of calcified structures (Table 4.2).
- A summary table of age validation methods used for all small and medium pelagic species in European waters was realized.
- Finally, a critical revision in term of feasibility for the small pelagic species and validation strength of the validation methods was implemented (Table 4.2; Figure 4.1).

Table 4.2. Summary of age validation methodologies, modified from Campana (2001) with methods used for small pelagic species according to the type of analysis (precision: yellow; corroboration: light green; validation: dark green).

Method	Annual /Daily	Age	Advantages	Limits	Applicability to small pelagics	Type of analysis
Several readings	A+D	All	Reduce error	Subjectivity	YES	PRECISION
Exchanges	A+D	All	Reduce error	Subjectivity	YES	PRECISION
Backcalculation	A+D	All	Reduce error	Subjectivity	YES	PRECISION
Modal Length/Weight Frequency Analysis	A	0-5 yr	Validation of first ages	Modes as age groups assumption	YES	CORROBORATION
Edge Nature	A	All	Validate periodicity	At times edge nature is confusing	YES	CORROBORATION
Marginal increment analysis	A	All	Validate periodicity	Uncertain in slow growing/older individuals	YES	CORROBORATION
Life history events	A+D	All	Linked to biology	Troublesome in fitting rings and events	YES	CORROBORATION
Microstructure (DGI)	A+D	<3 yr	Validation of 1st years	Daily periodicity premise	YES	CORROBORATION
Strong year-class progression	A	All	Easy to follow this year-class	Unusual episode	YES	CORROBORATION
Microchemistry	A+D	All	Relationship with environment	Isolatedly does not give age information	YES	CORROBORATION
Aquaculture (rearing from hatching)	A+D		Validate absolute age and periodicity	Unnatural conditions	YES	VALIDATION
Tagging	A	All	Validate absolute age and periodicity	Low recaptures. May affect survival. Not for small individuals	YES	VALIDATION
Tagging + chemical marks	A+D	All	Validate periodicity post release	Low recaptures. May affect survival. Not for small individuals	YES	VALIDATION
Radiochemical dating	A	Plus 5yr old	Validate absolute age old fishes	Can only distinguish between divergent estimates	NO	VALIDATION
Bomb radiocarbon	A	old ages	Validate absolute age and periodicity	Restricted to very old fish or historical otolith collection	YES	VALIDATION
Known age fish	A+D	All	Real age information	Almost unavailable	NO	VALIDATION

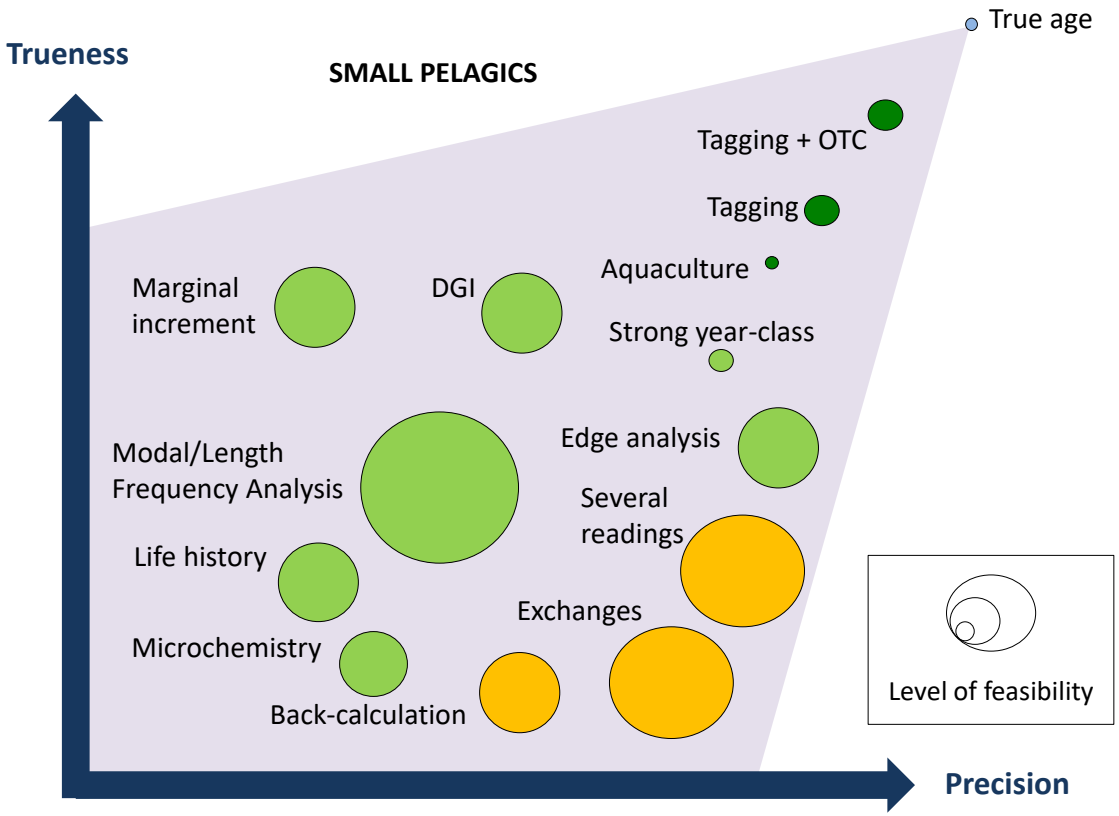


Figure 4.1. Different methodologies used in small pelagic ageing process related to trueness, precision and accuracy. Orange: precision methods; pale green: corroboration; dark green: validation and blue: objective.

WGBIOP suggests that one or two species (or group of species) should be identified to implement a validation process. These species could be taken as models in terms of the process used for calibration and validation methods to be applied to other species. The choice of the species should take into consideration the magnitude of literature and data available for the species. This approach will be considered under ToR a in the new term of WGBIOP.

The overview table on existing validation studies (Annex 4; Table 3) will initially be uploaded to the ICES Data Quality Assurance Repository and subsequently, be incorporated into the SID in order to make the information available for the whole community.

Given the workload behind this task, the proposal of creating a new dedicated ToR for prioritization of validation studies for the next three-year term of WGBIOP was evaluated.

Validation studies in maturity determination

Taking into consideration the effort made to identify and prioritise the validation studies required to have the more reliable methods for recognising the growth rings in small pelagic species, similar work will be done for maturity in the new term of WGBIOP (2021–2023). Considering that the best validation method, histology, is extremely expensive and time-consuming, an effort should be made to identify and prioritize alternative validation methods (GSI, whole-mount, etc.) that can give comparable results in terms of precision in maturity stage identification.

6. Receive and review national labs information on Quality Assurance procedures for age and maturity and compile best practice guidelines on a regional level

The table was revised and improved to get a higher level of information on the quality assurance procedures in place in all labs and national coordinators were requested to answer specific questions to evaluate their internal quality management. Regarding the age table, we had answers from 22 institutions of 15 countries; on the maturity table, 17 institutions from 13 countries provided information. As a rule, there is a great improvement in the number and quality of the answers comparing with the previous years. In general, there is more than one maturity stager/reader in each institute and macroscopic staging/otolith readings are compared amongst them. When possible, most of the institutes also participate in exchanges and intercalibration workshops. For the quality check a few institutes have automatic standard consistency checks within their databases while others plot maturity data/age data against length or use GSI in order to investigate for outliers. One institute conducts random microscopic checks on a number of maturity samples to verify the accuracy of the maturity staging. The manuals that most institutes use are the ones published by ICES but some have their internal manuals. The level of satisfaction with the Internal Quality Management among laboratory more frequent is "satisfied but some room for improvement" being the biggest challenges with it the lack of time to check the scores and also the lack of equipment and lack of human resources for routinely validate them with histology. It was also mentioned the challenge of being updated on the decisions taken and modifications made internationally on maturity assignment at the species level. In order to improve internal quality management, proposed actions are related to developing maturity reading reference catalogues along with histological validation and ensure clearer and more transparent in-house documentation of procedures, develop R routines to compare readers performance on a routine basis, set up maturity events on SmartDots to both inter-and intra-calibrate and establish a dedicated maturity determination group. There are several validation studies ongoing as well as a PhD thesis at IFREMER, started in September 2020 on the histological approach applied to four species (striped red mullet, blue withing, and two species of megrim). The information will serve as a basis to compile guidelines on quality assurance for age and maturity during the following WGBIOP period.

4.2.2 Progress during WGBIOP 2018–2020 (ToR b)

1. Update "material, techniques and methods" for maturity table and integration into SmartDots

For maturity, the work was started in 2018 by compiling a table structured on the age reading "material techniques and methods" table. In particular, information on the procedures used (macroscopic and/or histologic) to study the maturity of species, the type of gonads studied (testis and/or ovary), the macroscale used to define the reproductive condition within the laboratories of each country was requested. The subgroup began compiling the relevant reproductive data on the different species in each country based on the results from the ICES workshops on maturity and literature produced in recent years. While revising the content of the table in 2019 numerous problems in the format and inconsistencies in the data were noticed and thus the format was simplified. It was also decided (as for the age "material techniques and methods" table) that the SmartDots database would be a suitable place to store such information. The information could then be updated in a central database and easily accessible to the SmartDots users and event coordinators. In 2020 a list was compiled to indicate what maturity related material and methods information should go into SmartDots. This information was handed to WGSMART. A short version of the "material techniques and methods" maturity table will be kept with information that will not be included: only information on the different maturity scales used in each country and on the availability of a conversion table between these national scales and the SMSF

scale. Data going into ICES databases should always be in the SMSF scale. The name of the table was changed to "Maturity Scales used at Institutes" table.

2. Update "material, techniques and methods" for ageing table and integration into SmartDots

For age reading, a lot of work had been already done in the previous years of WGBIOP. In 2018, the subgroup requested all national laboratories to update the information in the tables and SmartDots in order to have up-to-date contact information for the organization of exchanges and workshops. In 2019, it was decided during the meeting that it makes no sense to gather the same information in two different places all information should be stored in the SmartDots database and available via the webpage for SmartDots users and event coordinators. In 2020, a list was compiled to indicate what age-related material and methods information should go into SmartDots. This information was handed to WGSMART.

3. Update guidelines for age reading exchanges and workshops

A complete review and update of the guidelines for ageing were done during the 2019 meeting. (https://www.ices.dk/community/Pages/PGCCDBS-doc-repository.aspx#others). The age reading guidelines were scrutinized thoroughly, simplified and updated to be in line with the use of SmartDots. Recommendations put forward during past workshops and exchanges were also included.

The main changes were:

- The benchmark cycles should be followed when organizing workshops and exchanges (and not follow the 3–5 year cycle as recommended before).
- Exchanges/workshops should be held by stock so that an AEM per stock can be delivered to the stock assessors.
- Reports of the workshops and exchanges should be sent to the stock assessor, who should disseminate to the different interested groups.
- A list of variables to be considered when organizing an exchange/workshop was compiled and described in the manual.
- Reports of the exchanges/workshops should be uploaded to the SmartDots webpage.
- Highlight conclusions from previous exchanges and workshops and ensure that the lessons learned from these are reviewed before setting up a new event.
- The text has been simplified.

4. Update guidelines for maturity staging exchanges and workshops

The maturity guidelines (http://ices.dk/community/Pages/PGCCDBS-doc-repository.aspx) were updated to be in line with the use of SmartDots. Recommendations accepted during workshops reviewed in 2019 were included.

The main changes can be summarized as:

- The internationally agreed scales (see the "SMSF scale" and "*GFCM scales"*) have to be followed when reporting maturity data to ICES and GFCM.
- Validated manuals (GFCM ATLAS 2019 and ICES CRR manual, under preparation) should be utilized in order to enhance accuracy in maturity staging across laboratories.
- Discrepancies in maturity staging between laboratories should be improved. Accuracy may be estimated utilizing whole-mounts and, if available, microscopic staging should be considered by analysing also the age of the samples as well. They should be statistically analysed in terms of precision and accuracy.
- References to SmartDots were inserted where necessary.

- The recommended use of SmartDots for maturity staging not only during exchanges but also during the workshops on maturity.
- Based on the oral communications presented during the scientific session on the validation methods for maturity at WGBIOP 2019, the list of validation methods to be used during the workshop has been updated (i.e. whole mounts and GSI-HSI).
- It is stressed that for exchange and workshop purposes the national maturity coordinators need to ensure their stagers' level of expertise (basic or advanced) is updated in the SmartDots database.
- In the protocol for regular sampling for histology at sea, an example table has been added to indicate which data should be included for an examination of the histological section. It is considered useful when comparing the histological section estimation of the different readers.
- It was added that images of the gonad in situ, out of the abdominal cavity and cut open are useful to better identify the macroscopic stage in an exchange.

5. Identify and prioritise the need for validation studies (with ToR a and c)—2020

The work for this task under ToR b was mainly done during WGBIOP 2020. The description of the work can be found under section 3.2 above. Further work will be conducted during the following WGBIOP term.

6. Receive and review national labs info on Quality Assurance procedures for age and maturity, compile best practice guidelines on a regional level.

Tables containing information on quality assurance procedures in national labs were compiled for age and maturity. The subgroup requested all national laboratories to provide up to date information on their quality assurance procedures annually based on the WKNARC 2011 (ICES, 2011a) Annex 11 – Quality Status of Age Reading at Institutes. During WGBIOP 2020, it was noticed that the information received from the different laboratories was very heterogeneous and sometimes inconsistent. Therefore, the headings of the table were revised and improved to get a higher level of information on the quality assurance procedures in place in all labs and the national coordinators were requested to answer specific questions to evaluate their internal quality management. All coordinators were asked to fill in the revised table. Regarding the age table, answers were received from 22 institutions belonging to 15 countries and for maturity, 17 institutions from 13 countries filled the table. The information will serve as a basis to compile guidelines on quality assurance for age and maturity during the following WGBIOP period.

4.2.3 New terms of reference for 2020–2023 (ToR b)

Improve training and quality assurance of age reading and maturity staging, and other biological parameters

Background information for the ToR: Guidelines for international calibrations are available, but methods, routines and protocols for monitoring the quality of age and maturity on national level need to be standardized. Internationally agreed on advice on targets (by stock) for accuracy of delivered biological data as input for assessments. If the target is not met a validation should be prioritized.

4.2.4 Work plan for 2020–2021 (ToR b)

- Compile the guidelines on a regional level regarding QA procedures for age and maturity, including further work to ensure readability/AQ scores are implemented at a regional level.

- Compile guidelines on standardisation of age reading preparation methods and/or data for stocks.
- Investigate evidence and provide recommendations on sampling of otoliths if sufficient accuracy is not achieved.
- Set stock-specific thresholds for validation and accuracy of biological parameters.
- Yearly update of guidelines for age and maturity exchanges and workshops.
- Yearly update of the "maturity scale used on institutional level" table.
- Integration of "material techniques and methods" information for maturity and ageing into SmartDots.

4.2.5 Deliverables for 2021–2023 (ToR b)

- Stock-specific targets for validation and accuracy of biological parameters achieved from exchanges and workshops.
- Prepare guidelines for method standardisation and implementation in cooperation with WGSMART.
- Review the current national procedures for quality assurance and outline best practice guidelines in cooperation with the RCGs.
- Guidelines for quality assurance (QA) in national laboratories (to include stock-specific threshold levels of agreement).
- Up-to-date guidelines for organizing age and maturity exchanges and workshops
- Continuous monitoring of the implemented standardized guidelines.
- Up-to-date "maturity scale used on institutional level" table.
- Liaise with WGALES on requirements for egg and larvae quality assurance.

4.3 ToR c: Evaluate the quality of biological parameters – issues and guidelines

4.3.1 Progress during WGBIOP 2020 (ToR c)

In 2020 various deliverables were prepared under this ToR:

- Compiled responses to the issue lists of stocks that are proposed for a benchmark assessment in 2021 (Annex 5; Table 1).
- Collated information on each stock to be benchmarked detailing existing age/maturity exchanges/workshops (Annex 5; Table 1). In case no (recent) calibrations were available this information was shared with the ToR a subgroup dealing with new upcoming workshops and exchanges. This information was also shared with the ToR b subgroup for the prioritisation of validation studies.
- Added comments to the issue lists in SID and emailed stock coordinators of stocks to be benchmarked about the WGBIOP responses to the issue lists with regards to biological parameters.
- Followed-up responses from stock coordinators received as feedback of WGBIOP 2019 comments to issue lists (Annex 5; Table 2).
- The Quality Indicator Table was finalized and sent to some assessment groups' chairs asking for comments on the setup of the table and if possible to already fill in the table for species assessed in their WG.

- A prioritization table of validation studies is prepared together with ToR a and b subgroups. ToR c provided the information for the need of validation following from the benchmark issue lists.

Biological parameters of stocks up for benchmark in 2021

The issues put forward by the assessment WG's for the upcoming benchmark stocks were collated from SID and the issues were discussed. Any necessary responses from WGBIOP were recorded in a table (Annex 5; Table 1) and reported to the stock coordinator, in SID (as a comment) and directly in an e-mail. If no issue list was available for a stock to be benchmarked in 2021, stock annexes were scanned for information on the type of assessment—if age, maturity are other biological parameters are used.

As of this year, a new possibility to inform stock coordinators of WGBIOP comments is available and was tested. Together with sending traditional emails to stock coordinators, WGBIOP added comments for respective stocks to SID.

This year the subgroup also scrutinised results from previous age and maturity calibration exercises for stocks for which a benchmark is planned in 2021. The goal was to inform the stock coordinator about the outcome of the most recent age and maturity exchanges, and workshops and to detect gaps in the quality assurance of these biological parameters.

The gaps in quality assurance were discussed in plenary in the ToR b subgroup. Two benchmark stocks (sol.27.7d, cod.27.47d20) had not had any age calibrations carried out, despite using an age-based assessment. These were noted as high priority stocks for future exchanges. However, WGBIOP received the issue lists of upcoming benchmarks in 2021 only in September 2020. This made it impossible to deliver results for cod.27.47d20 before the benchmark, as the data compilation workshop is already in December 2020. For sol.27.7d an exchange is going to be held in 2021 (Annex 3).

Several exchanges and workshops were postponed to 2021 due to COVID-19 measures. Keeping that in mind, it was crucial to limit calibration events for 2021 to stocks with high priority. Stocks with no recent calibration exercise, but not using age or maturity in the assessment were therefore deemed low priority stocks and were left without any WGBIOP action.

Quality Indicator Table

The table was discussed in the ToR c subgroup meeting and it was decided that instead of the original approach to send the table to the chairs of all assessment groups for further distribution to the stock coordinators and assessors, it would be preferable and more time-efficient to contact only a few assessment groups with chairs known to WGBIOP members to first get feedback on the table in order to maximize response later on.

WGBIOP got seven replies with information on stocks and feedback on the table. This feedback was helpful to improve the table further. Off the 40 questions in the table for each stock, most (90%) were answered, and 6 of the 7 participants responded following the drop-down list for each question. The replies are available on the WGBIOP SharePoint. The replies, as well as the follow up comments, were discussed in the final ToR subgroup meeting. Subsequently, after the group agreed on every useful improvement, the Quality Indicator Table took its final form. The update is available as well on the WGBIOP SharePoint for the future edification of the evaluation of the biological parameters used in fish stock assessment.

Currently, the table is in xls-format, with 40 questions for numerous ICES stocks. This makes it not easy/clear-cut for end-users. Therefore, it was suggested to convert the table into an interactive form (using for example Google forms). The idea was accepted by WGBIOP since an interactive form is much more user-friendly. It will guide a coordinator/assessor question by question and prevent them from giving answers other than suggested (i.e. in a multiple-choice format).

Once the table is converted into an interactive form, it will be sent to all assessment group chairs to be filed in for their stocks accordingly.

Prioritization of validation studies

This year prioritization of validation studies was a part of an intersessional work between ToR subgroups a, b and c. Details of this work can be found in section 4.2.1 above.

Age Error Matrices – case studies with mackerel, NSS herring and blue whiting

This year Age Error Matrices (AEMs) were prepared as part of intersessional work between ToR-subgroups c and d. Description of the work can be found in section 4.4.1 below.

4.3.2 Progress during WGBIOP 2018–2020 (ToR c)

Close communication between this ToR subgroup and stock coordinators and assessors during these three years was essential to a) producing the issue table evaluating biological parameters for upcoming benchmark species and b) formulating the quality indicators for biological parameters.

Biological parameters of stocks up for benchmark

Each year the group scrutinised results from previous age and maturity calibration exercises for stocks for which a benchmark was planned during the period 2019–2021. The goal was to inform the stock coordinator about the outcome of the most recent age and maturity exchanges, and workshops and to detect gaps in the quality assurance of biological parameters. Benchmark stocks that had not had any age/maturity calibrations carried out were noted as priority stocks for future exchanges.

Working together with ICES on better streamlining the flow from issues for benchmarks to WGBIOP for planning exchanges and workshops. With the further expansion of SID issue lists will potentially be more easily and earlier available to WGBIOP to scrutinize. Although the decision of ACOM which species will be benchmarked in the coming year is late in the current year, with the possibility to have access to issue lists well before benchmarks, WGBIOP planning for exchanges and workshops can potentially be improved.

Quality Indicator Table

As a result of the first triennial term 2015–2017 a quality indicator scheme was formed by WGBIOP to accommodate the need of evaluating the biological parameters that are used in fish stock assessment and two case studies (mackerel, *Scomber scombrus*, and sole, *Solea solea 7d*) were proposed to be carried out to investigate the effectiveness of that tool. That quality indicator scheme included six important topics and for each topic, a few questions were listed, regarding several parameters, so the evaluation process could be thorough and specific. Since the scheme was supposed to cover the entire workflow, from early stages to final steps, it was further enriched with new additions the following years (2018–2019). The first case study on mackerel was examined at the Workshop on Mackerel biological Quality Indicators (WKMACQI) 15–17 May 2018. This workshop investigated the sensitivity of the assessment model to including error matrices as quality indicators of age and maturity. The second case study (sole 7d) was superseded by another for whiting, which was scheduled for 2019. Due to unexpected delays, the Workshop on Whiting biological Quality Indicators (WKWHIQI) was postponed until 2020 and is further postponed due to COVID-19 measures.

In 2019, the Quality Indicator Table was reviewed extensively and revised. A new topic was added to incorporate information relating to reproduction. The form of the scheme was also al-

tered (dropdown lists with suggested replies were incorporated) as the improved form was considered more practical and easier to use. To finalize the scheme, the group approached several chairs of assessment groups as a final attempt to test the efficiency and practicality of the Quality Indicator Table. They provided feedback for improvements. The structure was finalized and the replies helped the group to identify and prevent any potential mistakes. Moreover, the suggestion to convert it to an even more user-friendly interactive form (using, for example, Google forms) will be taken into account before asking all ICES stock assessors/coordinators to fill it in. As a result of this effort, the group managed to prepare an indispensable tool for the evaluation of biological parameters in the assessment process (Annex 5).

Achievements

- Issue tables evaluating biological parameters for benchmarks in 2019–2021.
- Improving flow from issues for benchmarks to WGBIOP planning of exchanges and workshops.
- Quality indicators for 'classical' biological parameters.
- Flow scheme from data collection to stock assessment for quality indicators of biological parameters.
- Identify and prioritise the need for validation studies (intersessional work, together with ToRs a and b).
- Case studies on incorporating uncertainty estimates of biological parameters in the assessment process; incorporation of AEM into stock assessment was initiated (intersessional work together with ToR d).

4.3.3 New terms of reference for 2020–2023 (ToR c)

Evaluate the quality of biological parameters: Issues and review of the quality of biological parameters used in assessments.

Background information for the ToR: The biological parameters used in stock assessments must be of the highest quality. Guidelines for quality assurance of biological parameters have been developed in WGBIOP's previous terms. WGBIOP will collate information on quality assurance and accurate estimates of biological parameters used, in order to evaluate if improvements can be achieved.

4.3.4 Work plan for 2020–2021 (ToR c)

- Continue preparing issue tables and recording feedback from stock coordinators. Replies from stock coordinators will be collected for the further WGBIOP follow up on them.
- The use of SID in this process will be evaluated and where necessary improvements suggested.
- Quality indicator table will be converted from an excel file to an interactive form. Subsequently, it will be sent to all assessment group chairs, asking them to distribute it among stock coordinators/assessors to fill in the form for their stocks by the end of WGBIOP 2021 meeting.
- Create an overview of quality and accuracy estimates of biological parameters currently used in assessments.

4.3.5 Deliverables for 2021–2023 (ToR c)

- Evaluation of issues put forward by assessment WGs for benchmark stocks in 2022, 2023, and 2024.
- Review the use of SID in delivering issue lists for upcoming benchmarks and provision of WGBIOP information to the assessment groups.
- Interactive quality indicator form for biological parameters used in assessments.
- Create overview and evaluate quality and accuracy estimates of biological parameters currently used in assessments.

4.4 ToR d: Data availability, documentation, and methods to improve identified biological parameter estimates as input to assessments

4.4.1 Progress during WGBIOP 2020 (ToR d)

Towards the implementation of ageing error in assessments

Feedback from stock assessment model developers/users on the feasibility and interest in implementing Age Error Matrices (AEM) in their models.

The two main age-based stock assessment models used are Stock Synthesis and SAM (state-space assessment model). With respect to incorporating age-error matrices in these models, the situation is:

Stock Synthesis

Ageing error can be implemented without further development. A detailed description of the format required to that end may be found in the Stock Synthesis Manual[1] (page 47, paragraph 9.14.2 Ageing Error).

The format required is a vector of values of the mean reported age and the standard deviation of reported age for each true age. We note this appears to assume variation is symmetric, e.g. +1 year has the same chance as -1 year ageing error, but how the values feed into the model can be clarified with the developers.

To demonstrate different types of AEM outputs, we used the data from a calibration exchange of eastern Baltic cod. This exchange was carried out in 1994, with 100 otoliths from SDs 25–28 and 14 readers from 5 nations participating in the exchange. The age reading quality measures calculated for that exchange were Average agreement = 62.1% and Coefficient of variation = 27.3%. The data of that exchange are here used to demonstrate a traditional AEM and the corresponding input vector for Stock Synthesis.

An AEM is based on age estimate inputs from all readers, from which the modal age (most frequently occurring age) is assumed to be the "true" age. For each modal age, proportions assigned to both modal age and all other age groups are then calculated. The example of the eastern Baltic cod demonstrates that the misallocations to age groups of +/- 1 or more years are not symmetrical across the age range in the sample. When an AEM is used a model, this asymmetry in the ageing error should be accounted for.

[1] https://vlab.ncep.noaa.gov/documents/259399/3406930/SS3.30.10_User_Manual.pdf

Table 4.3. Age Error Matrix (AEM) of eastern Baltic cod carried out in 1994.

	Age estimates										
ModalAge	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9+**	**Grand Total**
0	**0.67**	0.30	0.03								1.00
1	0.01	**0.90**	0.09								1.00
2		0.06	**0.65**	0.22	0.06						1.00
3		0.01	0.08	**0.68**	0.20	0.03					1.00
4			0.03	0.21	**0.58**	0.14	0.03	0.01			1.00
5				0.05	0.18	**0.58**	0.14	0.05			1.00
6						0.28	**0.53**	0.17	0.03		1.00
7						0.08	0.27	**0.44**	0.14	0.07	1.00
8					0.02	0.05	0.07	0.21	**0.51**	0.14	1.00
10				0.08				0.17		**0.75**	1.00

The age error input vector as defined in the Stock Synthesis manual consists of three variables: Modal age, mean age and standard deviation of mean age. From the same 1994 eastern Baltic cod exchange, these variables were calculated, resulting in the example detailed in Table 4.4. Input vector of age estimation uncertainty for *Stock synthesis.*

Table 4.4. Input vector of age estimation uncertainty for *Stock synthesis.*

Modal Age	Mean age	StdDev
0	0.36	0.55
1	1.08	0.31
2	2.30	0.70
3	3.18	0.65
4	3.98	0.83
5	4.96	0.85
6	5.94	0.75
7	6.83	1.00
8	7.67	1.35
10	8.75	2.13
Grand total	**3.55**	**1.77**

SmartDots already calculates the mean age and standard deviation as part of the summary statistics produced. If these match the requirements of Stock Synthesis, then producing the results

automatically should only require selecting the appropriate otoliths and formatting the output for Stock Synthesis.

Therefore, WGBIOP recommends that the calculation and output of mean age and standard deviation vectors for use in the Stock Synthesis model[2] (defined on page 47, paragraph 9.14.2 Ageing Error) is added to the list of developments in SmartDots.

SAM

The situation for SAM is different and this was reflected in the outcome of a recommendation from WGWIDE to WGBIOP described below. According to the model developers, SAM cannot incorporate AEMs in its present form. However, it is a straightforward process to do the necessary adjustments. This does require some input in the form of time for coding, then testing, training assessors, and implementing the new development. Once the SAM model has been developed, the input information required may differ from an AEM, so an additional output format may be required from SmartDots. A one-page summary proposal was drafted and is shown below.

Therefore, WGBIOP recommends that SAM (state-space assessment model) is developed to incorporate age error matrix information. SAM is used for assessing 27 stocks and including ageing error in stock assessment models provides the mechanism to transfer results from age reading workshops into fisheries management. For stock synthesis models, including age reading error has improved model fit for eastern Baltic cod stock. To ACOM, Benchmark Overview Group, Methods WG (MGWG).

[2] https://vlab.ncep.noaa.gov/documents/259399/3406930/SS3.30.10_User_Manual.pdf

Proposal for EASME Tender project: Development and implementation of age estimation uncertainty in stock assessment

Background

Information on fish age is fundamental in the evaluation of a stock status, such as growth- and mortality rates, stock size and maturity patterns. Fish age is estimated from counting annual growth rings in the otoliths of the fish. Age estimates may, however, suffer from lack of accuracy. To that end, age calibration exchanges are regularly carried out under the guidance of the ICES Working Group on Biological Parameters (WGBIOP). The output from such exchanges are summarized in the form of Age Error Matrices (AEM). Although uncertainties in age estimates are well documented through > 200 calibration exercises, AEMs are generally not being used in stock assessment. A notable exception is the eastern Baltic cod stock, where the incorporation of ageing error in the stock assessment model "Stock Synthesis" improved the reliability of the assessment.

Problem statement

Among the stock assessment models most often used by the International Council for the Exploration of the Sea (ICES) is the State-space Assessment Model (SAM). SAM is used in 27 of the commercially most important fish stocks. Unfortunately, SAM is currently not capable of incorporating AEM. The incorporation of ageing error in SAM is, however, a feature that can be developed. This development requires funding of key personnel and actions that ensure correct implementation in stock assessments. Currently, there are no options to cover expenses for this development and its implementation through national or international sources.

Solution

Development of SAM to incorporate AEMs and implementation thereof in stock assessments will require funding of the following activities:

- Staff time to develop the AEM feature of SAM
- Staff time to prepare AEM output from historic calibration exchanges
- Staff time to program output of AEMs from SmartDots (the current online platform for exchanges)
- Workshop to collate all existing workshop data and discuss best practice with SAM developers
- Workshops to test a beta version of the updated SAM
- Workshops with ICES Working group representatives to train end-users

Project duration: 18 Months

Funding required: 280.000 €

- 6 staff months for model development and implementation (SAM) (75.500 €)
- 6 staff months for data compilation of historic exchanges, quality assurance and SmartDots programming (75.500 €)
- 7.5 staff months for workshops (94.400 €)
- Travel (34.600 €)

Response to Recommendation ID 127 from WGWIDE to WGBIOP (ToR c & d)

It was recommended that WGBIOP provides WGWIDE with the variance-covariance matrix for results of the age-reading by species (NSS herring, blue whiting, NEA mackerel), for use in the exploration of effects of ageing-errors on the assessments.

This recommendation is a positive move, with stock assessors considering and requesting age error information. Age error matrices were provided, and the development of the assessment models discussed.

For blue whiting, an age-error matrix was calculated from WKARBLUE2 2017 results based on otoliths from ICES stock area (otoliths from the Mediterranean were excluded) (Table 4.5). The AEM was tested on the assessment model in preparation to WGWIDE. This showed that further work is needed on model development to incorporate this information. An age reading intercalibration exercise is currently in progress and a workshop is planned for June 2021. It is planned that the resulting AEM will be used to correct the catch-at-age and survey data used for assessment, and the impact of these uncertainties on age reading on the stock assessment results will be investigated by WGWIDE.

Table 4.5. Age error matrix supplied for blue whiting.

	Agreed age									
Modal Age	0	1	2	3	4	5	6	7	8	**Total (n)**
0	1.000									**11**
1	0.038	0.923	0.038							**26**
2		0.083	0.917							**12**
3			0.095	0.857	0.048					**21**
4				0.273	0.727					**11**
5						0.800	0.200			**5**
6						0.333	0.667			**6**
7										**0**
8						0.250		0.250	0.500	**4**
Total										**96**

For NEA mackerel, AEMs were calculated using the results from the 2018 workshop for overall results, by regions and based on the results of the 28 quasi-validated otoliths from Norwegian tagging experiments. Results were given to mackerel stock assessor and discussed with the next benchmark assessment being a potential target for developments to incorporate the results into the current SAM. Currently, a small-scale exchange is organized and scheduled for the end of the year, which will provide further data.

For Norwegian spring spawning herring (NSSH), a more general discussion was triggered, as there are also challenges because of the mixing of the NSSH with other herring stocks at the edges of the distribution area and different ageing from otoliths and scales. This discussion ended in a recommendation from WGWIDE to WGBIOP.

WGWIDE: it is recommended that an age reading exchange and a subsequent workshop are held for Norwegian spring spawning herring. The work should also deal with issues related to the mixing of NSSH with adjacent herring stocks in the fringes of the distribution area. The workshop participants should be both age readers and participants with statistical, stock identification and stock assessment expertise.

WGBIOP will take on to prepare an exchange including otoliths and scales from NSS herring with a subsequent workshop when the four countries (Norway, Denmark, Iceland, and the Faroe Islands) have sampled both otoliths and scales from their catches. Due to the issues related to structure, it is vital that both structures are available from the same fish before an exchange can

be planned. IMR Norway has a draft manual for sampling NSSH otoliths and scales and will discuss this at the WGIPS meeting in January 2021. It is important that in 2021 the Faroe Islands, Iceland and Denmark follow the manual and collect samples on their pelagic surveys as this will provide a temporal and spatial representative sample set for an exchange in 2022.

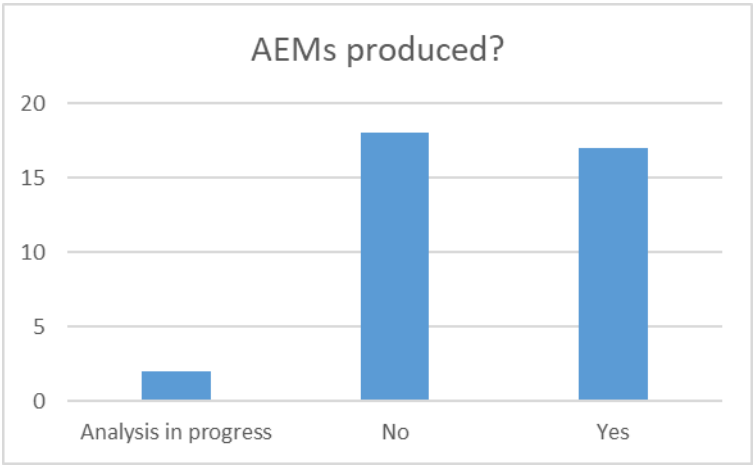
Production of Age Error Matrices

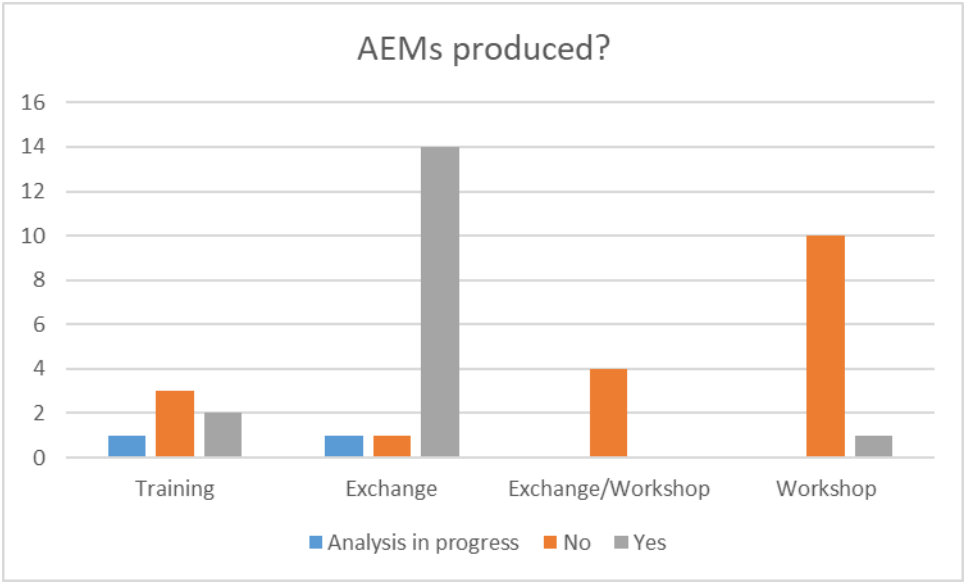
Alongside the use of ageing error, WGBIOP reviewed the production of AEMs in past ageing events. Ageing event information for events with start dates from 07/11/2017 to 31/08/2020 was downloaded from SmartDots, and if AEMs were included in the associated reported was reviewed. Then ageing workshop and exchange coordinators were contacted to ask:

1. During these events, were Age Error Matrices (AEMs) produced?
2. Were these AEMs requested by stock assessors, or on your own initiative, did you provide them to the assessment WGs?

Results showed that ageing events are producing AEMs, but only starting to report them to assessment WGs.

1. Number of replies = 37 events/species (Some workshops/exchanges included several species, which are in SmartDots considered separate events)





2. Number of replies = 10 out of the 17 "Yes" to Question 1

1	No
3	Not requested but provided in the summary report to the stock assessor
2	Not requested, will provide
2	Not requested (internal exercise, to compare methods)
1	Not sure
1	Yes, but not used

Additional information related to ageing

ScleroNet: An integrated network of sclerochronology collections, led by Dr Deirdre Brophy, GMIT, Ireland, has been submitted to the Horizon2020 program on Integrating Activities for Starting Communities in May 2020.

The proposed project aims at providing standardised manuals for curating otolith collections and facilitating transnational access to make use of these collections for scientists across Europe.

Among the initiatives that will be promoted, are access to physical otoliths as well as images and data that can serve to develop age error matrices for stocks of interest.

Stomach Sampling

Previous consultation with end-users highlighted the need for stomach sampling and analysis to deliver biological information for multispecies models. Here, we provide an overview of current work and ongoing collaboration on the development of sampling. The Draft EU-MAP (multi-annual plan for Data Collection) from 2022 onwards includes a requirement for stomach sampling and analysis for food webs (Member States "shall" provide this). The emphasis of data collection is on data for assessment. EU Regional Coordination Group (RCG) structures are now in place to take forward stomach sampling through an Intersessional subgroup (ISSG) on 'Regionally coordinated stomach sampling'. The Terms of Reference for the Workshop on Operational Implementation of Stomach Sampling (WKOISS), developed by WGBIOP, were presented to the ISSG to support its development.

The ISSG Workplan for 2020–2021 consists of developing a case study, funding and sampling allocation and intercalibration of protocols (from RCG-Baltic part I).

1. The development of a regionally coordinated sampling, using North Sea IBTS as a case study and based on the recommendations of WGSAM.
2. Discussions, to define specifically the repartition of sample collection and analyses among countries, and funding. Members of IBTS WG to be involved. This would require the approval of the formation of the subgroup by NC, to coordinate the work. Feedback needed from the COM to support this work.
3. A specific case study should also be developed to intercalibrate the IEO protocol with the WGSAM recommendation, as to guarantee the continuity of the stomach time series, and to allow the comparability of all data collected within EU-MAP.

With regards to the Workshop on Operational Implementation of Stomach Sampling (WKOISS), this was not held as scheduled because of the COVID-19 pandemic and associated restrictions. The proposed chair, who is also a co-chair of the ISSG, believes a physical meeting will be more appropriate for the first meeting of a new workshop. WBGIOP continue to support this im-

portant workshop and discussions are ongoing to find suitable chairs who will review the existing WKOISS ToRs in light of any updates to data collection and end-user requirements. Then, if appropriate, renew the WKOISS resolution with the meeting date set to the end of 2021 (see Annex 3 for the draft resolution).

Other developments related to stomach sampling include the development of a FishPi2 follow-up project proposal coordinated by Joel Vigneau (IFREMER) that was submitted July 2020 to the call MARE/2020/08. This proposal has been evaluated positively in November 2020 and the project will likely start early 2021. FishPi2 produced the sampling protocol for predator stomachs that the WK on Better Coordinated Stomach Sampling (WKBECOSS) recommended WGBIOP should consider and WGBIOP supports. The FishPi2 report and annexes are available here: https://crmg.st-andrews.ac.uk/current-projects/fishpi2/

In the Mediterranean and Black Sea regions, a follow on project to STREAM (STrengtheningREgional cooperation in the Area of fisheries biological data collection in the Mediterranean and the Black Sea, MARE/2016/22) is also in development. Considering that the new workshop on stomach contents in Mediterranean WKSTCON2 has the same topic as WKOISS, the two workshops were unified taking into account in the ToRs also the main results of the FishPi2 and STREAM.

Going forward, WGBIOP considers that stomach sampling is a sufficiently large and specialist subject to be organised separately, outside of WGBIOP. Requirements for stomach sampling are now included in the EU-MAP and the end-users, mainly the ICES Working Group on Multispecies Assessment Methods (WGSAM), are engaged with developments so they can propose future workshops.

If WGBIOP finds examples where work is being duplicated or diverging in different countries or regions, it should continue to promote and aid co-ordination. WGBIOP should also continue to share knowledge and processes from the quality assurance of ageing and maturity staging with stomach sampling groups, and liaise with the RCG ISSG as appropriate.

Links with Data Users

Provide a working document on the maturity values and references that WKLIFE uses in simulations, along with information on ageing or staging agreement if there have been age and maturity workshops for these stocks.

As described in WGBIOP 2019, WKLIFE uses simulated stocks to develop management rules for stocks that lack assessments. The A50 and L50 parameters used in simulations by WKLIFE are from peer-reviewed papers (Annex 6; Table 1). This aids the transparency of the process and demonstrates the value of comprehensive papers on biological parameters for specific stocks. For WGBIOP 2020, the referenced papers were sourced from the abbreviated reference provided (first author and year), DOIs provided to the references and the values used were checked against the reference text (Annex 6; Table 2a and Table 2b). The quality of the A50 and L50 parameters was considered in terms of did the area match the stock area, how recent the data were, and the number of biological samples. Discussion at WGBIOP raised the point that the sampling scheme used should also be checked to assess if papers accounted for length stratified sampling when calculating maturity estimates.

Inaccuracies in some maturity parameters used were identified, for example, where an L50 calculated for females was listed as combined sex. Quality varied, from values taken from recent comprehensive papers on the specific stock to values based on other stocks and older references (e.g. a 1965 reference for North Sea lemon sole). As part of the review, more appropriate references were provided for Biscay-Iberian anchovy. These findings were added to the spreadsheet of A50 and L50 values and shared with the WKLIFE modeller running the simulations. Along-

side this, there is also information on ageing and maturity staging available in the quality indicator table from ToR c). However, this is less directly usable as the simulation is for the underlying stock rather than the observed maturity.

Overall, the values used were acceptable for the simulations because the aim was to provide an illustrative set of stock values rather than stock-specific conclusions. However, there is a risk of the older, less relevant stock parameters being referenced and applied for different purposes by other studies.

Often, modellers rely on the peer-reviewed literature to obtain life-history parameter estimates. Selected species may not be assessed, or modellers might not know who the stock coordinators are nor contact them all individually when compiling data for multiple species. Assessing how appropriate maturity estimates are is part of the data evaluation and benchmark process for a stock. This work is the stage after WGBIOP's role in providing best practice and QA for collecting and staging maturity samples. However, there is an opportunity for WGBIOP to work with stock coordinators to investigate, document and calculate maturity estimates for specific stocks, where information is unavailable or old, as part of future work.

WGBIOP should look at how current knowledge on spawning behaviour can be made available and accessible and investigate the format and level of detail required for WGIPEM models.

During the Working Group on Integrated, Physical-biological and Ecosystem Models (WGIPEM) 2019 meeting, a joint web session was held between WGBIOP members and WGIPEM. Following this session, WGIPEM provided a summary of data used and information that is missing for integrated, physical-biological and ecosystem models. Multiple data needs were listed, with information on spawning behaviour identified as strongly related to WGBIOP's current work and expertise. Draft sections of the ICES CRR: Handbook on maturity staging of marine species now include information on spawning period, length at first maturity and where known, environmental effects on spawning. An example comparing spawning periods from several studies is shown below. This will be a good route to make spawning information for multiple species accessible to WGIPEM. It would be the basis for further discussions as there is still a need to investigate the format and level of detail required for WGIPEM models.

Table 4.6. Example of CRR Maturity timing information. Spawning period of *L. budegassa* in several studies in Atlantic and Mediterranean waters, highlighting the spawning peak in those studies where was available. The hatching period is shown in the otolith microstructure studies of La Mesa and De Rossi (2008) and Hernández *et al*. (2015). GSI: Gonado Somatic Index, HIS: Histological, MC: Morphocromatic, MSF: Maturity Stage Frequency, OM: Otolith Micro-increments.

Ocean / Sea	Stock	Ecoregion	ICES area / GSA	Area	Author	Methodology	spawning season / peak of the spawning (or hatching in otolith microincrements studies) — Month: J 1	F 2	M 3	A 4	M 5	J 6	J 7	A 8	S 9	O 10	N 11	D 12
Atlantic	7.b-k, 8.a,b,d	Bay of Biscay and Iberian Coast	8.a,b,d	Northern Bay of Biscay	Quincoces, 2002	MSF (HIS, MC), GSI												
	8.c, 9.a	Bay of Biscay and Iberian Coast	8.c	Southern Bay of Biscay	Landa et al., 2014	MSF (MC)												
		Bay of Biscay and Iberian Coast	8.c, 9.a2	Southern Bay of Biscay and Galicia	Hernández et al., 2015	OM												
		Bay of Biscay and Iberian Coast	8.c, 9.a	Atlantic Iberian waters	Azevedo, 1996a	MSF (MC)												
		Bay of Biscay and Iberian Coast	8.c, 9.a	Atlantic Iberian waters	Duarte et al. 2001	MSF (MC)												
Mediterranean	-	Western Mediterranean Sea	6	Northwestern Mediterranean Sea	Colmenero et al., 2013	MSF (HIS, MC), GSI												
	-	Adriatic Sea	17	Adriatic Sea	La Mesa and De Rossi, 2008	OM												
	-	Aegean-Levantine Sea	22	Aegean Sea	Tsimenidis, 1980	MSF (MC)												
	-	Aegean-Levantine Sea	22	North-eastern Aegean Sea	Yigin et al., 2015	MSF (MC), GSI												

4.4.2 Progress during WGBIOP 2018–2020 (ToR d)

WGBIOP outlined steps towards implementing Age Error Matrices (AEM) from age reading exchanges (available as a standard output from the current SmartDots platform and historic exchanges) into stock assessment by i) Summarising information on which Stock assessment models are being used by stock, ii) Discussing with the developers/users of the different models in use to what extent their models are capable of accommodating AEM, and iii) Promoting the development of the tools necessary to do so in practice.

The two main age-based stock assessment models used are Stock Synthesis and SAM (state-space assessment model). With respect to incorporating age-error matrices in these models the situation is:

Stock Synthesis:

Ageing error can be implemented without further development. A detailed description of the format required to that end may be found in the Stock Synthesis Manual. The format required is a vector of values of the mean reported age and the standard deviation of reported age for each true age. We note this appears to assume variation is symmetric, e.g. +1 year has the same chance as -1 year ageing error, but how the values feed into the model can be clarified with the developers.

SAM:

The situation for SAM is somewhat different and according to the model developers, SAM cannot incorporate AEMs in its present form. However, it is a straightforward process to do the necessary adjustments. This does require some input in the form of manpower. Once the SAM model has been developed, the input information required may differ from an AEM, so an additional output format may be required from SmartDots.

WGBIOP (ICES, 2018a) developed and proposed the Workshop on Better Coordinated Stomach Sampling (WKBECOSS) that met on 3–6 September 2019. WGBIOP supports evaluations and adoptions in term of protocol and analysis developed in FishPi2, STREAM project's stomach sampling protocol, WKBECOS, WKSTCON and the "Intersession Sub-group on Stomach Sampling" of the Regional Coordination Groups (RCGs). Moreover, to not duplicate the effort WGBIOP supported the idea to unify the initiatives on the stomach contents from ICES and GFCM context planning during the WGBIOP 2019 a new workshop. WGBIOP recommended a Workshop on Operational Implementation of Stomach Sampling (WKOISS) to follow up on the work of the abovementioned initiative and ensure continued knowledge sharing and coordination between different institutes and regions.

Fish condition can be calculated from comprehensive single fish data available at the RDB and DATRAS. In contemporary stock assessments, changes in condition factor are usually accounted for by the weight-at-age data so that fish condition as an additional factor is not required. However, there are examples for cod (*Gadus morhua*) addressing direct links between low condition and increased natural mortality (Dutil and Lambert, 2000; Casini *et al*., 2016). Hence, for certain species and/or stocks additional biological data such as condition can be very useful to improve fish stock assessments and as indicators of stock health (ICES 2016, WGFICON).

We assessed whether the required weight and length data would be available in ICES databases. Presently, "condition factor" is not a parameter that is estimated on a routine basis for the data uploads to the Regional Data Base (RDBES) or DATRAS (trawl survey database) at ICES. This may be mainly because there are no fish stock assessments that by default require data on fish condition. However, in case these data would be needed, both the RDBES and DATRAS provide single fish data on weight and length that could be used to calculate individual fish condition.

Alternatively, data calls could request condition factors to be additionally calculated. In the RDBES single fish data are uploaded as part of the CA table. While DATRAS only provides single fish data from the internationally coordinated trawl surveys conducted during certain times of the year, following standardised processing schemes. For instance, for each stratum (e.g. a depth zone in an ICES subdivision), only 10 fish per 1 cm length class are sampled. Thus, overall sample sizes from the survey are much lower than the samples collected from the commercial fisheries that are available in the RDBES.

Links with end-users of biological parameters have been developed through: i) a joint web session with the WG on Integrated, Physical-biological and Ecosystem Models (WGIPEM) that provided information on their models' data needs, and ii) a meeting to obtain the life history parameter estimates used in WKLIFE's stock simulation operating models.

4.4.3 New terms of reference for 2020–2023 (ToR d)

Investigate and develop data availability, documentation and methods to improve identified biological parameter estimates, as input to assessment models.

Background information for the ToR: Life-history parameters are required by expert groups on assessment, multispecies modelling, ecosystem modelling and data-limited stocks. Therefore, recent data from quality assured sources is essential. WGBIOP provides guidelines for collecting high-quality data and provides links between data providers and end-users. There is a need to assess the availability and use of biological parameters, and to support incorporating age error matrices and other biological parameter quality information into assessments.

4.4.4 Work plan for 2020–2021 (ToR d)

- Scrutinize the output of the third Workshop on Optimization of Biological Sampling (WKBIOPTIM3) in terms of sampling optimization and analysis of age and maturity parameters.
- Support the development and activity of the Workshop on Operational Implementation of Stomach Sampling (WKOISS). Maintain links between WGBIOP and the RCG intersessional subgroup on stomach sampling.
- For stocks that are identified as a prioritised stock for validation, investigate if length at maturity (L50) is properly identified in the assessment.
- Investigate the list of possible data needs from the Working Group on Integrative, Physical-biological and Ecosystem Modelling (WGIPEM) provided in WGBIOP 2019. For example, consider the format and level of detail required by WGIPEM models to make the best use of available knowledge on spawning, such as seasonality, inter-annual changes, and spawning season duration.
- Explore providing stock information data to organizers of upcoming age and maturity workshops/exchanges. The aim is to show how data are used in the assessment, for example, important age and length ranges.

4.4.5 Deliverables for 2021–2023 (ToR d)

- Promote the development of the tools necessary to integrate age error matrices (AEM) and other formats of age error information into stock assessment models.
- Document current sources of life-history parameter estimates identified by ICES/GFCM Expert Groups as critical components relevant to the improvement of assessment for ICES/GFCM stocks.

- Identify where biological information can be updated, provide input to improving data for life-history parameters.
- Referenced maturity at length and age information made easily accessible, e.g. through stock information database. Work with stock information database (SID) developers.
- An overview of quality assurance for stomach sampling. Provide support, share knowledge and processes from the quality assurance of ageing and maturity staging with stomach sampling groups.
- Facilitate closer links between data providers and end-users such as modellers and stock assessors.

4.5 ToR e: Address requests related to biological parameters and indicators

4.5.1 Progress during WGBIOP 2020 (ToR e)

In preparation for WGBIOP 2020 two main tasks were identified:

1. Address and plan actions if needed for each technical and statistical recommendation addressed to WGBIOP in 2020.
2. Finalise the summary table of the input data used in each species stock assessment (e.g. length, age, age plus group, maturity ogive).

Technical and statistical recommendation addressed to WGBIOP

Recommendations addressed to WGBIOP in 2019 and 2020 were evaluated and forward to ToR subgroups a, b, c and d to be taken up. Where necessary workshops or exchanges will be organised under the remit of WGBIOP.

Summary table of input data of stock assessment

WGBIOP 2019 compiled a table summarizing the age and maturity data used in each stock assessment (WGBIOP 2019 Table 2.6) and agreed that the ICES SID (http://sid.ices.dk/Default.aspx) would be the most suitable place to be able to obtain all of this information. During 2020, no further work was done on the content of the table as it was considered complete. Both WGBIOP and the RCG subgroup on end-user needs have noted the need for a better overview of the biological data and its sources, used in each stock assessment. As both groups have been working on suggestions for improvements to SID contact was made by the chairs of WGBIOP with the RCG subgroup in order harmonise and ensure no duplication of work. Contact was subsequently made with the responsible persons at the ICES secretariat and the WGBIOP suggestions were proposed. Included in the proposal was the information suggested by WGBIOP 2019 to be included in a "Maturity Information Sheet" (see WGBIOP 2019 report). This sheet would summarise stock information for the coordinators of calibration exchanges and workshops and a similar sheet summarising age information was also suggested. On review of the suggested sheets, it became apparent that the ICES SID could be the most suitable place to have such information.

ICES Stock Information Database (SID) developments relevant to WGBIOP

The ICES SID is currently under development and a presentation was given by Rui Catarino (ICES) at WGBIOP 2020 of the database, webpage and planned improvements that will include a module for managing benchmarks. Some of the functions most relevant to WGBIOP are the Benchmark Stock Rolling Issue Lists (which are publicly available at http://stockdatabase.ices.dk/Manage/rollingissues.aspx) where WGBIOP will be able to add responses to biological parameter related issues, such as results from previous exchanges and workshops. Stock

coordinators and assessors will then receive an email notification and comments will be addressed at the assessment and/or benchmark meeting. The benchmark module will include links to the benchmark reports and here it was suggested to have links to SmartDots exchange and workshop events and reports in the future. Keyword search functions will also be added. There are restricted levels of access to the SID and only information that does not need to be updated annually will be added by the ICES secretariat and in the future, this will most likely be done following a benchmark. Currently, only single stock information is included, as opposed to information on multispecies stock assessments, which WGBIOP feels would be useful. It is hoped that in the future the chairs of WGBIOP will be granted access to the "manage" stock pages where it is possible to download reports by expert groups, which can be filtered for information and data relevant to the work of WGBIOP. The ICES Transparent Assessment Framework (TAF) will provide information on the specific data used in the assessments, this will not be provided in SID. TAF is open to everyone to see but only stock assessors and coordinators have access to change and save data.

4.5.2 Progress during WGBIOP 2018–2020 (ToR e)

Technical and statistical recommendations addressed to WGBIOP

Recommendations addressed to WGBIOP from 2017 to 2020 were evaluated. In order to get further clarification on some recommendations, chairs from the working groups or workshops from which those recommendations came from were contacted. Recommendations were then forwarded to ToR subgroups and taken up in the WGBIOP work plan were possible. In some cases, WGBIOP could only provide advice through the recommendations SharePoint.

Summary table of input data of stock assessment

WGBIOP 2018 identified the need to have a list of all stocks currently assessed by ICES, with information on the type and periodicity of age and maturity data used in the assessment (age, age plus group, maturity ogive). This type of information is useful when planning future age and maturity calibration exercises but cannot be found in one central place but instead needs to be compiled from various reports, stock annexes and databases. Assessment reports were screened and in some cases, the information concerning the input data was not so evident and easy to find, thus a standard format table (WGBIOP 2019 Table 2.6) for the input data was proposed and work initiated to complete it. In 2019 the table was further updated and it was suggested that such a table should be included in each stock annex, it was later agreed that the ICES Stock Information Database (http://sid.ices.dk/Default.aspx) would be the best place to be able to obtain this information. In preparation for WGBIOP 2020 contact was made to the RCG subgroup on End User needs who wore working to improve the ICES SID with the ICES secretariat. The suggestion from WGBIOP was put forward and a presentation of the prioritised developments of the SID was given at WGBIOP 2020.

Cooperation with the ICES Workshop on Optimisation of Biological Sampling (WKBIOPTIM)

At WGBIOP 2018 the work of the ICES Workshop on Optimisation of Biological Sampling) WKBIOPTIM2 was presented, this included the Working Document "Hake (*Merluccius merluccius*) southern stock: otoliths and gonad collection" (WGBIOP 2018, Annex 3). The possibility to consider some metrics on age and maturity as methods to calculate effective sample size for biological parameters were discussed. It was suggested that WKBIOPTIM3 should use Hake in ICES divisions 9.a and 8.c as a case study. In support of WKBIOPTIM, a table was provided to all members of WGBIOP requesting information on national biological parameter sampling schemes by species. Also, the input data used in stock assessment table mentioned above would

give WKBIOPTIM an overview of the range of biological parameter estimates required for the individual stock assessments.

WKMSYCat34 template

WGBIOP 2019 evaluated the possibility of incorporating the proposed table on biological parameter data used in stock assessment into the WKMSYCat34 template to produce a more complete table of information for stocks in categories 3 and 4. The idea being, to allow for an easier compilation of information to assist the evaluation and decision making on whether the stock could be a candidate for a full analytical assessment with forecast (i.e. category 1). Based on the identification of the type of information required and the application of this table, the subgroup concluded that this subject is not under the scope of this working group.

4.5.3 New terms of reference for 2020–2023 (ToR e)

Across database developments combining biological parameter data collecting and quality assurance of this data. Address requests for technical and statistical recommendations/advice related to biological parameters and indicators.

Background information for the ToR: On a regular basis WGBIOP receives requests related to (quality of) biological parameters from EGs and other related groups. Filled templates for requests sent to WGBIOP before a specified deadline will be the basis for this ToR. Requests often deal with the provision of information or data on quality of biological parameters which are not easily accessible. In order to improve the accessibility of the data and the efficiency of the quality assurance processes, cross-database developments are essential. This will allow for combing through data from different sources, facilitating the work of WGBIOP and also supporting the ICES quality management system.

4.5.4 Work plan for 2020–2021 (ToR e)

- Review technical and statistical recommendations addressed to WGBIOP and take action to address and were necessary incorporate into WGBIOP work plan.
- Provide a combined overview of SmartDots/ RDBES/TAF and DATRAS outputs. Prepare work plan for flow diagram to combine outputs. Include stock overviews, benchmark module, link to report outputs from exchanges and workshops.

4.5.5 Deliverables for 2021–2023 (ToR e)

- Each received request for technical and statistical recommendations related to biological parameters and indicators will be addressed and included in the WGBIOP work plan where appropriate.
- Provide input for current and developing data storage and tools.
- Flow diagram combining outputs from SmartDots, RDBES, TAF and DATRAS to WGQUALITY, DIG and DSTSG. This will give an overview of countries/institutes collecting biological parameter data as input for quality assurance of biological parameters.

4.6 ToR f: Update and further develop tools for the exchanges and workshops

4.6.1 Progress during WGBIOP 2020 (ToR f)

During WGBIOP 2020 the subgroup has focused on:

- Compile comments and feedback from WGBIOP exchanges and workshops and list requirements for the coming years.
- Provide feedback for WGSMART.
- Maturity on SmartDots. Delivery of feedback to WGSMART on the SmartDots output from a test run and reporting.
- A new release of SmartDots came in September 2020. It was presented in detail at WGBIOP 2020.
- Modal age calculation and SmartDots reporting. Delivery of feedback on the multimodal age approach to WGSMART and cooperation with WGSMART in the implementation on the R-script.
- Shiny dashboard development to integrate RBD and SmartDots outputs.

Compile comments and feedback from WGBIOP workshops and exchanges

For the period September 2019 – September 2020 seventeen events took place in SmartDots (see https://smartdots.ices.dk/ViewListEvents) with four published.

Only one workshop WKAS provided feedback on the use of SmartDots and all other items were received directly from the age coordinators

Each issue was included in WGSMART GitHub (https://github.com/ices-eg/SmartDots/issues).

All feedback sent to WGSMART from the feedback website has been compiled at GitHub, all feedback has been discussed and prioritised and included in the work plan. During the WGBIOP 2020, all comments received by national age-coordinators, and the issues described on GitHub (https://github.com/ices-eg/SmartDots/issues) were checked and compared. This should be carried out on an annual basis.

During the summer of 2020, a SmartDots module for egg and larvae identification was developed to facilitate the online ICES Second Workshop on the Identification of Clupeid Larvae (WKIDCLUP2). A calibration event was completed as part of the workshop and feedback received from both the coordinator (Annex 7 below) and participants. A presentation of the module was given at WGBIOP 2020. WGSMART will discuss and prioritise the feedback and incorporate it into their work plan. The module was also presented at the ICES Working Group on Atlantic Larval and Egg Surveys (WGALES) with very positive responses. This module will be further developed for future exchanges and workshops.

In preparation for WGBIOP 2020, an e-mail was sent to all event coordinators and national age coordinators asking for feedback on the use of SmartDots. The questions asked were to try and capture the use, usefulness, and suggestions for future developments of the SmartDots application

- How do you utilise SmartDots—Exchanges/Training/Internal Quality Control (QC)
- Feedback on the general utilisation of SmartDots
- Suggestions for improvements to the system
- Other general comments

Twelve replies were received and there were many cross-cutting themes, lots of praise for the application and suggestions for improvements. WKSA reported that SmartDots was a potentially useful tool for recording the results of standardised ageing of reference shell data sets.

SmartDots is currently being utilised in a number of ways: International Exchanges and Workshops, internal QC and in addition, training both internal and between labs.

The table of suggestions will be brought forward to WGSMART where relevant items will be discussed and implemented where possible and relevant.

- Provide feedback for WGSMART

WGBIOP will provide feedback to WGSMART where it will be evaluated, prioritised and incorporated into the work plan.

- Maturity on SmartDots

This year the first exchange event aiming at sex categorization and maturity staging has been organized on SmartDots. The chosen case study was the North Sea Plaice. Reporting on a maturity exchange has several challenges in comparison to the age reading exchange reporting, these are related to the fact that sex and maturity are not quantitative but categorical variables. Due to this, some of the statistics that have been routinely presented in the age exchange reports cannot be calculated, like the Coefficient of Variation (CV) and the Average Percentage Error (APE). While for the APE there is not an equivalent for categorical variables, the CV has been replaced in the coefficient of unalikeability (CU) (Kader and Perry 2007) in the maturity reporting. The concept of unalikeability (Kader and Perry, 2007) focuses on how often observations differ within a group. Specifically, for the sex/maturity staging events, the CU provides a measure of how alike, for each modal maturity stage, the stages decided by each stager are (or all stagers together). The CU ranges between 0 and 1. The higher the CU value, the more unalike the data are.

For the case of a finite number of observations (n), a finite number of categories (m) and a finite number of objects, k_i, within category i, will allow expression of the coefficient of unalikeability as:

$$u = 1 - \sum p_i^2$$

where,

$$p_i = k_i / n$$

Unlike in the analysis of the age exchanges, where the real age of each fish individual is never known, and the defined modal age is selected as representative of the real age when calculating all the statistics and the age error matrix, in the maturity exchanges it is possible that for some or all the fish individuals selected for the exchange, the real sex and maturity stage is known due to the availability of histological samples. The histological samples have to be analysed by the exchange event coordinator, and that annotation is taken as the real sex and maturity stage of that fish individuals. Hence, for those individuals with histological samples, the mode is not calculated, and the annotation from the exchange coordinator is taken instead. However, for those individuals without histological sample, the mode needs to be calculated using the sex and maturity stage annotations from all the participant stagers. The same approach followed in the age reading exchanges is followed for sex and maturity. There are two approaches to calculate the mode, the standard approach, which might have problems of multimodality, and the multistage approach, that provides a solution to obtain a single mode in all samples. However, as highlighted in the section above, the multistage approach can only be applied when the experience of the stagers has been assessed following the agreed protocol.

The code to download the data from SmartDots, calculate all the statistics, produce tables and figures and the report have been developed in R. The report has the general structure presented in the age exchange reports, with space for a summary, introduction, material and methods (where the statistics applied are explained), results, discussion, annexes and literature. There are tables showing a general overview of samples and stagers, the percentage of multimodal cases, a table with all the information about those multimodal cases, and tables with CU, PA, EMs, and plots showing these statistics and the frequency distribution.

North Sea Plaice maturity exchange as a case study

As a case study to apply the new code to handle the data, calculate the statistics and produce the report the North Sea Plaice maturity exchange was used.

North sea plaice was chosen for the first maturity exchange on SmartDots as 1) a follow-up on a maturity and calibration workshop from 2010 and 2012 respectively was needed to update precision and accuracy of the stagers, 2) a number of institutes in the ICES community maturity stage North sea plaice thus allowing a fair number of stagers to participate in an exchange, and 3) macroscopic and microscopic images of gonads were available.

The exchange was set up in the SmartDots Web Application by the national maturity coordinators from Belgium and Denmark using the SmartDots maturity manual (http://ices.dk/sites/pub/Publication%20Reports/User%20Handbooks/SmartDots%20Maturity%20Manual.pdf). Two North Sea plaice stocks were used: from subarea 4 (27.4), North Sea and Division 7 (27.7d), Eastern English Channel. From a dataset of 211 gonads (males and females), a subset of 60 samples was selected for the exchange. Samples were chosen from the following criteria: 1) both macroscopic and microscopic images were available of the same gonad, 2) cover as many maturity stages in a reproductive cycle as possible making sure to include "problematic" stages (e.g. immature/regressing), and 3) images of reasonable quality.

The exchange took place from 1 July–September 2020 with 69 participants invited from 6 countries. 41 plaice maturity stagers, both expert and non-experts, participated in the event (DK=15, NE=7, GE=7, BE=4, PL=2).

Participants annotated (maturity staged) the 60 individual plaice gonads from 1–3 macroscopic images per individual. From the image material available, not all followed the WGBIOP guidelines for taking images of fresh gonads (http://ices.dk/community/Pages/PGCCDBS-doc-repository.aspx). Coordinators were aware of this when setting up the event, however, decided to use what image material was available to complete the test run of a maturity event in SmartDots.

While participants annotated gonads from macroscopic images, a maturity coordinator annotated the 60 microscopic (histological) images to define the "true" maturity stage. Once the event was closed the histological images were made available to participants for their interpretation.

The analysis of the exchange data output showed that the percentage of samples for which multiple modes were obtained when applying the standard traditional approach was 0% for sex determination and maturity staging, see tables Table 4.7 and Table 4.8. This low percentage of multiple modes was since there were microscopic images available for all fish individuals studied (60 out of 60 fish individuals) and these images were used to decide the real maturity (that makes unnecessary the determination of the modal maturity). It might also be that the multimodality is less of a problem for maturity exchanges than age reading exchanges. Whether the multistage approach is necessary or not for maturity exchanges (and hence weighting the stagers based in their experience), is an issue that will require several maturity exchanges before having a more conclusive answer.

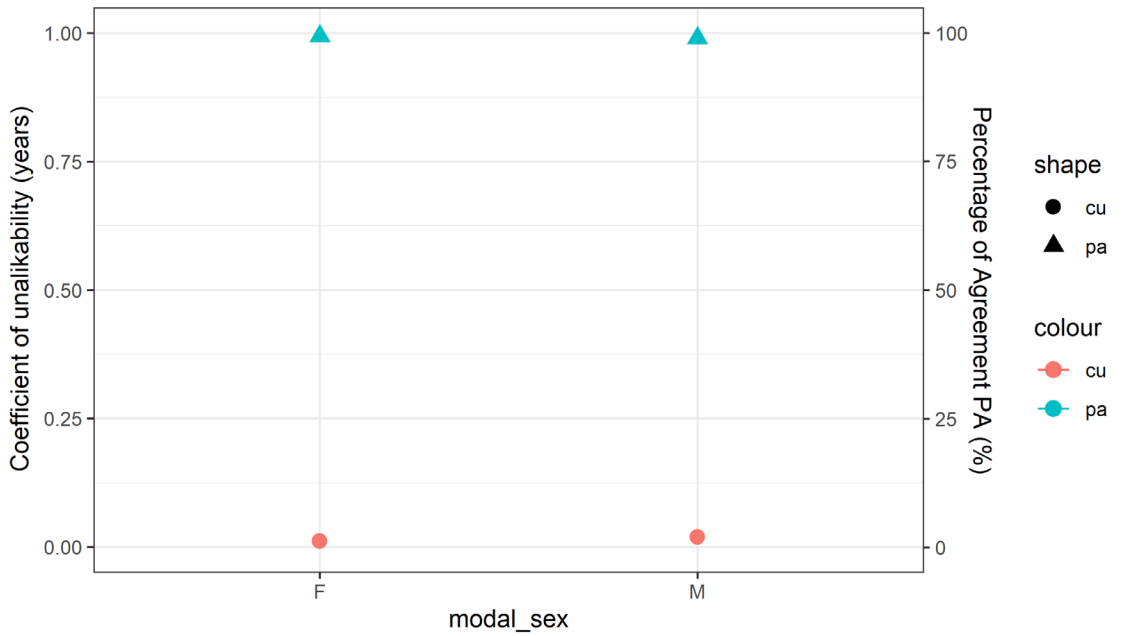
Table 4.7. Summary of statistics for sex staging; Total number of fish individuals studied (NSample), number of fish individuals with histological samples (Nhist), percentage of fish individuals without histology (Perc_not_Hist). The percentage of cases (fish samples) with multiple modes depending on the approach to weight the experience of the stager which will be considered when defining the fish sex stage mode. PercMM_traditional shows the percentage of the total samples for which multiple modes are obtained when all the stagers are equally weighted.

NSample	Nhist	Perc_not_Hist	PercMM_traditional
60	60	0	0 %

Table 4.8. Summary of statistics for maturity staging; Total number of fish individuals studied (NSample), number of fish individuals with histological samples (Nhist), percentage of fish individuals without histology (Perc_not_Hist). The percentage of cases (fish samples) with multiple modes depending on the approach to weight the experience of the stager which will be considered when defining the fish maturity stage mode. PercMM_traditional shows the percentage of the total samples for which multiple modes are obtained when all the stagers are equally weighted.

NSample	Nhist	Perc_not_Hist	PercMM_traditional
60	60	0	0 %

Overall, when all readers and samples were analysed together (Figure 4.2), the CU by modal sex category was very low (almost zero), while the PA was very high (close to 100%), which indicates that most readers agreed in the sex category assigned to all fish individuals and that in almost all the samples the decision made by the stagers agreed with the modal sex category. However, the CU was above 0.5 for all modal maturity stages and the PA was always below 60%, which indicates that there was considerable variance in the maturity stage decided by the group of stagers and a low degree of agreement with the modal maturity (especially for the modal maturity stage A).



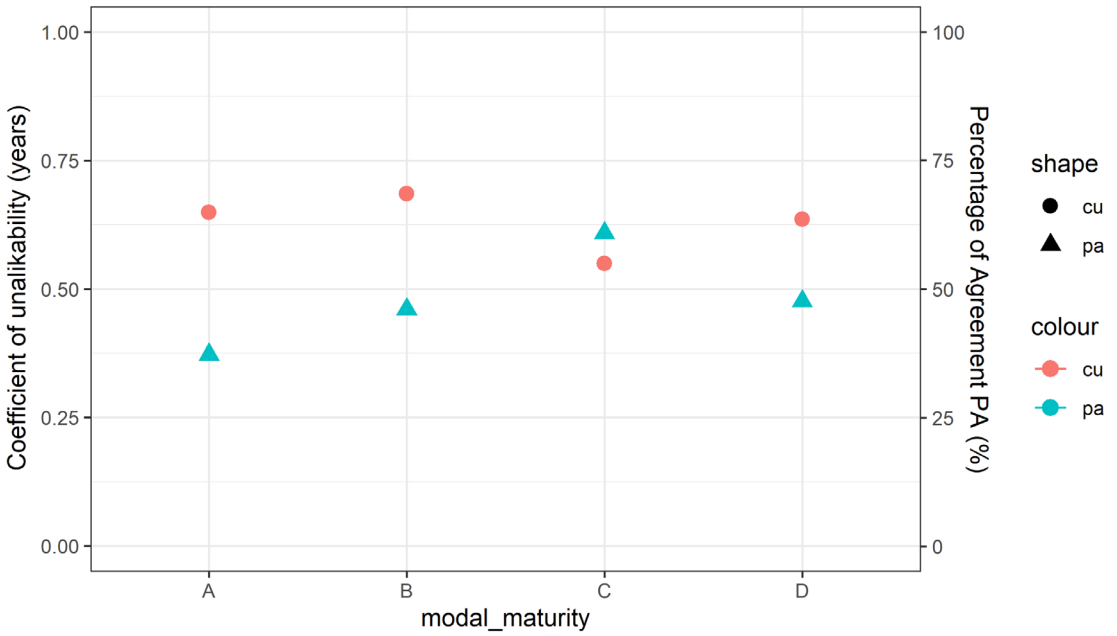


Figure 4.2. CU and PA are plotted against modal maturity and modal sex.

The relative frequency plot shows that most of the annotations agreed with the modal sex category (Figure 4.3), and only 0.6% of annotations for female and 1% of annotations for male modal sex categories did not agree and were assigned to the other sex.

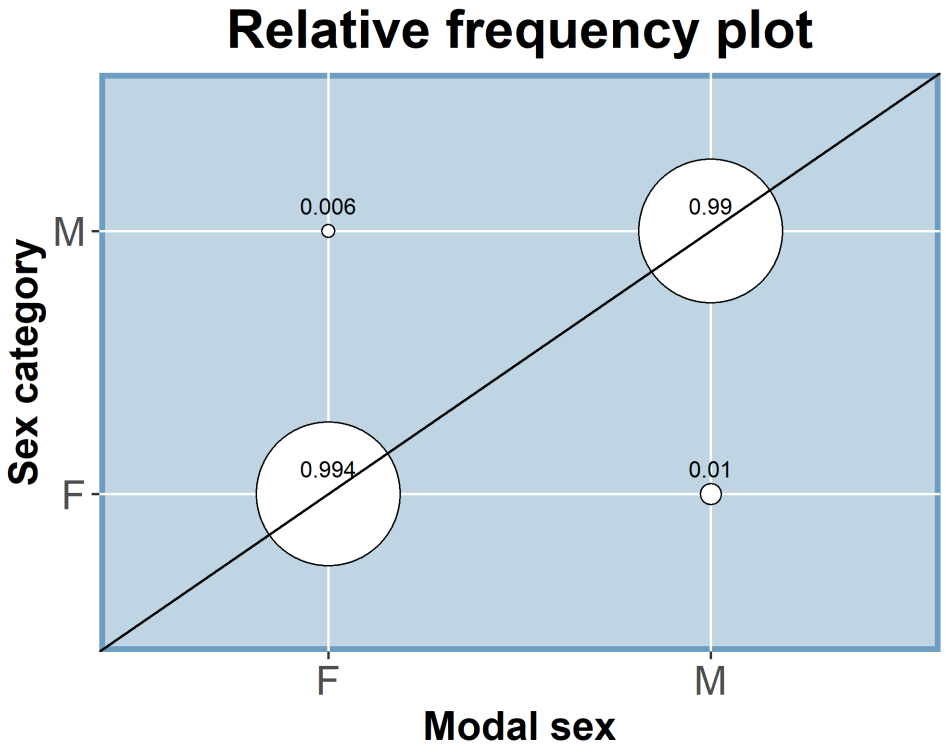


Figure 4.3. Frequency distribution by modal sex category and annotated sex category.

However, as already indicated when analysing the CU and PA, the success when annotating the maturity stage was much lower. The relative frequency (Figure 4.4) showed that for all the maturity stages, above 40% of the maturity stage annotations were to the wrong maturity stage

(different from the modal maturity stage). This was especially important for the modal maturity A, for which 44% of the annotations were assigned to the maturity stage B.

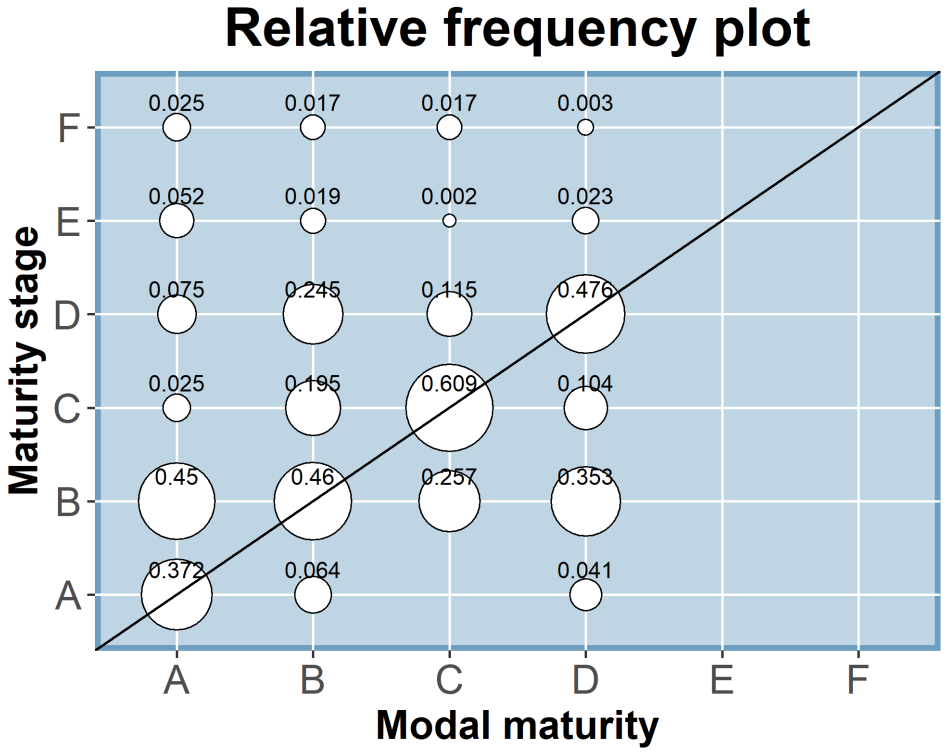


Figure 4.4. Frequency distribution by modal maturity stage and annotated maturity stage.

As this was the first maturity event run in SmartDots, feedback on the exercise from participants and coordinators was particularly important. A template with features (Table 4.9) was sent to all participants and a general observation was that the image quality of many gonads was poor and therefore not always easy to stage gonads from. In the results, this may explain at least partially the low PA. All feedback has been compiled (Annex 7; Table 1) and also sent to WGSMART to integrate for future maturity exchanges.

Table 4.9. Feedback template for maturity exchange.

Features		Good	Not efficient	Comments/Suggested Improvements	Questions
Access	Access to password				
	Access to event				
	Data access				
	Image access				
Images	Image quality				
	Level of detail				
	Colour and Brightness				
Sample Information	Clarity				
	Units of measurements				
	Appropriateness				
Input fields	Clarity of what is being requested				
	Relevancy of what is being requested				
	Layout				
	Comment field				
	Editing				
	Saving				
User friendliness	Layout				
	Navigation between samples/specimens				
	Navigation between images				
	Progress overview				
	Event overview				

- SmartDots release September 2020

A new release of SmartDots was released on 2020/09/30. For the development of the new functionalities, adjustments were needed in the SmartDots software, the Web API and the Web application.

A summary of the new SmartDots functionalities:

- Extra sample properties can be added by the event manager in the file panel. By default the following sample properties will be integrated: catch data, area and the preparation method.
- The functionality of the status colour has been extended. When the reader has created an annotation for the selected file/sample the status colour will change into orange. When the reader has approved an annotation, the status colour will change into green. The reader can sort on the status column by clicking in the column header.
- An additional dot type was added for false rings (non-counting mark) identification
- Dot type, size and colour can be easily changed by right-clicking on a dot.
- When multiple annotations are checked in SmartDots by the event manager each annotation will automatically get a custom colour. This allows a distinction to be made between the readings of the different readers.

The new SmartDots functionalities were explained in "SmartDots newsletter no 4.—September 2020" and were presented in detail at WGBIOP 2020.

More details of the implemented new SmartDots functionalities can be checked on GitHub: https://github.com/ices-eg/SmartDots/projects/3?card_filter_query=label%3A%221.+Software%22+milestone%3A%22SmartDots+Release+2020+09%22

I. Modal age calculation

When summarizing the output and reporting the results of the exchange events developed within the SmartDots framework, the modal age, sex or maturity stage (the most common age, sex or maturity stage decided by the stagers/readers for every fish sample) are the most relevant statistics, as they are used as the real age, sex or maturity stage of each individual. This is fundamental for the estimation of some other relevant statistics to assess the performance of the participants in the exchange event, e.g., the Percentage Agreement (PA), or input for stock assessments like the Error Matrices (EM). The modal age of a sample is ideally the age which a majority of readers have determined for that sample. However, in some cases, a sample might have been determined to two or more ages (e.g. 3 and 4) by an equal number of readers. As it is defined in the traditional standard method, the lowest age has in these cases been chosen to represent the "final" modal age. Such systematic underestimation of modal age will cause errors in the perceived age of fish individuals, and give unwanted discrepancies in growth curves, as well as bias in the calculation of the PA and AEM.

During the WGBIOP 2019 meeting, it was pointed out that in the 34 exchange events analysed, on average 18.9% of the fish samples presented more than one modal age (i.e. had more than one age with the same highest number of readers). The problem of multimodality is expected to occur also in the maturity exchanges, although the relevance of this problem shall have to be confirmed as more exchanges are conducted.

As a solution, a multistage approach to select the modal age has been tested. This multistage approach is based on different weights given to the age readers/gonad stagers, based on their work experience with the stock, area, and preparation methods used in the exchange event. Two different scales for the weight scores were given to each reader: one weight score decreasing linearly with the experience and another weight score decreasing with a negative exponential shape. The suggested stepwise procedure to obtain the modal age for samples is to primarily use

the obtained traditional modal age (most common age), and for samples with the same number of readers having determined to more than one age, to use the linear weighted mode (weights based on experience scores of readers), and if there are still samples with the same number of readers for more than one age, to apply the negative exponential weighted mode.

In a preliminary analysis using these two weighting scores, it was found that the combination could be used to decide a single modal age for all fish individuals in most of the exchange events, thus, removing the problem of multimodality. Results indicate that this may still have an impact on the calculated PA and EM, although the importance of that influence still needs to be assessed.

The application of the multistage approach requires that each reader/maturity stager is assigned a score that reflects his/her expertise compared with the rest of the participants in the event. The protocol to assign an "experience score" has been developed and agreed within a group of WGBIOP experts in age reading and maturity staging. The information required is 1) the year when the reader/stager started to work with the stock targeted in the exchange, and 2) the mean number of otoliths/gonads analysed per year. Information should also be provided for 3) the general experience with other stocks in maturity staging/age reading. This information must be provided at the level of resolution that is considered of importance to assess the capacity of the reader in relation to the difficulties of the samples selected (stock, area, preparation methods). The more accurate the assessment of the experience in relation to the difficulties of the otoliths in each exchange event, the more precise the multistage approach will be. At this moment the experience score can only be calculated in an excel table, but in the future, this protocol will be incorporated into the SmartDots WebApp, where the exchange coordinators will have to enter the required information and the score and experience ranking will be calculated automatically.

Once the weight is assigned to each reader the modal age/maturity can be calculated using the multistage approach. There will also be a possibility of producing the results and the report using the standard traditional approach (both options are not yet implemented in the SmartDots WebApp). The age reporting has been modified and the multistage approach has been implemented in the code, producing some specific tables showing the multimodal cases.

North Sea Plaice age exchange as a case study

As a case study for applying the protocol to assign weight to different readers based on their experience, and thereby applying the multistage approach for obtaining modal age, the 2020 North Sea and Skagerrak Plaice (*Pleuronectes platessa*) exchange (SmartDots event 281) was used. Included samples were whole plaice otoliths from Skagerrak (27.3.a.20) and whole as well as sectioned (reflected light) from the North Sea (27.4.b + 27.4.c). The whole and sectioned samples from the North Sea were taken from the same fish individuals. For applying the multistage method of modal age calculation, the strata used for the ranking of readers were preparation methods (whole and sectioned). The areas were not considered as strata, as plaice within the three areas (27.3.a.20, 27.4.b + c) is considered to be from one stock.

Scores and rankings within strata based on reader experience were calculated as follows: National age-reading coordinators provided information on 1) the number of years reading the stock and 2) the mean number of otoliths from the stock read per year. These numbers were used to produce a score for readers within each stratum, in this case for each preparation method that the reader had been reading (Table 4.10). A maximum value for this score would be 2, i.e., if only one reader alone would be considered. A second score for readers within each stratum was produced based on information provided on 3) the readers' general experience in number of years of age reading using otoliths. This score was weighted by a factor 0.25, to down weigh the general age reading experience in relation to the experience of the current event stock. For each reader, the scores for the current event stock and the score for general experience were added together to a total score. Then, for each stratum, the scores of the readers were used to rank the readers

within that stratum. This rank was used in the multistage approach to determine modal age, in case of multiple modal ages of samples (different ages given by equal numbers of readers).

Table 4.10. Criteria used for calculating scores to reflect reader expertise, within strata.

Calculation of score for reader expertise		Max value	
No. years reading this stock	Score based on current event stock	2	(1 + 1)
Mean number of otoliths read per year for this stock			
No. years reading otoliths (general)	Score based on other event stocks	0.25	(1 * weight 0.25)
	Total Score (used for Experience rank of readers by stratum)	**2.25**	

In total, 17 readers from 9 countries participated in the exchange. Among the countries, the routine preparation method was either whole or sectioned otoliths (in some cases a combination of both methods). Readers were asked to read samples prepared with the method they were familiar with. Three strata were defined: Skagerrak-Whole, North Sea-Whole, and North-Sea Sectioned. The resulting expertise rankings were compared with the existing classification of readers into "Advanced" (readers that provide input for stock assessment) and "Basic" (who's readings are not used in stock assessment) (Table 4.11). In some cases, the classification of readers did not correspond with the rank, as some advanced readers had a lower rank compared to Basic readers, and vice versa.

Of the 302 samples, 6% had multiple modal ages when annotations from all readers were included, and 10% had multiple modal ages if only advanced readers were included. After applying the multistage approach, a single modal age could be obtained for all samples. For the three strata, comparisons were made of the PA and CV resulting from the traditional method (selecting the lowest age in the case of multiple modal ages), and the multistage modal age approach method applying reader rank weights (Table 4.12).

The percentage agreement (PA) was in general comparatively high for all strata (69–79% using the traditional approach and results from all readers). There was a relatively high agreement comparing PA and CV values from the traditional and the multimodal approach (Table 4.12), and only in 4.9% of the samples, the standard and multistage approaches produced different modal ages. The relatively small differences were expected, as only 6% of the samples had multiple modal ages. It might be expected that for other stocks where the percentage of cases with multimodal age is higher (20–30% as observed in other exchanges), the differences the standard and multistage methods would be higher. This is something that will be checked as more exchange events apply the multistage approach to define modal age.

However, it is important to note that there is no *a priori* expectation for the multistage method to produce a higher or lower CV, PA, APE or any other statistics. The decision to use the multistage approach should be based on the fact that for those samples having multiple modes using the standard method, it is a suitable approach to use the information on reader experience to decide on a single modal age.

An additional conclusion regarding the plaice ageing exchange 2020 is that it would be desirable to be able to compare results from different preparation methods, taking into account that samples prepared by two methods have been taken from the same fish individual. This shall hopefully be possible to explore in connection to a coming workshop.

Table 4.11. Resulting ranks of reader expertise compared to initial classification of readers (Advanced or Basic) for different strata, applying the multistage approach for determining modal age in the plaice age reading exchange 2020 (SmartDots event 281).

Strata	n readers	Expertise rank	Expertise	Strata	n readers	Expertise rank	Expertise
Skagerrak - Whole	14, 7 advanced	1	Advanced	North Sea - Whole	14, 7 advanced	1	Advanced
		2	Advanced			2	Advanced
		3	Advanced			3	Advanced
		4	Advanced			4	Advanced
		5	Advanced			5	Advanced
		6	Basic			6	Advanced
		7	Basic			6	Basic
		8	Advanced			7	Basic
		8	Basic			8	Basic
		9	Advanced			9	Advanced
		10	Basic			10	Basic
		10	Basic			10	Basic
		10	Basic			10	Basic
		11	Basic			11	Basic
				North Sea - Sectioned	7, 5 advanced	1	Advanced
						2	Advanced
						3	Advanced
						4	Basic
						5	Advanced
						5	Advanced
						5	Basic

Table 4.12. Resulting percentage agreement (PA) and coefficient of variation (CV) in determining modal age, by using the traditional approach and the multistage modal age approach, in different strata of areas and preparation methods, within the plaice age reading exchange 2020 (SmartDots event 281).

Strata	N samples	N readers	Modal age range	Comparison	PA	CV
Skagerrak - Whole	90	14 (7 advanced)	0–14	All readers (traditional approach)	69%	56%
				All readers Multistage modal age approach	67%	43%

Strata	N samples	N readers	Modal age range	Comparison	PA	CV
North Sea - Whole	106	14 (7 advanced)	0–11	All readers (traditional approach)	79%	47%
				All readers Multistage modal age approach	80%	51%
North Sea – Sectioned	106	7 (5 advanced)	0–16	All readers (traditional approach)	79%	39%
				All readers Multistage modal age approach	78%	40%

II. Shiny Dashboard

Currently, there are different databases and platforms, e.g. RDB/RDBES, DATRAS, TAF and SmartDots, which contain information of benefit to WGBIOP and the end-users. Example: information on species, area, sampling platform, sampling country, numbers of ages sampled, numbers of maturity stages sampled by month/quarter, is available in the RDBES and could be compiled in an overview, eventually linked to information available in SmartDots. In the longer term, dashboards could be developed, linking the information from different sources, generating specific overviews 'on-demand' which could be used for quality assurance purposes both at national and regional levels. During 2020, WGBIOP has started to identify and formulate the needs for specific overviews, in cooperation with WGSMART and the RCG's based on the cooperation between WGBIOP, WGSMART and the RCG subgroup on fisheries overviews in 2019. The intention was to have a WGBIOP intersessional subgroup working on the RDB output to outline suggestions as to how WGBIOP could utilise the RDB output in their work, unfortunately, given the COVID-19 pandemic this work was not initiated.

The conclusion from 2020 is that this could be taken up in the new three-year term of WGBIOP (2021–2023) under a new ToR which will focus on cross-database issues.

4.6.2 Progress during WGBIOP 2018–2020 (ToR f)

The history and background of SmartDots can be found in the WGBIOP 2018 report Annex 8.a.

SmartDotsWebAPI

The WebAPI is the communication channel between the software and the database. A Web API is an application programming interface for the webserver to communicate with the SmartDots software. It is a web development concept, usually limited to a web application's client-side. The architecture chosen for the WebAPI was Representational State Transfer (REST). This is an architectural style that defines a set of constraints to be used for creating web services. The SmartDotsWebAPI is developed in C# and it allows the communication and the operations between the software and the SmartDots Database. The SmartDotsWebAPI is an open-source WebAPI and it is available in GitHub[3].

Software

SmartDots Software was released and uploaded to GitHub[4].

[3] https://github.com/ices-eg/SmartDots/tree/master/WebAPI

[4] https://github.com/ices-eg/SmartDots/tree/master/SmartDots

A SmartDots portable version was developed. This is for users that do not have administrator access and cannot install applications on their computer. A portable application (portable app), sometimes also called standalone, is a program designed to read and write its configuration settings into an accessible folder in the computer.

SmartDots Web Application

The SmartDots web application was developed by ICES to facilitate the setup of Exchanges, Workshops and Training of events. The main aims of the SmartDots web application is to allow the community to store and update age readers expertise, organize events and of course store and allow images to be read into SmartDots (software).

In reality, the WebApplication is connected to a database developed in Microsoft SQL server accessed via a web interface. This interface allows operations such as managing the age reader expertise, create and manage events and upload samples and images.

Currently, SmartDots supports four types of calibration events, Age reading, Maturity determination, Eggs and Larvae identification (in development), the three last ones run exclusively in the web application, they don't have for now any software module.

1. The web interface currently has three areas:
2. The front page that is public and with links to the list of Workshops and Exchanges
    - The management area where SmartDots users can log in to perform operations like:
    - Add new users to the platform (needs to have the role of country manager)
    - Setup user expertise (needs to have the role of country manager)
    - Propose a new event (needs to have the role of country manager)
    - Manage, view or annotate (for maturity determination, larvae identification or eggs identification) the current events
    - List of events
    - Verify if a sample if according to the format
    - Create a new token (to use in the SmartDots software)
3. The administrative area (only for administrators and WGSMART chairs)
    - Edit SmartDots readers and coordinators (for any country)
    - Create a new event
    - View and endorse events

Two manuals are available that describe the operations in the Web Application and they can be found in the ICES Library:

- SmartDots Maturity Manual
- ICES SmartDots Web Application Manual

SmartDots reporting module

The SmartDots reporting module originated in 2017 when DTU Aqua analysed the different datasets from previous exchanges and created a first version of a workshop/exchange output report. This report template was developed based on an R-script which replicated the analysis from the GuusEltinkAGE COMPARISONS.XLS workbook. All tables in the template were replicates of those in the workbook output and the report layout was developed with input from WGBIOP. The report is based on two analyses, the first where all readers are included and the second where only readers who provide age data for stock assessment purposes are included. In addition to the traditional analysis, a calculation of average percentage error (APE) and age error matrices (AEM's) were added. The latter is based only on those readers providing age data for stock assessment purposes, with the intention being that such a matrix can be used in a sensitivity analysis when testing the effects of age errors on the stock assessment models. As SmartDots

provides a measure of distance between the annotations made by the readers' plots were added to the analysis which shows average measures of growth increment width and allowed for a comparison of growth curves for each fish and each reader. A summary report template was also developed with the aim to provide an overview of the results relevant to the stock assessors.

Since 2018 the SmartDots report template has been integrated into the SmartDots database and hosted on the ICES-TAF Github site: https://github.com/ices-taf/SmartDotsReport_template. At WGBIOP 2019, during the WGBIOP 2019 meeting, a presentation on "Mode Selection" was given where it was shown that on average, the 20% of the samples of the exchange events accomplished up to that moment had multiple modal ages. A multistage approach was proposed as a solution to deal with that problem. In 2020, among several other modifications, the code has been updated to incorporate that multistage approach to estimate a single modal age by fish individual (see the section below), with the possibility of analysing the data and presenting the results by strata (e.g. by preparation method, ices area, stock…). In parallel, and following a similar structure, the code to produce summary and full reports for the maturity events have also been developed. This code will be also integrated into the new SmartDots software for maturity exchanges.

WGSMART

During 2018, the need to establish a steering group or governance group was emphasised and proposed by the project group and by ICES. The decision was taken to set up a SmartDots Governance Group, ToRs were described and the Working Group on SmartDots Governance (WGSMART) was approved in the week prior to the WGBIOP 2018 meeting (ICES 2018b Annex 8.b). WGSMART met for the first time, to develop and agree on the SmartDots work plan for the coming years, at ICES Headquarters in December 2018. Since then WGSMART has administrated feedback from users of SmartDots and worked to improve the software.

On the ICES website, the link https://ices.dk/data/tools/Pages/smartdots.aspx is where an event can be created, events can be managed, and user handbooks can be found.

Additionally, in 2019 the SmartDots platform was developed further to be used for maturity calibration events and in 2020 for egg and larvae events.

During WGBIOP 2018, it was decided to use the SmartDots GitHub site (https://github.com/ices-eg/SmartDots) as the only repository for describing the issues to be developed further. WGSMART developed a user-friendly platform for feedback in 2019 (https://smartdots.ices.dk/Userfeedback) from which they interpret and prioritise feedback to be placed in the SmartDots GitHub site https://github.com/ices-eg/SmartDots/issues. The issues listed in GitHub were initially compiled during the WGBIOP 2018 meeting and combined with the wish list for improvements to WebGR plus those issues in the feedback-documents filled in by the age coordinators and readers who participated in events during 2018. Comments were checked with the issues already in the SmartDotsGitHub, and a final list of issues was created. In 2019 the same process was followed. The issues are given labels (Software, WebAPI, Web Application, Reporting, Manuals or Governance as well as Age, Maturity, Larvae or Egg) and are given a priority number 1, 2, 3 or 4. Issues given priority 1 will be assigned to members who will be responsible for the issue, and a date for completion of the task. The full list of the issues raised in 2018 and 2019 can be found in ICES 2018b Annex 8.c and ICES 2019 Annex 5.a. In 2018 a prioritisation of issues was done during WGBIOP, since then this has been done by WGSMART in GitHub. There is now a feedback page on the ICES SmartDots web application at https://smartdots.ices.dk/Userfeedback where users can contact WGSMART directly with feedback and request help with issues. WGBIOP will continue to compile and deliver feedback from the workshops and exchanges to WGSMART.

SmartDots is open source software, available at https://github.com/ices-eg/SmartDots. The SmartDots software connects via a Web API to a database. ICES has developed a Web API and

database for international workshops and exchanges. Institutions could also use SmartDots for internal age reading, in that case, a custom Web API and a database is needed. It was suggested to develop a generic Web API and one single database hosted in the cloud for managing the national data of all interested countries. A survey was sent out to all the national coordinators asking for their internal use of SmartDots and images for assessment purposes. From the reply, it was clear that most institutes would prefer an internal database (not in the cloud) and this is an obstacle to the development of a generic platform. Further, many institutes are not interested in using the software (or images) for routine otolith analyses. Therefore, it was decided that SmartDots@home will not be developed further.

Multistage approach

When summarizing the output and reporting the results of the exchange events developed within the SmartDots framework, the modal age (the most common age decided by the age readers for every fish sample) is the most relevant measurement. It is a key statistic by itself that indicates the most likely age of each sampled fish. But it is also fundamental for the estimation of some other relevant statistics to assess the performance of the techniques assessed in the exchange event, like the Percentage Agreement (PA), or input for stock assessments like the Age Error Matrix (AEM). During the WGBIOP meeting in 2019, it was raised that on average, in the 34 exchange events analysed, the 18.9% of the fish samples presented more than one modal age (i.e. different ages got the same highest number of readers). As it is defined at this moment, the mode is taken as the lowest age of the multiple modal ages. Accordingly, this implies a wrong perception of the age by fish individual and the introduction of bias in the calculation of the PA and AEM. A multistage approach to select the modal age was presented as a possible solution to solve partially this problem. This multistage approach was based on the different weight given to the age readers based on their experience. Two different weight scores scales were assigned, a weight score decreasing linearly and another decreasing with a negative exponential shape. It was found that the combination of the modes decided using these two weighting scores in together with the mode obtained with the current method, allows assigning a single modal age to each fish individual. It was indicated that this might still have an impact on the calculated PA and AEM, although the importance of that influence still needs to be assessed. The application of this multistage approach will require the development of a protocol to assign different "experience score" to the different readers participating in an event. An excel sheet will be used in near future exchanges to test the approach. When accepted it should be incorporated into SmartDots.

4.6.3 New terms of reference for 2020–2023 (ToR f)

Provide feedback and guidance on updating and development of tools for exchanges and workshops on biological parameters.

Background information for the ToR: Based on feedback from users of these tools and end-users of results of workshops and exchanges, improvements and alterations will be suggested and evaluated.

4.6.4 Work plan for 2020–2021 (ToR f)

- Evaluate and provide feedback from WGBIOP exchanges and workshops to governance groups (e.g. WGSMART).
- Continued communication of software and web application updates to WGBIOP.
- Promote SmartDots manuals and training materials to WGBIOP and delivery of feedback WGSMART.

- Review of the SmartDots reporting module and cooperation with WGSMART on the implementation of the required improvements to the R-script.

4.6.5 Deliverables for 2021–2023 (ToR f)

- Annual compilation of comments and feedback from WGBIOP exchanges and workshops. Listed requirements for the coming year will be evaluated based on end-user needs and provided to governance groups (e.g. WGSMART).
- An annual presentation of the new SmartDots release.
- Delivery of feedback on the SmartDots maturity, egg and larvae modules to WGSMART
- Delivery of feedback on the multimodal age approach to WGSMART.
- Evaluation of the tutorial videos on the SmartDots YouTube channel https://www.youtube.com/channel/UCa4bjXo-eBDfW0cm1oElWeQ/videos?disable_polymer=1. Based on this evaluation future training requirements to be proposed.

4.7 Other achievements

- Continuous intersessional work with the Working Group on SmartDots Governance (WGSMART) on the further development of the platform as a quality assurance tool for age reading and maturity staging in the ICES and GFCM areas.
- Intersessional work with the Regional Coordination Groups (RCGs) subgroups on end-user needs and Fisheries Overviews.
- Developed a work plan for the CRR handbook on maturity staging.
- Looked into possible further use of otoliths in biological parameters besides ageing.
- On the request of WGWIDE Age Error Matrices were provided for three species. WGBIOP members participating in WGWIDE worked together with the stock assessors to assess if and how age error data can be incorporated into assessment models.

5 References

Eltink, A.T.G.W. 2000. Age reading comparisons. (MS Excel workbook version 1.0 October 2000) Internet: http://www.efan.no

Follesa M.C., Carbonara P. (Eds) 2019. Atlas of the maturity stages of Mediterranean fishery resources. Studies and Reviews n. 99. Rome FAO. 268 pp. http://www.fao.org/3/ca2740en/ca2740en.pdf

ICES. 2020a. Workshop on Better Coordinated Stomach Sampling (WKBECOSS). ICES Scientific Reports. 2:26. 73 pp. http://doi.org/10.17895/ices.pub.5991

ICES. 2020b. ICES Workshop on age validation studies of small pelagic species (WKVALPEL). ICES Scientific Reports. 2:15. 76 pp. http://doi.org/10.17895/ices.pub.5966

ICES. 2019. Working Group on Biological Parameters (WGBIOP). ICES Scientific Reports. 1:85. 93 pp. http://doi.org/10.17895/ices.pub.5682

ICES. 2018a. Working Group on Biological Parameters (WGBIOP), 1–5 October 2018. Ghent, Belgium. ICES CM 2018/EOSG:07. 186pp.

ICES. 2018b. Report of the Workshop on Mackerel biological parameter Quality Indicators (WKMACQI), 15–17 May 2018, IJmuiden, The Netherlands. ICES CM 2018/EOSG 34. 42 pp.

Kader, G. D., and M. Perry. 2007. Variability for Categorical Variables. Journal of Statistics Education **15**

Vitale, F., Worsøe Clausen, L., and Ní Chonchúir, G. (Eds.) 2019. Handbook of fish age estimation protocols and validation methods. ICES Cooperative Research Report. No. 346. 180 pp. http://doi.org/10.17895/ices.pub.5221

https://vlab.ncep.noaa.gov/documents/259399/3406930/SS3.30.10_User_Manual.pdf

WKSTCON, 2019. Workshop on sampling, processing and analysing the stomach contents (WKSTCON). Palma de Mallorca, Spain 24–27 April 2018. 46 pp.

Annex 1: List of participants

Name	Institute	Country	Email
Alfonso Pérez Rodríguez	Institute of Marine Research	Norway	alfonso.perez.rodriguez@hi.no
Ângela Canha	DRP/RAA-Regional Directorate for Fisheries in Azores	Portugal	angela.ml.canha@azores.gov.pt
Annelie Hilvarsson	Swedish University of Agricultural Sciences, Institute of Marine Research	Sweden	annelie.hilvarsson@slu.se
Argyris Sapounidis	Fisheries Research Institute Hellenic Agricultural Organization	Greece	asapoun@inale.gr
Carine Sauger	Ifremer Head Office	France	Carine.Sauger@ifremer.fr
Carmen Gloria Piñeiro	Instituto Español de Oceanografia IEO Centro Oceanográfico de Vigo	Spain	carmen.pineiro@ieo.es
Christoph Stransky	Thünen Institute of Sea Fisheries	Germany	christoph.stransky@thuenen.de
Cindy van Damme (chair)	Wageningen Marine Research (IMARES)	Netherlands	cindy.vandamme@wur.nl
Cristina Nunes	IPMA - Portuguese Institute for Ocean and Atmosphere	Portugal	cnunes@ipma.pt
David Maxwell	Centre for Environment Fisheries and Aquaculture Science (Cefas)	UK	david.maxwell@cefas.co.uk
Els Torreele	Institute for Agricultural and Fisheries Research (ILVO)	Belgium	els.torreele@ilvo.vlaanderen.be
Francesca Vitale	Swedish University of Agricultural Sciences, Institute of Marine Research	Sweden	francesca.vitale@slu.se
Helen McCormick	Marine Institute	Ireland	helen.mccormick@marine.ie
Inês Farias	IPMA - Portuguese Institute for Ocean and Atmosphere	Portugal	ifarias@ipma.pt
Jane Aanestad Godiksen	Institute of Marine Research	Norway	Jane.godiksen@hi.no
Jari Raitaniemi	Natural Resources Institute Finland	Finland	jari.raitaniemi@luke.fi
Jens Ulleweit	Thünen Institute of Sea Fisheries	Germany	jens.ulleweit@thuenen.de
Joanne Smith	Centre for Environment Fisheries and Aquaculture Science (Cefas)	UK	joanne.smith@cefas.co.uk
Jonna Tomkiewicz	DTU Aqua - National Institute of Aquatic Resources	Denmark	jt@aqua.dtu.dk
Jorge Landa	Instituto Español de Oceanografia IEO Centro Oceanográfico de Santander	Spain	jorge.landa@ieo.es
Julie Coad Davies (chair)	DTU Aqua - National Institute of Aquatic Resources	Denmark	joco@aqua.dtu.dk

Name	Institute	Country	Email
Karen Bekaert	Institute for Agricultural and Fisheries Research (ILVO)	Belgium	karen.bekaert@ilvo.vlaanderen.be
Karin Hüssy	DTU Aqua - National Institute of Aquatic Resources	Denmark	kh@aqua.dtu.dk
Kélig Mahé	Ifremer Boulogne-sur-Mer Centre	France	kelig.mahe@ifremer.fr
Konstantina Ofridopoulou	Fisheries Research Institute Hellenic Agricultural Organization	Greece	ofridopoulouk@inale.gr
Mandy Gault	Marine Laboratory Scotland	UK	m.gault@marlab.ac.ukl
Maria Cristina Follesa	University of Cagliari	Italy	follesac@unica.it
Maria Korta	AZTI - Tecnalia	Spain	mkorta@azti.es
Maria Krüger-Johnsen	DTU Aqua - National Institute of Aquatic Resources	Denmark	mkru@aqua.dtu.dk
Pedro Torres	Instituto Español de Oceanografía Centro Oceanografico de Málaga	Spain	pedro.torres@ieo.es
Pierluigi Carbonara (chair)	COISPA Tecnologia & Ricerca, Stazione Sperimentale per lo Studio delle Risorse del Mare	Italy	carbonara@coispa.it
Ruadhán Gillespie-Mules	Marine Laboratory Scotland	UK	ruadhan.gillespie-mules@gov.scot
Stephanie Haase	Thünen Institute of Baltic Sea Fisheries	Germany	stefanie.haase@thuenen.de
Tiit Raid	Estonian Marine Institute University of Tartu	Estonia	tiit.raid@gmail.com
Ulrika Beier	Wageningen Marine Research (IMARES)	Netherlands	ulrika.beier@wur.nl
Uwe Krumme	Thünen Institute of Baltic Sea Fisheries	Germany	uwe.krumme@thuenen.de
Valerio Visconti	Centre for Environment Fisheries and Aquaculture Science (Cefas)	UK	valerio.visconti@cefas.co.uk
Wim Allegaert	Institute for Agricultural and Fisheries Research (ILVO)	Belgium	wim.allegaert@ilvo.vlaanderen.be
Zuzanna Mirny	National Marine Fisheries Research Institute	Poland	zuzanna.mirny@mir.gdynia.pl

Annex 2: Resolutions

The Working Group on Biological Parameters (WGBIOP), chaired by Pierluigi Carbonara, Italy, Cindy van Damme, The Netherlands, and Julie Coad Davies, Denmark will work on ToRs and generate deliverables as listed below.

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2018	1–5 October	Ghent, Belgium	Interim report by 9 November 2018 to EOSG, SCICOM and ACOM	
Year 2019	7–10 October	Lisbon, Portugal	Interim report by 8 November to EOSG, SCICOM and ACOM	Chaired by Pierluigi Carbonara, Italy, and Julie Coad Davies, Denmark
Year 2020	~~6–10 October~~	~~Gothenburg, Sweden~~	Final report by end 2020 to EOSG, SCICOM and ACOM	Was changed into online meetings divided over the year with intersessional work sessions and meeting by subgroups to complete the work for WGBIOP 2020

ToR descriptors

ToR	Description	Background	Science plan codes	Duration	Expected deliverables
a	Plan studies, workshops, and exchange schemes on interpretation of fisheries data on stock-related biological variables, and review the output of this work outcomes.	Review incoming suggestions for inter-sessional work from EGs, WKs and other ICES related groups, e.g. planned benchmarks.	3.1, 3.2	Generic ToR	Yearly provision of a prioritized overview of planned studies, workshops and exchanges will be delivered to PGDATA for review.
b	Improve training and quality assurance of age reading and maturity staging. Identify the need for validation studies and assign priorities.	Routines for monitoring the quality of age and maturity are currently based on national protocols and these need to be standardized. Validation is essential to ensure the accuracy of biological data used as input for assessment	3.1, 3.2	Generic ToR	Review the current national procedures for quality assurance. Devise best practice guidelines on a regional level. Continuous monitoring of the implemented standardized guidelines.

ToR	Description	Background	Science plan codes	Duration	Expected deliverables
c	Evaluate the quality of biological parameters: Issues and guidelines.	Guidelines were established in 2017 for a qualitative evaluation of biological parameters. This ToR will further develop these guidelines, for (quantitative) quality indicators of biological parameters.	3.1, 3.2, 5.1	3 years Generic	Generic guidelines for a quantitative evaluation of the quality of biological parameters. Evaluation of issues put forward by the assessment WGs for benchmark species in 2018–2020. Carrying out case studies on one or two species through a specific workshop in close cooperation with stock assessors.
d	Investigate and develop data availability, documentation and methods to improve identified biological parameter estimates, as input to assessment models.	WGBIOP 2015–2017 identified a series of life-history parameters required by end-users by means of literature review, input from experts and in consultation with Expert Groups on Integrated Ecosystem Assessment and Multispecies modelling.	3.1, 5.2, 6.6	3 years	Document current sources of life-history parameter estimates identified by ICES/GFCM Expert Groups, as critical components and relevant to improvement of modern assessment for ICES/GFCM stocks. Facilitate a closer link between data providers and data end-users.
e	Address requests for technical and statistical recommendations/advice related to biological parameters and indicators.	Filled templates for requests send to WGBIOP before a specified deadline will be the basis for this ToR.	3.1, 3.2, 3.3	Generic ToR	Each received request for technical and statistical recommendations related to biological parameters and indicators will be addressed and included in the WGBIOP work plan where appropriate.
f	Update and further develop tools for the exchanges and workshops (e.g. SmartDots and statistical tools).	Based on feedback from users of these tools, improvement/alterations will be evaluated.	3.1, 4.1	Generic ToR	Potential improvement/alteration of the tools on a yearly basis.

Summary of the Work Plan

Year 1	Continue the collation of ToR d) information related to biological parameters; c) benchmark issue lists and guidelines; ToR a, b, e and f are generic tors and will be dealt with on a yearly basis in WGBIOP. Begin the process of realigning the scheduling of WGBIOP exchanges/WKs with the benchmark cycle.
Year 2	Continue the collation of ToR d) information related to biological parameters; c) benchmark issue lists and guidelines; ToR a, b, e and f are generic tors and will be dealt with on a yearly basis in WGBIOP. Devise and implement best practice guidelines for quality assurance on a regional level under ToR b.
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.

Supporting information

Priority	A main objective of WGBIOP will be to support the development and quality assurance of regional and national provision of biological parameters as reliable input data to integrated ecosystem stock assessment and advice, while making the most efficient use of expert resources. As biological parameters are among the main input data for most stock assessment and mixed fishery modelling, these activities are considered to have a very high priority.
Resource requirements	None.
Participants	All National Age Reader/Maturity Stager Coordinators (ICES and GFCM) will be invited. Experts relevant to the current Benchmark of the year of WGBIOP will be invited as well as relevant external experts such as statisticians or specific EG members.
Secretariat facilities	None.
Financial	None.
Linkages to ACOM and groups under ACOM	WGBIOP supports ACOM and SCICOM by promoting improvements in quality of biological parameters from fishery and survey data underpinning the integrated ecosystem assessment approach.
Linkages to other committees or groups	WGBIOP links with the SCICOM/ACOM Steering Group: Ecosystem Observation Steering Group (EOSG). It links to stock assessment EGs and benchmark assessment groups by providing input on the data quality. WGBIOP also links with, the Regional Database Steering Group.
Linkages to other organizations	Regional Coordination Groups and PGMed.

Annex 3: ToR a. additional information

a) 2019 & 2020 Workshops and Exchanges

Workshops Completed in 2019–2020

The following is a summary of the biological variable workshop carried out in 2019 Q4:

Workshop on age validation studies of small pelagic species (WKVALPEL)

WKVALPEL met 22–24 October 2019 in Boulogne sur mer, France and was chaired by Kélig Mahe, France, Pierluigi Carbonara, Italy, and Javier Rey, Spain. Report can be found at WKVALPEL 2019.

The workshop focused on validating ageing criteria for small pelagic species. The aim of the workshop was to collate information on existing ageing protocols and to use these to support development of a validated protocol to better standardize age estimates.

The latest available information on ageing data (precision and/or validation studies) was presented for a number of different species of small pelagics. Methods highlighted included marginal increment analysis (MIA), marginal analysis (MA), length frequency distribution analysis (LFDA) and back-calculation (BC). A synthesis table of the last annual growth workshops and exchanges by species is also presented. The goal, for each species (*Engraulis encrasicolus, Sardina pilchardus, Clupea harengus, Sprattus sprattus, Scomber scombrus, Scomber colias, Trachurus trachurus, Trachurus mediterraneus, Trachurus picturatus, Micromesistius potassou*), was to add information on the exchange or workshop and to present the major difficulties that caused low Percentage of Agreement between the age readers as well as to recommend some guidelines to overcome those difficulties.

Given that several methods exist for validation of age readings of calcified structures, a summary table of age validation methods used for all small and medium pelagic species in European waters was developed with a focus on the feasibility for the small pelagic species and validation strength of the following methods: BC, LFDA, Weight frequency distribution (WFD), Progression of strong year-classes, MIA, MA, daily growth increments (DGI), Daily increments widths, Tag-recapture analysis and Captive rearing.

Exchanges Completed in 2019–2020

The following are summaries of the age reading exchanges carried out in 2019 and 2020.

North Sea Sandeel (*Ammodytes sp.*) Otolith Exchange

Event 219 in SmartDots. Area North Sea (120 otoliths). Overall agreement was 77% for all readers, rising to 81% for expert readers only. Overall CV of 26% for all readers and 24% for expert readers.

Some reoccurring issues have been addressed, the most problematic being the interpretation of the edge in Q4. The disagreement between Denmark and Norway as to whether or not there is a false winter ring laid down before the first true winter ring should be addressed, this may be area-specific and otolith microstructure examination of the problematic otoliths which are not mounted in eukit will hopefully clarify this. The rereading of the subset from the 2016 exercise showed a very high level of agreement (PA 92.5%) when only those readers who took part in both exercises were included. This shows how important it is to have all readers participate in the calibration exercises.

Results by stocks showed the highest PA for san.sa.1r and the Age Error Matrix shows the proportions of age readings in agreement with modal age to also be high. For san.sa.3r there is much more variability around the modal age and for san.sa.5r the variability is also higher. The otolith readability scores show most AQ2's and AQ3_QA's are given for samples belonging to these stocks in comparison to those from san.sa.1r. This may be due to the image quality but it should be taken into consideration that the age range of the samples in san.sa.3r and san.sa.5r is much wider.

Coordinator: Julie Coad Davies (Denmark).

This event has been published, and the report can be downloaded at the following link: https://smartdots.ices.dk/sampleImages/2019/219/2019%20North%20Sea%20Sandeel%20Age%20Reading%20Exchange%20Report.pdf

Western Baltic Cod (*Gadus morhua*) Otolith Exchange

Event 251 in SmartDots. Area Western Baltic SD22 (360 otoliths). Overall agreement was 84% for all readers, decreasing to 81% for expert readers only. Overall CV of 15% for all readers and 17% for expert readers.

Modal age 0, 6 and 7 showed particularly low percent agreement (PA) but also other modal ages did not show PA above 89%. An average PA of 81% and a CV of 17% for advanced readers is not satisfactory for a stock for which otolith age reading is validated and considered relatively clear and easy. However, it has to be kept in mind that Sweden and Denmark do not read sliced otoliths on a routine basis, which were used for this and the previous exchange and readers might therefore have been less trained in reading sliced otoliths. Moreover, Swedish age readers usually do not read cod otoliths from SD22 because Sweden is not fishing in SD22 and also is not involved in surveys in SD22. Discrepancies in age determination can be categorized into three error sources; misinterpretation of the first translucent summer ring, misinterpretation of the edge zone/ not accounting for recapture month and counting of double rings.

An age reading guide was compiled and can be found at the end of the report.

Coordinators: Stefanie Haase and Uwe Krumme (Germany).

This event has been published, and the report can be downloaded at the following link: https://smartdots.ices.dk/sampleImages/2019/251/SmartDots_Report_Event_251_incl%20age%20reading%20guide.pdf

Herring (*Clupea harengus membras*) Otolith Exchange

Event 250 in SmartDots. Area Baltic SD30 (100 otoliths). Overall agreement was 87.6% for all readers, rising to 93.8% for expert readers only. Overall CV of 23.4% for all readers and 2.4% for expert readers.

This was the first time the readers used SmartDots. Therefore non-assessment readers were not aware that they should use the scale bar provided with the images. Readers were used to estimate age both from the size of the otoliths as well as the growth zones. By not using the scale bar in the images, the size of the small otoliths were overestimated. This was especially true for Age 0. When no annual growth zones were visible in the images, the readers then interpreted thin ring structures as annual growth zones.

Coordinators: Yvette Heimbrand and Martina Blass (Sweden).

The report is in preparation and will be uploaded to SmartDots when finished.

Plaice (*Pleuronectes platessa*) Otolith Exchange

Event 281 in SmartDots. Event 281 in SmartDots. Area Skagerrak (90 otoliths, whole) and North Sea (106 otoliths, whole and sectioned). This event was the first event using "multistage modal age approach" and comparing it with the traditional approach. It should be noted that the calculation of the CV's in the R-script has changed to include modal age 0, the leads to very high values. This will be reverted to the original calculation.

Overall agreement for Skagerrak (all readers, whole otoliths) was 69% for the traditional approach and 67% for the multistage modal age approach. Overall CV of 56% for the traditional approach and 43% for the multistage modal age approach.

Overall agreement for North Sea (all readers, whole otoliths) was 79% for the traditional approach and 80% for the multistage modal age approach. Overall CV of 47% for the traditional approach and 51% for the multistage modal age approach.

Overall agreement for North Sea (all readers, sectioned otoliths) was 79% for the traditional approach and 78% for the multistage modal age approach. Overall CV of 39% for the traditional approach and 40% for the multistage modal age approach.

Analysis are not finished and more will come.

Some conclusions so far are; relatively high agreement (in general), small differences using multistage modal approach compared to all readers (current, normal approach), not possible to compare methods (using information of two methods (from same fish sample).

Coordinators: Ulrika Beier (Netherlands) and Julie Coad Davies (Denmark).

Dab (*Limanda limanda*) Otolith Exchange

Events 244 and 245 in SmartDots and dab.27.3a4. areas: 3a and 4a–c (244), 4b–c and 5a (245) and 3a and 4a–c (dab.27.3a4).

The three events main goals were to compare preparation methods (whole, sectioned and stained sectioned) and to do edge analysis.

Event 244 compared all three methods. Whole otoliths had an overall agreement of 67% and an overall CV of 15%. Sectioned otoliths had an overall agreement of 59% and an overall CV of 20%. Sectioned and stained otoliths had an overall agreement of 65% and an overall CV of 17%. Event 245 compared two methods. Whole otoliths had an overall agreement of 61% and an overall CV of 17%. Sectioned and stained otoliths had an overall agreement of 66% and an overall CV of 14%. Event dab.27.3a4 compared two methods. Whole otoliths had an overall agreement of 69% and an overall CV of 14%. Sectioned and stained otoliths had an overall agreement of 73% and an overall CV of 13%.

Conclusions made were that uncertainty is relatively high for dab and the highest uncertainty is seen in Q3.Best statistics when using stained sections but bias stained section vs. whole. Edge analysis for 4b–c showed that an opaque zone starts in May–June but the edge analysis for 5a gave strange results.

Recommendations: Validation study to determine if whole or stained section is closer to true age. Edge analysis requires larger sample size and discussion/agreement between readers.

Coordinator: Loes Bolle (Netherlands).

The report is in preparation and will be uploaded to SmartDots when finished.

Seabass (*Dicentrarchus labrax*) Otolith and Scale Exchange

Event 271 in SmartDots. Area7a 7d 7e 7f 7g (100 stained otoliths and matching scales).

This event followed two previous exchanges (2011, 2013) and a workshop (2015), intending to address the recommendation to compare stained otoliths and matching scales. Overall, all readers achieved 80% agreement for otoliths (9% CV) and 68% for scales (11% CV). However, advanced readers scored 71% and 73% agreement for otoliths and scales, respectively. In particular, specific biases were found in modal ages 2, 3, and over 12 years. All the participants read both calcified structures. This provides a good base to assess biases and recommend the best method in the following WKARDL2 to take place in June 2021.

Coordinators: Valerio Visconti and Mary Brown (UK),

The report is in preparation and will be uploaded to SmartDots when finished.

Lemon sole (*Microstomus kitt*) Otolith Exchange

Event 115 in SmartDots. The main objectives of this exchange were to evaluate the accuracy and precision in age reading of lemon sole IV & VIId, identifying any reading issue, and estimate accuracy across different preparation techniques. Three methods were used: sectioned and stained/broken and burnt and whole otolith. Overall agreement was low with sectioned and stained otolith resulting in the highest agreement (72%), and 53% and 49% for the whole otolith and broken and burnt otolith, respectively. The coordinator recommended a workshop to take place in the future.

Coordinator: Joanne Smith (UK).

The report is in preparation and will be uploaded to SmartDots when finished.

Whiting (*Merlangius merlangus*) Otolith Exchange - small scale study

Event 242 in SmartDots. This exchange took place following WKARWHG2 recommendation to look at accuracy in different reading methods (i.e. sectioned, broken and burnt, and whole otolith). Only expert readers participated in this exchange. Results show good overall agreement (82%) with no obvious difference in reading methods. The coordinator recommends otolith chemistry study to resolve the historical issue of age discrepancy due to common features found in whiting otolith that can lead to confusion in age results.

Coordinator: Joanne Smith (UK).

The report is in preparation and will be uploaded to SmartDots when finished.

Ongoing Work in 2020

Workshops and exchanges scheduled to take place in Q4 2020.

- Otolith Exchange of Haddock (*Melanogrammus aeglefinus*) from Rockall, North Sea and Skagerrak (areas 4.a and 6.a and SD20) has been expanded to also include subareas 1 and 2, to align with the benchmark review in 2020 for this stock. Coordinator: Mandy Gault (Scotland). This event (ID 235) is closed and analysis pending.
- Otolith exchange of Megrim (*Lepidorhombus whiffiagonis*) areas 8.c and 9.a. Coordinator: Jorge Landa (Spain). The event (ID 277) was closed October 29 and analysis pending.
- Otolith age reading exchange on Blue whiting (*Micromesistius poutassou*). Coordinators: Patrícia Gonçalves (Portugal) and Jane Godiksen (Norway). The event (ID 278) is ongoing with an end date in November 2020.

Workshops planned for 2021

Due to the COVID-19 pandemic the two workshops planned for 2020 have been postponed to 2021.

- The Workshop on the identification of clupeid larvae (WKIDCLUP2), chaired by Matthias Kloppmann, Germany, will meet in Bremerhaven, 30 August – 3 September 2021. A short online meeting was held in 2020, but the physical (if possible) meeting is postponed to 2021.
- The Workshop on Operational Implementation of Stomach Sampling (WKOISS), chaired by Pierre Cresson, France, and Maria Cristina Follesa, Italy, will meet in Cagliari, Italy. Originally planned for April 2020, postponed to 2021.
- The Workshop on Age reading of Sea bass (*Dicentrarchus labrax*) (WKARDL2), chaired by Mary Brown (UK) and Valerio Visconti (UK) will meet in CEFAS UK in 2021.
- The Workshop on Age reading of European anchovy (*Engraulis encrasicolus*) WKARA3, chaired by Gualtiero Basilone, Italy, and Andrés Uriarte, Spain, will meet in Mazara del Vallo (Sicily, Italy) in October 2021.
- The Workshop on Age reading of blue whiting (*Micromesistius poutassou*) (WKARBLUE3), chaired by Jane A. Godiksen, Norway and Patrícia Gonçalves, Portugal, will meet in Torshavn, Faroe Island, 31 May–4 June 2021.
- The Workshop on Mackerel, Horse Mackerel and Hake Eggs Identification and Staging (WKMACHIS) chaired by Matthias Kloppmann, Germany, will meet in Bremerhaven, Germany, 11–15 October 2021.
- The Workshop on Adult Egg Production Methods Parameters estimation in Mackerel and Horse Mackerel (WKAEPM) chaired by Maria Korta, Spain, will meet in San Sebastian, 22–26 November 2021.
- The Second Workshop on Age Reading of North Sea Plaice (*Pleuronectes platessa*) (WKARP2) chaired by Ulrika Beier, The Netherlands and Julie Coad Davies, Denmark, will meet online and report to the benchmark data compilation meeting for North Sea Plaice by November 2021 resolutions to be added
- The Workshop on Age reading of Horse Mackerel, Mediterranean Horse Mackerel and Blue Jack Mackerel (*T. Trachurus, T. mediterraneus and T. picturatus*) (WKARHOM4), chaired by Andrea Massaro (Aplysia, Italy) and Alba Jurado-Ruzafa (IEO, Spain), will meet in Livorno (Italy), 24–28 October 2022.

The **Workshop 2 on the identification of clupeid larvae** (WKIDCLUP2), chaired by Matthias Kloppmann*, Germany, will meet in Bremerhaven, 30 August–3 September 2021 to:

a) Conduct comparative identification trials focusing on clupeid and clupeid-like larvae evaluating suitable criteria for the identification using the trial – analysis – re-trial methodology (Science Plan codes: 3.1, 3.2);

b) Review available information on the identification of clupeid larvae on the Northeast Atlantic Shelf, with special consideration of the larval appearance and morphology through development (Science Plan codes 3.1, 3.2);

c) Identify and evaluate sources of misidentification of larvae by preparing an uncertainty matrix of clupeid larvae identification (Science Plan codes: 3.1, 3.2);

d) Standardize sample processing and data reporting of clupeid larvae surveys (Science Plan codes: 3.1, 3.2).

WKIDCLUP2 will report by 16 October 2021 for the attention of EOSG, SCICOM, WGSINS, WGALES, WGBIOP and HAWG.

Supporting Information

Priority	Different clupeid larvae surveys, e.g. IHLS and MIK are carried out on the Northeast Atlantic Shelf and provide essential data for the assessment of fish stocks in the North Sea, Irish Sea and the Baltic.
Scientific justification	Larvae surveys are carried out by different countries and the result of these surveys are of direct importance for the assessment. In recent years other clupeids besides herring are occurring in the survey samples in increasing numbers. Since clupeid larvae can easily be mixed up, effective quality control and proper larvae identification is essential for reliable survey results. The overall agreement on clupeid larvae identification between participants at the 2014 WKIDCLUP workshop was 66%. It is necessary to repeat these identification workshops regularly in order to keep the level of identification for experienced and train and improve the skills of new survey participants.
Resource requirements	None.
Participants	Mainly scientists and technicians (approximately 12–15) involved in the surveys.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to advisory committees	SCICOM, ACOM
Linkages to other committees or groups	HAWG, WGSINS, WGALES, IBTSWG, WGBIOP
Linkages to other organizations	None.

WKOISS – Workshop on Operational Implementation of Stomach Sampling

20XX/WK/EOSGXX The **Workshop on Operational Implementation Stomach Sampling (WKOISS),** chaired by XXX, XX and Maria Cristina Follesa (Italy), will be established and will meet in Cagliari, Italy, in November 2021 to:

a) Analyse and discuss the results of the two pilot studies established during the previous WKSTCON (*Merluccius merluccius* for Mediterranean and *Psetta maxima* for Black sea); (Science Plan codes: 1.7);

b) Take into account the pilot studies results and other recent findings from stomach content studies (i.e. Atlantic and Mediterranean areas), select the best suited methods / indices to fill in data gaps useful by example in the improvement of currently available ecosystemic models; (Science Plan codes: 5.2);

c) Taking into account the RCG recommendations, review factors of variability in diet (ontogeny, time, space, etc.), prioritize the most relevant in terms of effect on stocks variability and propose sampling plan that take it into account; (Science Plan codes: 1.7; 3.2; 3.3);

d) Taking into account WKBECOSS and RCG recommendations and WGSAM requirements, propose a standardized sampling scheme and selection method for species (or species groups) and objective of study to be included in stomach content, that could (1) take into account regional similarities and differences in species abundance and importance in community functioning and fisheries and (2) allow comparison between systems; (Science Plan codes: / 1.9; 3.1);

e) Develop an appropriate stomach sampling manual (i.e. ATLAS in SmartDots) or guidelines for best practice (Science Plan codes: / 1.5; 1.9);

f) Review formats (e.g. ICES, DAPSTOM as listed in WKBECOSS) for stomach content data and their regional suitability; (Science Plan codes: 3.1);

g) Consider the development of an intercalibration approach that will allow the results obtained separately by several partners at the regional scale to be combined; (Science Plan codes: 3.1; 3.4; 6.3);

This workshop has to be considered as a follow up of the previous WKSTCON workshop held in Palma de Mallorca, Spain, in April 2018, WKBECOSS, held in Santander, Spain, in September 2019 and RCG held as virtual meeting in June 2020.

WKOISS will report by XXX XXXX for the attention of the EOSG.

Supporting information:

Priority:	The EU Multi-Annual Programme (EU MAP) on Data Collection requests data on predator-prey relationships and planning for future data collection for each marine region. After the Workshop on Better Coordinated Stomach Sampling (WKBECOSS) in 2019, this meeting on the operational aspects for stomach contents is needed and is urgently to begin to organize the sampling of new biological data from 2020. Therefore, these activities are considered to have a high priority.
Scientific justification	The EU MAP provides a unique opportunity for the regular collection of diet data within fisheries research surveys. To ensure a homogeneous data set with suitable spatio-temporal coverage and make effective and efficient use of available resources, coordination of stomach sampling studies is essential. Stomach sampling is necessary to ensure that multi-species and ecosystem models remain relevant and to support MSFD descriptor 4 regarding the structure and functioning of food webs. This work could benefit to the new research on the food web from the ecosystem models.

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 stomach contents. The workshop will work closely with the newly formed RCG Intersessional subgroup on Stomach Sampling.
Secretariat facilities:	None
Financial:	None
Linkages to advisory committee:	ACOM
Linkages to other committees or groups:	WGBIOP, SCICOM, RCGs, WGSAM
Linkages to other organizations:	GFCM

WKARDL2 Workshop on Age reading of Sea bass (Dicentrarchus labrax) 2 2020/WK/DSTSGXX

The **2nd Workshop on Age reading of Sea bass (*Dicentrarchus labrax*) 2 (WKARDL2)**, chaired by Mary Brown, UK, and Valerio Visconti, UK, will be established and will work remotely using a microscope camera and video conference, 7–11 June 2021 to:
a) Clarify the interpretation of annual growth rings using stained otolith sections and scales on the same fish (Science Plan codes: 3.1, 3.2 and 5.2);

b) Continue the guidelines and common ageing criteria (Science Plan codes: 3.1, 3.2 and 5.2);

c) Develop existing reference collections of calcified structures and improve the existing database of scales images (Science Plan codes: 3.1, 3.2 and 5.2);

d) Address the generic ToRs adopted for workshops on age calibration (see 'WGBIOP 2019 Guidelines for Exchanges And Workshops on Age Reading') (Science Plan codes: 3.1, 3.2 and 5.2).

WKARDL2 will report by 30 November 2021 for the attention of ACOM.

Supporting Information

Priority	Essential. Age determination is an essential feature in fish stock assessment t estimate the rates of mortalities and growth. Age data are provided by diffe ent countries and are estimated using international ageing criteria. It is nece sary to continue to clarify this guideline of age interpretation. An otolith an scale exchange took place in 2020 for the purpose of intercalibration betwee ageing labs. Results of this otolith exchange will be discussed durir WKARDL2.
Scientific justification	The aim of the workshop is to identify the current ageing problems between readers and standardize the age-reading procedures in order to improve the accuracy and precision in the age reading of this species.
Resource requirements	No specific resource requirement beyond the need for members to prepare for and participate in the meeting.

Participants	In view of its relevance to the DCF, and ICES WG, the Workshop will try t join international experts on growth, age estimation and scientists involved i assessment in order to progress towards a solution. Participants should announce their intention to participate in the WK no later than two months before the meeting.
Secretariat facilities	None.
Financial	None.
Linkages to advisory committe	ACOM, SCICOM
Linkages to other committees groups	WGBIOP, WGCSE, WGBIE
Linkages to other organisations	There is a direct link with the EU DCF.

A 3nd **Workshop on Age estimation of European anchovy (*Engraulis encrasicolus*)** (WKARA3)

2020/WK/DSTSGXX A Workshop on Age estimation of European anchovy (Engraulis encrasicolus) (WKARA3), chaired by Gualtiero Basilone*, Italy, will be established and will meet in Capo Granitola, Sicily, Italy, in November 2021 to:

a) Review information on anchovy age determination, otolith exchanges, workshops and validation works done so far (Science Plan codes: 5.1, 5.2);

b) Analyse growth increment patterns in anchovy otoliths and to improve (if necessary) the guidelines for their interpretation (Science Plan codes: 5.1, 5.2);

c) Analyse the results of the exchanges carried out in 2018 and the potential source of discrepancies, according to the literature review and new validation studies carried out (Science Plan codes: 5.1, 5.2);

d) Increase existing reference collections of agreed aged otoliths by stocks and areas (Science Plan codes: 5.1, 5.2);

e) Address the generic ToRs adopted for workshops on age calibration (see WGBIOP Guidelines for Workshops on Age Calibration) (Science Plan codes: 5.1, 5.2).

WKARA3 will report to the attention of WGBIOP, SCICOM and ACOM.

Supporting information WKARA3 will report by end 2021 to the attention of WGBIOP, SCICOM and ACOM.

Supporting Information

Priority	Age determination is an essential feature in fish stock assessment to estima the rates of mortality and growth. In order to arrive at appropriate manag ment advice ageing procedures must be reliable. Age data are provided by di ferent laboratories and countries using internationally agreed ageing criteri It is necessary to continue to clarify the guideline of age interpretation. Ther fore, otolith exchanges should be carried out on a regular basis, and if seriou problems exist age reading workshops should be organised to solve thes problems.
Scientific justification	An otolith exchange was made in 2018 and at WKARA3 results from this otolith exchange will be presented and discussed, in view of the poor precision of age determination resulting from the exchange programme.

	Presentation of new validation or corroboration studies. Involvement of others research groups also from different Mediterranean Sea areas (i.e. non EU and non EU countries with shared resources).
Resource requirements	No specific resource requirements beyond the need for members to prepare fo and participate in the meeting.
Participants	In view of its relevance to the ICES quality assurance, the Workshop is ex pected to attract wide interest from both Mediterranean and Atlantic area ICES and the General Fisheries Commission for the Mediterranean (GFCM The Workshop tries to bring together international experts on anchovy ag reading and fish growth and scientists involved in stock assessment to asse the accuracy and precision of the age determination.
Secretariat facilities	None.
Financial	None.
Linkages to advisory committe	ACOM , GFCM
Linkages to other committees groups	SCICOM, WGBIOP, WGCOMEDA and WGHANSA
Linkages to other organisations	Working Group on Stock Assessment of Small Pelagic Species (WGSASP) fro GFCM

The **Workshop on Age reading of blue whiting (*Micromesistius poutassou*)** (WKARBLUE3), chaired by Jane A. Godiksen, Norway and Patrícia Gonçalves, Portugal will meet in Torshavn, Faroe Island, May31th – June 4th 2021 to:

a) Review new information from validation study on first annual ring identification from daily increments; ICES Science plan 3.3, 5.1

b) Review otolith growth table made by IPMA after WKARBLUE2 for aging of Blue whiting; ICES Science plan 3.3, 4.1

c) Clarify the interpretation of annual growth rings (1-3) by sex, quarter and age through image analysis (measurements of ring distances and back calculation); ICES Science plan 3.1, 3.3, 4.1, 4.4, 5.1, 5.2

d) Update on guidelines and common ageing criteria. With emphasis on testing the scheme made by WKARBLUE1; ICES Science plan 3.3, 4.1, 5.1

e) Increase existing reference collections of otoliths and improve the existing data base of otolith images; ICES Science plan 3.1, 3.2, 4.1

f) Analyse the age reading quality from the exchange using the 3-point scale of the image (mentioned in WKNARC); ICES Science plan 3.1, 3.2, 3.3, 4.1

g) Address the generic ToRs adopted for workshops on age calibration (see 'PGCCDBS Guidelines for Workshops on Age Calibration'); ICES Science plan 3.1, 3.2, 5.1, 5.2.

WKARBLUE3 will report by 31 August 2021 to the attention of the ACOM Committee.

Supporting Information

Priority:	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 *Micromesistius poutassou* 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 2020 and at WKARBLUE3 results 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 EU Data Collection Framework (DCF) and to the ICES quality assurance, the Workshop is expected to attract interest from ICES Member States. The Workshop tries to bring together international experts on blue whiting 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 , SCICOM
Linkages to other committees or groups:	WGWIDE,WGBIOP, ACOM, RCMs, all WKACs (Age Calibration Workshops)
Linkages to other organisations:	There is a direct link with the EU DCF.

The **Workshop on Mackerel, Horse Mackerel and Hake Eggs Identification and Staging (WKMACHIS)** chaired by Matthias Kloppmann*, Germany, will meet in Bremerhaven, Germany, 11–15 October 2021 to:

a) Carry out comparative plankton sorting trials on typical survey samples. This should follow the pattern of trial – analysis– identification of problem areas – retrial; ICES Science plan 3.1
b) Carry out comparative egg staging trials for mackerel and horse mackerel eggs following the pattern used in the previous egg staging workshops; ICES Science plan 3.1
c) Discuss sources of misidentification and -staging of fish eggs and prepare an uncertainty matrix of mackerel, horse mackerel and hake egg identification and staging; ICES Science plan 3.1
d) Review available documentation on species identification and staging of fish eggs, define standard protocols and updated relevant descriptions and pictures in the survey manual; ICES Science plan 3.1

WKISMAHE will report by 11 January 2022 for the attention of EOSG, WGMEGS and WGBIOP

Supporting Information

Priority	Data quality, used to provide fisheries advice through WGWIDE, will be impaired if this workshop is not conducted.
Scientific justification	Sorting fish eggs from plankton samples, their staging and identification to species remains one of the key proficiencies in the execution of the mackerel and horse mackerel egg surveys. As this is carried out by a number of different operators in many different countries, and then the data combined, it is vital that the process be standardized. WGMEGS strongly feels that this is best done through the mechanism of a regular workshop to compare results between survey participants. In the context of the triennial egg surveys, it proved appropriate to hold a workshop prior to every survey to standardize approaches and methodologies in the run-up to the surveys. This will have the advantage of training new operators as well as harmonizing the approach of experienced operators. Egg staging workshops were held since 2000, and were very successful in achieving these aims. It is recommended that experiences gathered during these be used for setting up the procedures for the proposed workshop in 2022. The workshop will use the proven method of carrying out a set of sorting trials, analysing the results and identifying problems, and then repeating the trials on the basis of the new understanding. The workshop will also be tasked to update the descriptions and photographs given in the MEGS manual to assist in the plankton sample handling procedure.
Resource requirements	None
Participants	Mainly scientists and technicians (approximately 20) involved in the surveys.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to advisory committees	SCICOM, ACOM
Linkages to other committees or groups	WGMEGS, WGBIOP and WGWIDE
Linkages to other organizations	None.

The **Workshop on Adult Egg Production Methods Parameters estimation in Mackerel and Horse Mackerel (WKAEPM)** chaired by Maria Korta*, Spain, will meet in San Sebastian, 22–26 November 2021 to:

a) Intercalibrate the estimation of adult parameters in egg production methods (Annual and Daily Egg Production Methods), in particular, screening (histological maturity assignment), (batch) fecundity and atresia estimation, and POF staging; ICES Science plan 3.1, 3.3, 5.1

b) Harmonize the analysis and interpretation of results with those of previous surveys; ICES Science plan 3.1, 3.3, 5.1
c) Review current, previously utilized and new developed methods and calculations for realised fecundity estimation as well as batch fecundity and spawning fraction estimation, and document changes in procedures and their consequences in a protocol to be stored on the WGMEGS GitHub; ICES Science plan 3.1, 3.3, 5.1
d) Review available documentation on adult parameters estimation, both textual and figures, to redefine the standard protocols and update the survey manual; ICES Science plan 3.1, 3.3, 5.1

WKAEPDM will report by 11 January 2022 for the attention of EOSG, WGMEGS and WGBIOP.

Supporting Information

Priority	Data quality, used to provide fisheries advice through WGWIDE, will be impaired if this workshop is not conducted.
Scientific justification	Adult parameters estimation is fundamental for conversion of egg production into spawning stock biomass of western and southern mackerel and horse mackerel stock components. Both (batch) fecundity and atresia estimation as well as spawning fraction estimation are carried out using histological and image analysis methods, and the analysis and interpretation of these materials requires standardization across participating institutes. The standardization in this aspect is carried out in workshops since 2001 which have been extremely helpful for agreed practices among institutes and is recommended that experiences gathered during these workshops be extended during the consecutive workshop in 2021. It is expected that the workshop will refine the developed methodologies and clarify established calculations for these adult parameters estimation to obtain unbiased biomass output from the egg surveys. In this sense, the workshop will also update the manual for the fecundity, atresia, and spawning fraction estimation from sampling to analysis procedures and final calculations, which will improve the agreed MEGS standard survey manual.
Resource requirements	None
Participants	Mainly scientists and technicians (approximately 20) involved in the surveys.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to advisory committees	SCICOM, ACOM
Linkages to other committees or groups	WGMEGS, WGBIOP and WGWIDE
Linkages to other organizations	None.

The **Second Workshop on Age Reading of North Sea Plaice (*Pleuronectes platessa*) (WKARP2)** chaired by Ulrika Beier, the Netherlands and Julie Coad Davies, Denmark, will be established and will meet online, 26–28 October 2021 to:

Review results and outcomes of the 2020 North Sea Plaice exchange (SmartDots ID 281); (Science Plan codes: 5.1 & 5.2)

Review and compare existing methods for age reading of North Sea plaice (Science Plan codes: 5.1 & 5.2);

Review information on age estimations, otolith exchanges, workshops and validation work done so far; (Science Plan codes: 5.1 & 5.2);

Review existing guidelines and ageing criteria and compile an updated age reading manual with reference image sets; (Science Plan codes: 5.1 & 5.2)

Address the generic ToRs adopted for workshops on age calibration; (Science Plan codes: 5.1 & 5.2).

WKARP2 will report by XXXX for the attention of the XXXXX Committee.

Supporting information

Priority	Age determination is essential in fish stock assessment where estimates of growth and mortality rates are utilised in the models. Reliable age estimates are thus required to support suitable management and advice procedures. Age data are provided by national laboratories using internationally agreed ageing criteria and it is necessary to er sure that guidelines and criteria are agreed upon and followed. Therefore, otolith exchanges should be carried out on a regular basis and if reoccurring problems exist the an age reading workshop should be organised to address and solve these issues.
Scientific justification	The general aim of the workshop is to standardise the age determination criteria followed in national age reading laboratories and to identify and address existing and pc tential problems in the age determination of *Pleuronectes platessa*. Examination of level of accuracy and precision across readers and laboratories is required to improve the quality of the age data as input into stock assessment models. Analysis of the variability in the growth patterns observed in the otoliths can support the age determination process and provide biological parameter related information relevant to the stock assessment. Validation studies based on these patterns can result in a true age determination and a review of validation studies to date will be made. The results of the 2020 North Sea Plaice age reading exchange will be presented and discussed and will form the basis of an analysis of the most suitable method for age reading of north sea plaice.
Resource requirements	No specific resource requirements beyond the need for participants to prepare for and partake in the meeting.
Participants	In view of its relevance to the EU Data Collection Framework (DCF) and to the ICES quality assurance, the workshop is expected to attract interest from ICES Member States. The workshop aims to bring together international experts on plaice age reading and scientists involved in assessment in order to assess the accuracy and precision of the age data used as input into stock assessment.
Secretariat facilities	Report formatting and WebEx coordination, if required.
Financial	No financial implications.
Linkages to advisory committees	ACOM.
Linkages to other committees or groups	WGBIOP, WGSMART
Linkages to other organizations	There is a direct link with the EU DCF.

The Fourth **Workshop on Age reading of Horse Mackerel, Mediterranean Horse Mackerel and Blue Jack Mackerel (*T. Trachurus, T. mediterraneus and T. picturatus*)** (WKARHOM4), chaired by Andrea Massaro (Aplysia, Italy) and Alba Jurado-Ruzafa (IEO, Spain), will be held in Livorno (Italy), 24–28 October 2022 to:

- Review information on age determination, otolith exchanges (the last one to be performed during October 2021) and validation studies on these species; 3.1 ; 5.1
- Revise and agree the ageing schemes for each species; 3.1; 5.1
- Evaluate the effect of different ageing schemes related to different date of birth; 3.1; 5.1
- Update guideline and reference images by species for the ageing analysis 3.1; 5.1
- Address the generic ToRs adopted for workshops on age calibration (see 'PGCCDBS Guidelines for Workshops on Age Calibration') 3.1; 5.1

Supporting information

Priority	Essential. Age estimation represent a mandatory step in fish stock assessment to estimate the rates of mortalities and growth. In order to avoid bias due to the subjectivity of the readers and/or to different procedures used, it is necessary to update the guidelines of age interpretation. Otolith exchange program will be carried out in 2021 following recommendations in WKARHOM3, encouraging participation of the Azores and Madeiran scientific, and results will be discussed during WKARHOM4.
Scientific justification	The aim of the workshop is to review the available information on age determination, and validation for *Trachurus spp*., to discuss and to improve all technique of preparation and standardize interpretation of calcified structure in order to improve the precision and accuracy in the age reading. Otolith exchange in 2021 will be useful to highlight the critical issues affecting precision in age reading process. During workshop, in 2022, results from the exchange will be presented and discussed.
Resource requirements	No specific resource requirements beyond the need for members to prepare for and participate in the meeting. Additional resources required to undertake additional activities (e.g. SharePoint access and ICES Secretariat support) in the framework of this group are negligible. Logistical support for the use of Smart Dots may be required.
Participants	In view of its relevance to the DCF, and ICES WG, the Workshop try to join international experts on growth, age estimation and scientists involved in assessment in order to progress towards a solution.
Secretariat facilitie	
Financial	
Linkages to advisory committees	ACOM, SCICOM
Linkages to other committees or groups	WGBIOP
Linkages to other organizations	There is a direct link with the EU DCF.

Age Calibration Exchanges starting in 2020 Q4, to be completed in 2021:

- Small-scale otolith exchange for NEA mackerel. Coordinators: Rosario Navarro Rodrigues (Spain) and Jens Ulleweit (Germany). The event (ID 280) has a start date in November 2020 and an end date in February 2021.
- Otolith exchange of Golden Redfish (*Sebastes norvegicus*), area 27.1–2 and 27.561214. Coordinator: Lise Heggebakken (Norway). Exchange will start during autumn 2020.
- Otolith exchange of Beaked Redfish (*Sebastes mentella*), area 21 and 27 Coordinator: Lise Heggebakken (Norway). Exchange will start during autumn 2020.
- Scale exchanges of Salmon (*Salmo salar*). Coordinator: Zuzanna Mirny and Adam Lejk (Poland). The initial plan to include samples from both Baltic and North Atlantic salmon has changed and the exchange will only include Baltic samples. Exchange will start during autumn 2020.
- Deepwater spp. otolith images exchange will take place in 2020. Coordinator: Torfinn Erling Larsen (Norway). Exchange will start during autumn 2020.
- Otolith exchange of Sprat (*Sprattus sprattus*) from Baltic Sea (SD 25–27) Coordinators: Julita Gutkowska (Poland) and Annelie Hilvarsson (Sweden). Exchange will start during autumn 2020.

Age and maturity calibration exchanges planned for 2021 and 2022

- Maturity staging exchange on elasmobranch spp. Coordinator: Maria Cristina Follesa (Italy). This exchange will follow up on recommendations by WKMSEL and will take place in 2021.
- Otolith exchange of Megrim (*Lepidorhombus whiffiagonis*) areas 7.b–k, 8.a–b, and 8.d. will take place in 2021. Coordinator: Jorge Landa (Spain).
- Vertebrae exchange of Elasmobranchs in Mediterranean and Atlantic will take place in 2020. Coordinators: Karen Bekaert (Belgium) and Kelig Mahe (France). Postponed to 2021.
- Otoliths Exchanges of Red mullet and striped red mullet (*Mullus barbatus* and *Mullus-surmuletus*). Coordinator: Pierluigi Carbonara (Italy). The exchange was originally proposed for 2019 but has been postponed to 2021.
- Sole maturity staging exchange 2021 to include immature fish. Coordinators: Karen Bekaert (Belgium) and Maria Krüger Johnson (Denmark)
- Sole otolith exchange 2021. Area 7d Coordinators: Karen Bekaert (Belgium), Joanne Smith and Valerio Visconti (UK).
- Otolith exchange of Four- spotted megrim (*Lepidorhombus boscii*) areas 8.c and 9.a. will take place in 2022. Coordinator: Jorge Landa (Spain).
- Otolith Exchange Sole (*Solea solea*), in subdivisions 20–24 (Skagerrak and Kattegat, western Baltic Sea). Coordinator: Julie Davies (Denmark). The basis for this exchange is a Danish EMFF project "Improvement of the biological advice for Common Sole in Danish Waters", to be expanded upon to include addition samples sol.27.20–24. This event has been postponed because of the benchmark being postponed and will take place once the benchmark year is decided.
- Otolith exchange of Horse Mackerel, Mediterranean Horse Mackerel and Blue Jack Mackerel (*T. Trachurus, T. mediterraneus and T. picturatus*) will take place in 2021. Coordinators: Andrea Massaro (Aplysia, Italy) and Alba Jurado-Ruzafa (IEO, Spain).

Annex 4: ToR b. additional information

A list was compiled with the different sample types, preparation and observation methods which should go into SmartDots.

Table A4.1. List of different sample types, preparation and observation methods for maturity which should go into SmartDots.

Sample Type	Preservation Method	Preparation Method	Observation Method
Gonad	Fresh	No preparation	*De visu*
Gonad	Frozen (to be linked with preparation method)	Histology in paraffin stained with H&E	Microscope-based, transmitted light
Gonad	In formaldehyde	Histology in paraffin stained with Toluidine Blue	Image-based, transmitted light
Gonad	In brine	Histology in paraffin stained with Trichrome	Image-based
Gonad	In ethanol	Histology in resin stained with H&E	
		Histology in resin stained with Toluidine Blue	
		Histology in resin stained with Trichrome	
		Whole mount method	

Table A4.2. List of different sample types, preparation and observation methods for age reading which should go into SmartDots.

Sample Type	Preparation Method	Observation Method
Anal fin spine	Burnt	Microscope-based, transmitted light
Caudal fin spine	Cleaned and dried	Microscope-based, reflected light
Cleithral bone	Dried	Image-based, transmitted light
Dermal denticle	Impression on acetate slides	Image-based, reflected light
Dorsal fin ray	Ground	Image-based, polarized light
Dorsal fin spine	Ground and polished	
Illicium	Ground and stained	
Opercular bone	Broken	
Otolith	Broken and baked	
Scale	Broken and burnt	

Sample Type	Preparation Method	Observation Method
Spine	Broken and burnt and polished	
Statolith	Broken and polished	
Vertebra	Sectioned	
Wing bone (Metapterygoid)	Sectioned and polished	
	Sectioned and polished and stained	
	Sectioned and Stained	
	Whole in distilled water	
	Whole in ethanol	
	Whole in fresh water	
	Whole in glycerin	
	Whole in resin	
	Whole in salty water	
	Whole stained	
	Whole untreated	
	Whole with oil	

Table A4.3. Overview of validation study by stock.

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Clupea harengus	Herring	her.27.30 and her.27.31	27.30 & 27.31	Gulf of Bothnia	Herring (Clupea harengus) in subdivisions 30 and 31 (Gulf of Bothnia)	*126417*	*Baltic Sea Ecoregion*	*WGBFAS*	5	N	2021	75%	Y		ICES. 2020. ICES Workshop on age validation studies of small pelagic species (WKVALPEL). ICES Scientific Reports. 2:15. 76 pp. http://doi.org/10.17895/ices.pub.5966	ICES Workshop on Age Validation Studies of Small Pelagic Species (WKVALPEL)

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Gadus morhua	Cod	cod.27.47d20	27.3-7	North Sea	Cod (Gadus morhua) in Subarea 4 and divisions 7.d and 20 (North Sea, eastern English Channel, Skagerrak)	*126436*	*Greater North Sea Ecoregion*	*WGNSSK*	1	Y	2021		Y		ICES. 2013. Report of the Workshop on Age Validation Studies of Gadoids (WKAVSG), 6 - 10 May 2013, IMEDEA, Mallorca. ICES CM 2013/ACOM:50. 33 pp.	Report of the Workshop on Age Validation Studies of Gadoids (WKAVSG)

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Gadus morhua	Cod	cod.27.1-2	27.1-2	*Barents Sea, Norwegian Sea*	Cod (Gadus morhua) in subareas 1 and 2 (Northeast Arctic) North East Arctic cod	*126436*	*Arctic Ocean Ecoregion, Barents Sea Ecoregion, Faroes Ecoregion, Greenland Sea Ecoregion, Iceland Sea Ecoregion, Norwegian Sea Ecoregion*	*AFWG*	1	Y	2021		Y		ICES. 2013. Report of the Workshop on Age Validation Studies of Gadoids (WKAVSG), 6 - 10 May 2013, IMEDEA, Mallorca. ICES CM 2013/ACOM:50. 33 pp.	Report of the Workshop on Age Validation Studies of Gadoids (WKAVSG)
Engraulis encrasicolus	Anchovy	ane.27.8	27.8	Bay of Biscay	Anchovy (Engraulis encrasicolus) in Subarea 8 (Bay of Biscay)	*126426*	*Bay of Biscay and the Iberian Coast Ecoregion, Oceanic Northeast Atlantic Ecoregion*	*WGHANSA*	1	Y	2019	Bay of Biscay = 91%, Strait of Sicily = 86%	Y		Uriarte *et al.*, 2016	Validation of age determination using otoliths of the European anchovy (Engraulis encrasicolus L.) in the Bay of Biscay

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Engraulis encrasicolus	Anchovy	ane.27.9a	27.9	Atlantic Iberian Waters	Anchovy (Engraulis encrasicolus) in Division 9.a (Atlantic Iberian waters)	*126426*	*Bay of Biscay and the Iberian Coast Ecoregion*	*WGHANSA*	3	Y	2020	Bay of Biscay = 91%, Strait of Sicily = 86%	Y		Uriarte *et al.*, 2016	Validation of age determination using otoliths of the European anchovy (Engraulis encrasicolus L.) in the Bay of Biscay

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Trachurus trachurus	Horse mackerel	hom.27.2a4a5b6a7a-ce-k8	Subarea 8 and divisions 2.a, 4.a, 5.b, 6.a, 7.a-c,e-k	Northeast Atlantic	Horse mackerel (Trachurus trachurus) in Subarea 8 and divisions 2.a, 4.a, 5.b, 6.a, 7.a–c,e–k (the Northeast Atlantic)	*126822*	*Bay of Biscay and the Iberian Coast Ecoregion, Barents Sea Ecoregion, Celtic Seas Ecoregion, Faroes Ecoregion, Greenland Sea Ecoregion, Iceland Sea Ecoregion, Greater North Sea Ecoregion, Norwegian Sea Ecoregion, Oceanic Northeast Atlantic Ecore*	*WGWIDE*	1	Y	2019	55.80%	Y		Waldron, M. E., and Kerstan, M. 2001	Age validation in horse mackerel (Trachurus trachurus) otoliths

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Pleuronectes platessa	European plaice			North Sea									Y	Released marked fish	Etherton (2015)	https://www.researchgate.net/publication/277726542_European_plaice_Pleuronectes_platessa_and_sole_Solea_solea_indirect_age_validation_using_otoliths_from_mark-recapture_experiments_from_the_North_Sea

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Solea solea	common sole / Dover sole			North Sea									Y	Released marked fish	Etherton (2015)	https://www.researchgate.net/publication/277726542_European_plaice_Pleuronectes_platessa_and_sole_Solea_solea_indirect_age_validation_using_otoliths_from_mark-recapture_experiments_from_the_North_Sea

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
eleven species of Lutjanus				central Great Barrier Reef									y	Mark–recapture chemically tagged fish	Cappo, M., Eden, P., Newman, S. J., & Robertson, S. (2000). A new approach to validation of periodicity and timing of opaque zone formation in the otoliths of eleven species of Lutjanus from the central Great Barrier Reef (*). Fishery Bulletin, 98(3), 474.	https://go.gale.com/ps/anonymous?id=GALE%7CA64909346&sid=googleScholar&v=2.1&it=r&linkaccess=abs&issn=00900656&p=AONE&sw=w
Engraulis encrasicolus	Anchovy			Bay of Biscay									y	marginal increment analysis (MIA)	Uriarte *et al*. (2016)	

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
				Galician waters (Division 9.a N)									y	marginal increment analysis (MIA)	ICES (2016c)	
				Gulf of Cadiz									y	marginal increment analysis (MIA)	ICES (2010d)	
				Alboran Sea									y	marginal increment analysis (MIA)	ICES (2010d)	
				Northern Adriatic Sea									y	marginal increment analysis (MIA)	ICES (2010d)	
Sardina pilchardus	Sardine			Bay of Biscay									y	marginal increment analysis (MIA)	ICES (2011d)	

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
				Atlantic Iberian waters									y	marginal increment analysis (MIA)	Alvarez and Porteiro (1981); Porteiro and Alvarez (1983); Jorge and Costa Monteiro (1980)	
Sprattus sprattus	Sprat			Skagerrak and Kattegat									y	marginal increment analysis (MIA)	Torstensen *et al*. (2004)	
Scomber scombrus	Mackerel			Portuguese coast									y	marginal increment analysis (MIA)	Gordo *et al*. (1982)	
				North and northwest of the Iberian Peninsula									y	marginal increment analysis (MIA)	Villamor *et al*. (2018)	

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Scomber colias	Chub mackerel			North and north-west of the Iberian Peninsula									y	marginal increment analysis (MIA)	ICES (2016a); Navarro *et al*. (2018)	
				Portuguese coast									y	marginal increment analysis (MIA)	Martins *et al*. (1983)	
				Azores Islands									y	marginal increment analysis (MIA)	Carvalho *et al*. (2002)	
				Madeira Islands									y	marginal increment analysis (MIA)	Vasconcelos *et al*. (2011); Vasconcelos (2006)	

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
				Gulf of Cadiz									y	marginal increment analysis (MIA)	Rodriguez-Roda (1982)	
				Canary Islands									y	marginal increment analysis (MIA)	Lorenzo *et al*. (1995)	
				South-western Mediterranean (Alboran Sea)									y	marginal increment analysis (MIA)	Velasco *et al*. (2011)	
				North-western Mediterranean (Catalan coast)									y	marginal increment analysis (MIA)	Perrota *et al*. (2005)	

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
				Eastern Mediterranean (Hellenic seas)									y	marginal increment analysis (MIA)	Kiparissis *et al*. (2000)	
Trachurus trachurus	Horse mackerel			North-east Atlantic									y	marginal increment analysis (MIA)	Kerstan (1985); Waldron and Kerstan (2001)	
				Eastern Mediterranean (Hellenic seas)									y	marginal increment analysis (MIA)	Karlou-Riga and Sinis (1997)	
				Southern Adriatic Sea									y	marginal increment analysis (MIA)	Carbonara and Casciaro (2018)	

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Trachurus mediterraneus	Mediterranean			Eastern Mediterranean (Hellenic seas)									y	marginal increment analysis (MIA)	Karlou-Riga (2000)	
Trachurus picturatus	Blue jack			Azores Islands									y	marginal increment analysis (MIA)	García *et al*. (2015)	
				Madeira Islands									y	marginal increment analysis (MIA)	Vasconcelos *et al*. (2006)	
				Canary Islands									y	marginal increment analysis (MIA)	Jurado-Ruzafa and Santamaría (2018)	
Engraulis encrasicolus	Anchovy			Northwestern Mediterranean Sea									y	length frequency analysis	Pertierra (1987); Morales-Nin and Pertierra (1990)	

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Sardina pilchardus	Sardine			North-western Mediterranean Sea									y	length frequency analysis	Pertierra and Mo- rales-Nin (1989); Morales-Nin and Pertierra (1990)	
				Central Mediterranean Sea (Gulf of Salerno – west of Italy)									y	length frequency analysis	Romanelli *et al.* (2002)	
Scomber colias	Chub mackerel			Madeira Islands									y	length frequency analysis	Vasconcelos (2006)	
				North and north-west of the Iberian Peninsula									y	length frequency analysis	Navarro *et al.* (2018)	

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Trachurus trachurus	Horse mackerel			North-east Atlantic									y	length frequency analysis	Letaconnoux (1951); Ramalho and Pinto (1956); Barraca (1964); Macer (1977)	
				Hellenic seas									y	length frequency analysis	Karlou-Riga and Sinis (1997)	
				Adriatic Sea									y	length frequency analysis	Alegria Hernandez (1984)	
Trachurus mediterraneus	Medit. horse mackerel			Adriatic Sea									y	length frequency analysis	Arneri and Tangerini (1984)	
				Southern Adriatic Sea									y	length frequency analysis	Carbonara and Casciaro (2018)	

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Engraulis encrasicolus	Anchovy			Bay of Biscay									y	progression of strong year classes	Uriarte and Astudillo (1987); Uriarte *et al*. (2002); Uriarte *et al*. (2016)	
Trachurus trachurus	Horse mackerel			North-east Atlantic									y	progression of strong year classes	Eltink and Kuiter (1989); Abaunza *et al*. (2003)	
Engraulis encrasicolus	Anchovy			Bay of Biscay									y	Daily increments between annuli	Aldanondo et al. (2013); Hernández et al. (2013)	
Sardina pilchardus	Sardine			Atlantic Iberian waters									y	Daily increments between annuli	ICES (2011d); Silva *et al*. (2012)	
				Northern Adriatic Sea									y	Daily increments between annuli	ICES (2013b)	

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Engraulis encrasicolus	Anchovy			Strait of Sicily									y	back-calculated length analysis	Basilone *et al*. (2004)	
Sardina pilchardus	Sardine			Atlantic Iberian waters									y	back-calculated length analysis	Costa Monteiro and Jorge (1982); Porteiro and Alvarez (1983)	
Scomber colias	Chub mackerel			Canary Islands									y	back-calculated length analysis	Lorenzo *et al*. (1995)	
				Madeira Islands									y	back-calculated length analysis	Vasconcelos (2006)	
				Gulf of Cadiz									y	back-calculated length analysis	Rodriguez–Roda (1982)	

Species name	English name	Stock code	Area	Area description	Stock description ICES	AphiaID	Ecoregion	Assessment WG	Stock category	Age Based Assessment Y/N?	Subject to Benchmark review - When?	Age:% agreement from age readers, reading for assessment from most recent EX/WK	Age Validated Y/N	Method	Reference	Links to validation reports
Trachurus trachurus	Horse mackerel			Hellenic seas									y	back-calculated length analysis	Karlou–Riga and Sinis (1997)	
				Southern Adriatic Sea									y	back-calculated length analysis	Carbonara and Casciaro (2018)	

Annex 5: ToR c. additional information

Table A5.1. Issue table.

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	ank.27.8c9a	Black-bellied anglerfish (*Lophius budegassa*) in divisions 8.c and 9.a (Cantabrian Sea, Atlantic Iberian waters)	MSYSPiCT 2021	15-19.02.2021	Teresa Moura; tmoura@ipma.pt		*no issue list available*			
						Age	The latest research about white anglerfish ageing, *White Anglerfish Illicia and Otoliths Exchange 2011*, highlighted that neither illicia or otolith age readings have not been validated and, in the case of illicia studies, the agreement among readers and the precision were not acceptable.	–	WGBIOP waits for the results of the project concerning age validation using otolith microchemistry	results of the project would be available soon
						Maturity	–	–	–	–

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	bll.27.3a47de	Brill (*Scophthalmus rhombus*) in Subarea 4 and divisions 3.a and 7.d-e (North Sea, Skagerrak and Kattegat, English Channel)	MSYSPiCT 2021	15-19.02.2021	Lies Vansteenbrugge, lies.vansteenbrugge@ilvo.vlaanderen.be		*no issue list available*			
						Age	No Age based assessment	_	The last brill otolith exchange was in 2019 (SmartDots event 200). The average PA=84%, CV=15% and APE=8% for all readers annotating stained sectioned otoliths; the average PA=63%, CV=29% and APE=22% for all readers annotating whole otoliths	Inform the stock coordinator about the results. Stock coordinator has been informed.
						Maturity	_	_	The last maturity staging workshop was in 2012. PA=94% for fresh staging and 73% for staging from pictures,	

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	cod.27.1-2	Cod (*Gadus morhua*) in subareas 1 and 2 (Northeast Arctic)	WKBarFar 2021	31.12.2021	Yuri Kovalev (stock coordinator), kovalev@pinro.ru ; Bjarte Bogstad, bjarte.bogstad@hi.no	Age	Weight at age in stock and catch as well as maturation data are calculated without using all available data. Biology of older ages, particularly 12+ (weight at age in stock/catch/M) not well known. Method for handling skipped spawners when calculating ogives need to be checked. Revision of weight/maturity at age from winter survey is needed (only revised numbers at age have been included in the time series). Would not change the numbers much but should be done for consistency	Weight at age in stock - utilize all surveys Weight at age in stock and catch - consider present use of time series average both for catch and stock weights for older fish Maturation - revise Norwegian time series following update of survey series. Consider also data from commercial fisheries.	Data are available; The last age otolith exchange was in 2018 and the overall PA=87,7%	Inform the stock coordinator about the workshops reports. Stock coordinator has been informed.
						Maturity			–	

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	cod.27.1-2coast	Cod (*Gadus morhua*) in subareas 1 and 2 (Norwegian coastal waters cod)	WKBarFar 2021	31.12.2021		Age	–	–	no age-based as-sessment; The last age valida-tion workshop was in 2013: Report of the Workshop on Age Validation Studies of Gadoids (WKAVSG)	Inform the stock coordinator about the workshops re-ports. Stock coordinator has been informed (via SID).
						Maturity	Re-estimate weight in stock and ma-turity (earlier esti-mated from the coastal survey)	The coastal survey is in a sea-son when the cod gonads are in a resting stage. Better to use ma-turity data from commercial sam-pling in Feb-April (calculate by ECA)	Required Weights and maturity at age in quarter 1(or Feb-April) catch sam-pling. The last Workshop on Sexual Maturity Staging was in 2013. Females PA= 77% (modal stage) and 73% (histol-ogy); Males PA=69% (modal stage) and 66% (histology)	

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	cod.27.47d20	Cod (*Gadus morhua*) in Subarea 4, Division 7.d, and Subdivision 20 (North Sea, eastern English Channel, Skagerrak)	WKNSEA 2021	22-26.02.2021	Nicola Walker, nicola.walker@cefas.co.uk	Age	–	–	The last age valida-tion workshop was in 2013: Report of the Workshop on Age Validation Studies of Gadoids (WKAVSG), the last calibration work-shop (WKARNSC) was in 2008, PA=74%, CV=39,8%; no recent age cali-bration, although age is used in the assessment	Inform the stock coordinator about the workshops re-ports. Stock coordinator has been informed

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
						Maturity	Maturity: account-ing for an increase in maturity-at-age may give the im-pression that spawning stock bio-mass is in better condition than it is given possibility of lower fecundity of younger age groups and the potential for a maternal age effect on survival.	Investigate the sig-nificance of spawner age on re-productive poten-tial. Re-evaluate the base approach for deriving ma-turity-at-age con-sidering weighting of subarea differ-ences and the im-portance of sam-pling intensity to in-terannual variation in maturity esti-mates.	The last Workshop on Sexual Maturity Staging was in 2013. Females PA= 77% (modal stage) and 73% (histol-ogy); Males PA=69% (modal stage) and 66% (histology) Required - Maturity data from surveys (IBTS Q1); infor-mation on survival rates of eggs and larvae from small fish maturing at a younger age and smaller size.	Inform the stock coordinator about the workshop re-port. Stock coordinator has been informed. No WGBIOP action required, because fecundity data are used

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	cod.27.7a	Cod (*Gadus morhua*) in Division 7.a (Irish Sea)	MSYSPiCT 2021	15-19.02.2021		Age	–	–	no age-based as-sessment; The last age valida-tion workshop was in 2013: Report of the Workshop on Age Validation Studies of Gadoids (WKAVSG)	Inform the stock coordinator about the workshop re-port. Stock coordinator has been informed (via SID).
						Maturity	–	–	–	–
						Stock iden-tity	The stock identity of Irish Sea cod is at the moment un-clear. It is under-stood that mature fish migrate out of the area, such as the Celtic Sea. How-ever it is unknown whether the migra-tion is permanent or whether the fish still contribute to the SSB or recruit-ment in area 7A.	The migratory pat-tern of cod and the stock structure is being investigated using DST tags, oto-lith trace element analysis and genet-ics. The use of DST tags will hopefully also shed light on the movement of cod in the Irish Sea itself regarding temperature.	Data is going to be collected starting in 2020.	No WGBIOP action required.

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	dab.27.3a4	Dab (*Limanda limanda*) in Subarea 4 and Division 3.a (North Sea, Skagerrak and Kattegat)	MSYSPiCT 2021	15-19.02.2021	Holger Haslob, holger.haslob@thuenen.de		*no issue list available*			
						Age	–	–	The last Otolith Exchange of Dab (Limanda limanda) North Sea and 5a was in 2019; for this stock PA=69%, CV=14 (whole) and PA-73%, CV=13% (stained section)	Inform the stock coordinator about the results. Stock coordinator has been informed
						Maturity	–	–	The last dab maturity staging workshop was in 2012 (WKMSSPDF2); overall PA=86%	

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	dgs.27.nea	Spurdog (*Squalus acanthias*) in Subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters)	WKNSEA 2021	22-26.02.2021			*no issue list available*			
						Biological parameter	WG would like to highlight the need for better estimates of natural mortality.	–	–	–
						Maturity	-	–	The last Workshop on Sexual Maturity Staging of Elasmobranchs (WKMSEL3) was in 2018	Inform the stock coordinator about the workshop report. Stock coordinator has been informed (via SID).
						Age	WG would like to highlight the need for updated and validated age and growth parameters, in particular for larger individuals.	–	Routine ageing of individual from commercial catches or surveys is not carried out, but age is used in assessment	No WGBIOP action required.

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	fle.27.3a4	Flounder (*Platichthys flesus*) in Subarea 4 and Division 3.a (North Sea, Skagerrak and Kattegat)	MSYSPiCT 2021	15-19.02.2021	Holger Haslob, holger.haslob@thuenen.de		*no issue list available*			
						Maturity	–	–	The last flounder maturity staging workshop was in 2012 - (WKMSSPDF2); overall PA=80%	Inform the stock coordinator about the workshop report. Stock coordinator has been informed
						Age	–	–	no age used in the assessment	No WGBIOP action required.

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	gur.27.3-8	Red gurnard (*Chelidonichthys cuculus*) in subareas 3-8 (Northeast Atlantic)	WKWEST 2021	1-4.12.2020 (by correspondence), 22-26.02.2021 (ICES HQ)	Robert Bellail	Age	In surveys series, length data were available and age compositions are now available since 2008 at least for the FR-EVHOE survey	–	Study proposal 2011 NO age calibration. Lack of regular sampling for red gurnard in commercial landings and discarding to provide series of length or age compositions usable for a preliminary analytical assessment.	This stock is cat 6. No WGBIOP action is required.
						Maturity	A maturity ogive is not available except an assumed knife-edge at age 3.	–	no maturity data used in the assessment	

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	her.27.3031	Herring (*Clupea harengus*) in subdivisions 30 and 31 (Gulf of Bothnia)	WKCLuB 2021	1-3.12.2020 (?)	Pönni Jukka (Luke) jukka.Ponni@luke.fi		*no issue list available*			
							PLEASE NOTE THAT due to an error in input data the outcomes of the WKCLUB 2020 benchmark are not valid. Catch opportunities for 2021 were estimated based on landings data only (see WGBFAS 2020 report).	–	–	–
						Age	–	–	The last Otolith exchange was in 2019 (SmartDots event 250); PA=93,8%, CV=2,4% (assessment readers)	Inform the stock coordinator about the results. Stock coordinator has been informed
						Maturity	The share of mature fish in each age group is calculated from annual data and the annual number of the individual samples for maturity definitions that are used for the maturity ogives has been on average (2010–2015) 283 in SD 30 and 212 in SD 31.	Both countries (Sweden and Finland) which are providing data to the assessment are carrying out maturity calibration during cruises, an exchange before the coming benchmark is not indispensable.	The last Workshop (WKMSHS2) was in 2017; PA for pictures modal = 74%, validated = 52%; frozen modal = 76%	

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	lez.27.6b	Megrim (*Lepidorhom-bus spp.*) in Division 6.b (Rockall)	MSYSPiCT 2021	15-19.02.2021			*no issue list availa-ble*			
						Age	-	_	No accepted ana-lytical assessment for this stock	No WGBIOP action required.
						Maturity	-	_		
2021	lin.27.5b	Ling (*Molva molva*) in Division 5.b (Faroes grounds)	WKBarFar 2021	31.12.2021	Lise H. Ofstad, liseo@hav.fo	Biological parameter	Take a closer look at the ALK	Investigate if it is ok to use the same ALK for all years. Now the back-ground data for ALK in each year is cal-culated by using the all age read data	All data are availa-ble.	_
						Age	-	_	Otolith Exchange of Deepwater species Image 2020, Coor-dinator: Torfinn Er-ling Larsen The last age calibra-tion for ling was carried out during WKAMDEEP2 in 2013: PA =60%, CV=10, 3, data category 3.2, age not used in the assessment.	Inform the stock coordinator about the exchange in 2020. Stock coordinator has been informed.
						Maturity	-	_	_	_

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	nep.fu.25	Norway lobster (*Nephrops norvegicus*) in Division 8.c, Functional Unit 25 (southern Bay of Biscay and northern Galicia)	MSYSPiCT 2021	15-19.02.2021	Isabel González Herraiz, isabel.herraiz@ieo.es		*no issue list available*			
						Age	-	_	No age or maturity data used in the assessment; no exchanges or workshops for the stock. Since 2017 TAC=0	No WGBIOP action required.
						Maturity	-	_		
2021	nep.fu.2829	Norway lobster (*Nephrops norvegicus*) in Division 9.a, Functional Units 28-29 (Atlantic Iberian waters East and southwestern and southern Portugal)	MSYSPiCT 2021	15-19.02.2021	Cristina Silva		*no issue list available*			
						Age	-	_	No age or maturity data used in the assessment; no exchanges or workshops for the stock.	No WGBIOP action required.
						Maturity	-	_		

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	nep.fu.31	Norway lobster (*Nephrops norvegicus*) in Division 8.c, Functional Unit 31 (southern Bay of Biscay and Cantabrian Sea)	MSYSPiCT 2021	15-19.02.2021	Yolanda Vila, yolanda.vila@ieo.es		*no issue list available*			
						Age	-	_	No age or maturity data used in the assessment; no exchanges or workshops for the stock. Since 2017 TAC=0	No WGBIOP action required.
						Maturity	-	_		

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	pil.27.7	Sardine (*Sardina pilchardus*) in Subarea 7 (Southern Celtic Seas, English Channel)	WKWEST 2021	1-4.12.2020 (by correspondence), 22-26.02.2021 (ICES HQ)	E. Duhamel, L. Citores, L. Ibaibarriaga, L. Pawlowski, I. Riveiro, M. Santos and A. Uriarte and the members of WKPELA	Biological parameter	Natural Mortality.	Identify and enumerate predators, especially top predators and other small pelagics	Survey and literature data are available	No WGBIOP action required.
							Information from the ICES WKSAR workshop (ICES, 2016) suggests higher growth rates for the populations of the English Channel and Celtic Sea (sub area 7) than for the Bay of Biscay (Sub area 8) but it is unknown if this results from different oceanographic conditions or from population characteristics.	Analyses of available data	Lengths, weights and ages from all sources are required.	
						Age	-	_	data category 5, no age or maturity used in the assessment,	
						Maturity	-	_		

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	ple.27.7h-k	Plaice (*Pleuronectes platessa*) in divisions 7.h-k (Celtic Sea South, southwest of Ireland)	WKWEST 2021	1-4.12.2020 (by correspondence), 22-26.02.2021 (ICES HQ)	Hans Gerritsen, hans.gerritsen@marine.ie	Life history parame-ters	Life history parame-ters are not cur-rently available for this stock.	Request detailed life history parame-ters for each ICES division, with an aim to applying them in data lim-ited assessment methods.	–	–
						Age	Results of age vali-dation exercise.	Calibration of age-ing data.	results available: Otolith Exchange 2019: whole otoliths PA=78%, CV=12%, APE=7%; sectioned otoliths PA=64%, CV=17%, APE=10%	Inform the stock coordinator about the results. Stock coordinator has been informed.
						Maturity	-		The last maturity staging workshop was in 2012 - Work-shop on Sexual Ma-turity Staging of sole, plaice, dab and flounder (WKMSSPDF2); PA=80%	

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	pol.27.67	Pollack (*Pollachius pollachius*) in subareas 6-7 (Celtic Seas and the English Channel)	WKWEST 2021	1-4.12.2020 (by correspondence), 22-26.02.2021 (ICES HQ)		Age	Age data has never been provided. Four years of age data is available from Ireland	Collect age and biological data, request age data by gear/quarter from other member countries	the last otolith exchange was in 2016, PA=91.6%, CV=3.8%; APE= 0.8%	Inform the stock coordinator about the results. Stock coordinator has been informed.
						Maturity	-		data category 4; no age or maturity data are used	
2021	pol.27.89a	Pollack (*Pollachius pollachius*) in Subarea 8 and Division 9.a (Bay of Biscay and Atlantic Iberian waters)	MSYSPiCT 2021	15-19.02.2021	Paz Sampedro, paz.sampedro@ieo.es		*no issue list available*			
						Age	-	_	No reliable assessment was presented for this species in the southern European Atlantic shelf ecoregion due to the lack of sufficient data.	No WGBIOP action required.
						Maturity	-	_	_	
2021	por.27.nea	Porbeagle (*Lamna nasus*) in subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters)	MSYSPiCT 2021	15-19.02.2021			*no issue list available*			
						Age	Further age and growth studies are needed to provide growth parameters for the NE Atlantic porbeagle stock. (SA)	_	An age-structured production (ASP) model was also applied to the NE Atlantic stock of porbeagle to provide contrast with the BSP model (see ICCAT 2009)	No WGBIOP action required.

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	rjc.27.3a47d	Thornback ray (*Raja clavata*) in Subarea 4 and in divisions 3.a and 7.d (North Sea, Skagerrak, Kattegat, and eastern English Channel)	MSYSPiCT 2021	15-19.02.2021			*no issue list available*			
						Age	-	_	Elasmobranchs are not routinely aged. Stock assessment based on survey trends.	No WGBIOP action required.
						Maturity	-	_	_	

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	san.sa.1r	Sandeel (*Ammodytes spp.*) in divisions 4.b and 4.c, Sandeel Area 1r (central and southern North Sea, Dog-ger Bank)	WKSandeel 2021	15-17.06.2021, 1-5.11.2021	Lotte Worsøe Clausen/ Mikael van Deurs/ Anna Rindorf		*no issue list avail-able*			
						Age	-	_	otolith exchange in 2019 PA=84%, CV=26%; another exchange (event 273) is ongoing on SmartDots (2020)	Inform the stock coordinator about the results. Stock coordinator has been informed (via SID)
						Maturity	-	_	During WKSAND 2016 it was decided to use average ma-turities as no trends were observed in maturity in any of the sandeel areas and no analyses documented rela-tionships between maturity and stock size or weight at age.	No WGBIOP action required.

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	san.sa.2r	Sandeel (*Ammodytes spp.*) in divisions 4.b and 4.c, and Subdivision 20, Sandeel Area 2r (Skagerrak, central and southern North Sea)	WKSandeel 2021	15-17.06.2021, 1-5.11.2021	Espen Johnsen/ Lotte Worsøe Clausen/ Mikael van Deurs/ Anna Rindorf		*no issue list available*			
						Age	-	_	an exchange (event 273) is ongoing on SmartDots (2020)	Inform the stock coordinator about the results once available). Stock coordinator has been informed (via SID).
						Maturity	-	_	During WKSAND 2016 it was decided to use average maturities as no trends were observed in maturity in any of the sandeel areas and no analyses documented relationships between maturity and stock size or weight at age.	No WGBIOP action required.

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	san.sa.3r	Sandeel (*Ammodytes spp.*) in divisions 4.a and 4.b, and Subdivision 20, Sandeel Area 3r (Skagerrak, north-ern and central North Sea)	WKSandeel 2021	15-17.06.2021, 1-5.11.2021	Espen Johnsen/ Lotte Worsøe Clausen/ Mikael van Deurs/ Anna Rindorf		*no issue list avail-able*			
						Age	-	_	otolith exchange in 2019 PA=79%, CV=22%; another exchange (event 273) is ongoing on SmartDots (2020)	Inform the stock coordinator about the results. Stock coordinator has been informed (via SID).
						Maturity	-	_	During WKSAND 2016 it was decided to use average ma-turities as no trends were observed in maturity in any of the sandeel areas and no analyses documented rela-tionships between maturity and stock size or weight at age.	No WGBIOP action required.

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	san.sa.4	Sandeel (*Ammodytes spp.*) in divisions 4.a and 4.b, Sandeel Area 4 (north-ern and central North Sea)	WKSandeel 2021	15-17.06.2021, 1-5.11.2021	Lotte Worsøe Clausen/ Mikael van Deurs/ Anna Rindorf/Peter Wright		*no issue list availa-ble*			
						Age	-	_	otolith exchange (event 273) is ongo-ing on SmartDots (2020)	Inform the stock coordinator about the results. Stock coordinator has been informed (via SID).
						Maturity	-	_	During WKSAND 2016 it was decided to use average ma-turities as no trends were observed in maturity in any of the sandeel areas and no analyses documented rela-tionships between maturity and stock size or weight at age.	No WGBIOP action required.
2021	sdv.27.nea	Smooth-hound (*Mustelus spp.*) in subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters)	MSYSPiCT 2021	15-19.02.2021			*no issue list availa-ble*			
						Age	-	_	data category 4; no age or maturity data are used	No WGBIOP action required.
						Maturity	-	_		

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	seh.27.1	Harp seals (*Pagophilus groenlandicus*) in Subarea 1 (Barents and White seas breeding stock)	WKSEAL 2020	14-17.09.2021 (Canada), 31.12.2021 (by correspondence)			*no issue list available*			
						Age	-	_	_	No WGBIOP action required.
						Maturity	-	_	_	
2021	seh.27.125a14	Harp seals (*Pagophilus groenlandicus*) in Greenland Sea	WKSEAL 2020	14-17.09.2021 (Canada), 31.12.2021 (by correspondence)			*no issue list available*			
						Age	-	_	_	No WGBIOP action required.
						Maturity	-	_	_	
2021	sez.27.2514	Greenland Sea hooded seal ???	WKSEAL 2020	14-17.09.2021 (Canada), 31.12.2021 (by correspondence)			*no issue list available*			
						Age	-	_	_	No WGBIOP action required.
						Maturity	-	_	_	

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	sol.27.7d	Sole (*Solea solea*) in Division 7.d (eastern English Channel)	WKNSEA 2021	22-26.02.2021	Lies Vansteenbrugge, lies.vansteenbrugge@ilvo.vlaanderen.be	Age	data category 3; Age-structured model (XSA): used for trends only	_	There are no recent age calibrations, although the age is used in the assessment.	An otolith exchange for sole was proposed. Karen Bekaert and Jo Smith will coordinate it.
						Maturity	-	_	The last sole maturity staging workshop (WKMSSPDF2) was in 2012, PA=82% (fresh staging)	Inform the stock coordinator about the results. Stock coordinator has been informed.
2021	sol.27.8c9a	Sole (*Solea solea*) in divisions 8.c and 9.a (Cantabrian Sea and Atlantic Iberian waters)	MSYSPiCT 2021, WKWEST 2021	15-19.02.2021,1-4.12.2020 (by correspondence), 22-26.02.2021 (ICES HQ)	Maria de Fatima Borges, mfborges@ipma.pt		*no issue list available*			
						Age	-	_	no age calibration , but it is data category 5 stock, no age or maturity used in the assessment	No WGBIOP action required.
						Maturity	-	_		

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	spr.27.7de	Sprat (*Sprattus sprattus*) in divisions 7.d and 7.e (English Channel)	IBPSprat 2021	2-4.02.2021	johnathan.ball@cefas.co.uk; richard.nash@cefas.co.uk	Age	-	–	no age used in the assessment; The last otolith exchange was in 2014, PA=62%, CV=44% (all readers), PA=78%, CV=45% (expert readers)	Inform the stock coordinator about the results. Stock coordinator has been informed.
						Maturity	-	–	–	–
2021	usk.27.1-2	Tusk (*Brosme brosme*) in subareas 1 and 2 (Northeast Arctic)	MSYSPiCT 2021	15-19.02.2021	Kristin Helle, kristin.helle@hi.no		*no issue list available*			
						Age	-	–	CPUE trends-based assessment. data category 3.2, Deepwater species (Image) (Coordinator: Torfinn Erling Larsen) is going to start in autumn 2020 The last age reading workshop was in 2018 (WKAMDEEP2) PA=48.4%, CV=11.5%	No age used in the assessment. No WGBIOP action required.
						Maturity	-	–	–	–

Bench-mark year	Stock code	Species/ stock	Proposed WK	Dates WK	Stock coordi-nator email	Biological parameter	Issue (source: issue lists/stock annex)	Solution proposed (source: issue lists)	WGBIOP comments or questions	WGBIOP actions
2021	usk.27.3a45b6a7-912b	Tusk (*Brosme brosme*) in subareas 4 and 7-9 and divisions 3.a, 5.b, 6.a, and 12.b (Northeast Atlan-tic)	MSYSPiCT 2021	15-19.02.2021	Kristin Helle, kristin.helle@hi.no		*no issue list availa-ble*			
						Age	-	_	CPUE and catch trends-based as-sessment.- data category 3.2, An Otolith Ex-change of Deep-water species (Im-age) (Coordinator: Torfinn Erling Larsen) is going to start in autumn 2020	No age used in the assessment. No WGBIOP action re-quired.
						Maturity	-	_	_	_

Table A5.2 Stock coordinators replies and WGBIOP follow-up.

Species/stock	biological parameters	replied to WGBIOP	advice taken or con-sidered	replies	follow-up WGBIOP	Feedback
hke.27.3a46-8abd	maturity ogive	yes	yes	For nhke we are using a fixed ma-turity and length-weight relation-ship based on some historic data, does it make sense? They are con-stant enough along years so we could obviate the variability in the assessment? Could a big increase in the population impact on those var-iables?	Check for results of a maturity exchange 2020 if they are avail-able (ask Maria and Ana)	Maturity exchange was definitely cancelled due to COVID-19.

Species/stock	biological parameters	replied to WGBIOP	advice taken or considered	replies	follow-up WGBIOP	Feedback
pol.27.8c.9a	age, maturity	yes	yes	Age is not a priority for pol89a, as other main issues have to be improved before (length sampling, estimate recreational catches). On the other hand, maturity is a key information if we are going to try DataLimitedMethods to assess the stock.	Check in a benchmark report if they are using maturity, check overview table for age and maturity (materials and techniques)	In the stock annex it is stated that: Length-at-maturity for females was considered 47.1 cm and 36.1 cm for males (Fernández Cohen *et al*.(1990) give a maximum length of 130 cm, maximum published weight of 18.1 kg and maximum reported age of eight years. Life-history (growth) parameters for Pollack 89a were estimated to be Lmax= 130 cm, Linf= 85.6 cm, K= 0.19 year-1, and M=0.55 (ICES, 2012). According to the table, they use fresh gonads (ovaries and testes) in macroscale BIOSDEF 1998 for fish from commercial catches, for purposes: Age reading, species' biology. No reliable assessment was presented for this species in the southern European Atlantic shelf ecoregion due to the lack of sufficient data. For data limited stocks without information on abundance or exploitation (Category 5) ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indication that the current exploitation is appropriate for the stock.
mon.27.8c9a	age	yes	yes	The results of this Project (concerning age validation using otolith microchemistry - Kelig Mahe) could validate the age criteria so ALK will be available in the medium-long term. Currently, mon8c9a is assessed with a length-based model, using growth parameters from published studies, any improvement (update) of these parameters would be very welcomed.	Ask Kelig about the results. How can we include those results in the assessment. Ask Kelig which structure they are using (ilicia, otolith, or both)	The final report to European Commission in march. Kelig or Deidre Brophy (leader of this project) could present the results to the next WGBIOP. The sampling of this project were ices VII for monkfish and ices VIII (tagging study)+ Mediterranean sea for hake Kelig's personal idea is that it is too difficult to use microchemistry to help ageing. This project showed some new microchemistry information for research not for assessment but it is possible to ask to the leader because we have no final meeting to discuss around this project.
	maturity			In the assessment we are using the maturity ogive for northern stock taken from paper (year: 2002). Studies of the maturity ogive based on microscopic determination of maturity can help to improve the assessment of mon8c9a.	Look up for maturity information on the other (than northern) stocks and check the tables. Check if ma-	

Species/stock	biological parameters	replied to WGBIOP	advice taken or considered	replies	follow-up WGBIOP	Feedback
					turity data are collected and uploaded to DATRAS.	
ank.27.8c9a	age	yes	yes	Regarding black-bellied anglerfish (Lophius budegassa) in divisions 8c and 9a we are very interested in the results from the age validation study. Growth parameters are lacking for this stock which have implications in the assessment. We usually collect otoliths (and illicia) from individuals caught during our surveys (both Lophius species) that can later be used to assess age, based on the outputs from this study.	Ask Kelig if this stock is also taken into account in the same study as above stock.	The sampling of this project were ices VII for monkfish and ices VIII (tagging study) + Mediterranean sea for hake.
meg.27.8c9a, meg.27.7b-k8abd	age	yes	yes	We can also inform that we have otoliths from megrims collected during IPMA surveys. At the moment we have no one involved in ageing this species (here at IPMA) but are interested in following the exchange that will take place in 2020.	Jorge is making megrim exchange this year. Ask him about the results of this exchange and check who and which countries are involved. Ruadhán and Ines will check the exchange progress. Zuzanna will check the megrim report.	Two otolith exchanges of megrim (Lepidorhombus whiffiagonis) were planned for 2020, one based on samples from ICES Div. 8.c, 9.a. and other from Div. 7.b-k, 8.a,b,d. They are both full exchanges and based on both a whole otolith set and the image set of those otoliths. - **Megrim 8.c, 9.a.** It is already on going and we hope to finish it in the last quarter of 2020 (if all goes well). Its beginning has had to be postponed for months, mainly due to the COVID-19. A total of 8 age readers from 3 institutes agreed to participate in this exchange: IEO (Spain), AZTI (Spain) and IFREMER (France). It is based on 120 otoliths, 60 of them from each semester. IPMA (Portugal): Megrim otoliths from Portuguese survey have not been requested for any exchange and no one is reading them at IPMA. SC is interested on the exchange. - **Megrim 7.b-k, 8.a,b,d.** Several of the readers of this exchange also participate in that of 8.c, 9.a, so as not to overload exchanges on

Species/stock	biological parameters	replied to WGBIOP	advice taken or considered	replies	follow-up WGBIOP	Feedback
						the readers, we cannot start the 7.b-k, 8.abd exchange until we finish the other one. Therefore I think that this exchange of 7.b-k, 8.abd will have to be postponed to 2021. A total of 15 age readers from 6 institutes have agreed to participate in it: IEO (Spain), AZTI (Spain), IFREMER (France), ILVO (Belgium), CEFAS (UK) and Mar. Inst. (Ireland).
gur.27.3-8	age	no	no			
	maturity	no	no			
bss.27.4bc7ad-h	age	no	no			
	maturity	no	no			
hke.27.8c9a	age, natural mortality	yes	yes	Growth is an important issue that has been studied extensively but has not been able to be resolved to date. The assessment model follows a constant von Bertalanffy model with fixed Linf = 130 cm, t0=0 and estimating k parameter with M=0.4 (WKROUND, ICES CM 2010/ACOM:36). This was the growth basis for the GADGET assessment model until 2020. The		

Species/stock	biological parameters	replied to WGBIOP	advice taken or considered	replies	follow-up WGBIOP	Feedback
				Benchmark planned for 2021 has been postponed to 2022.		
	maturity	yes	yes	The stock is assessed with annual maturity ogives, sex combined, only from Spain. It is planned to get annual maturity ogives that also include Portuguese data but as these data present some variability at spawning season which may impact on the assessment, a solution is being sought.		
rng.27.5b6712b	age	no	no			
sol.27.8ab	age	no	no			
	maturity	no	no			
ank.27.78abd	age	no	no			
mon.27.78.abd	age	no	no			

Annex 6: ToR d. additional information

Excel versions of the following tables are available on the WGBIOP SharePoint under working documents\ToR d. Filename: WKLIFE stock_list_full2_WGBIOP 2020 review.xlsx

Table A6.1. Maturity parameters used in WKLIFE simulations.

name	common	area	stock	sex	l50	a50	source.L50	source.A50	Comment
Clupea harengus	Herring	Celtic Seas	her-nis	F	23	NA	Thorpe *et al.* 2015		
Pollachius pollachius	Pollack	North Sea	pol-nsea	C	47.1	NA	Alonso-Fernandez *et al.* 2013		L50 from Galicia
Molva molva	Ling	Widely	lin-comb	C	74	7.2	Magnussen 2007	Magnussen 2007	
Sebastes norvegicus	Rose fish	Northern	smn-con	C	40.3	NA	Ni & Templeman 1985		
Mullus surmuletus	Red mullet	Celtic Seas	mut-comb	F	16.9	NA	Mahe *et al.* 2013		S North Sea and Channel data
Scopthalmus maximus	Turbot	North Sea	tur-nsea	F	34.2	2.2	Van der Hammen *et al.* 2013	Van der Hammen *et al.* 2013	
Microstomus kitt	Lemon sole	North Sea	lem-nsea	C	27	NA	Thorpe *et al.* 2015		
Lepidorhombus whiffiagonis	Megrim	North Sea	meg-4a6a	C	23	3	Jennings *et al.* 1999	Jennings *et al.* 1999	
Ammodytes spp.	Sandeels	North Sea	san-ns4	C	12	NA	Thorpe *et al.* 2015		
Pleuronectes platessa	Plaice	Celtic Seas	ple-celt	F	22.9	NA	van Walraven *et al.* 2010		North Sea data
Merlangius merlangus	Whiting	Celtic Seas	whg-7e-k	F	28	NA	Hehir 2003		
Melanogrammus aeglefinus	Haddock	Celtic Seas	had-iris	C	NA	2		WGNSDS2007, VIIa	Irish Sea data

name	common	area	stock	sex	l50	a50	source.L50	source.A50	Comment
Lophius piscatorius	White anglerfish	Celtic Seas	ang-78ab	C	73	NA	Alfonso-Diaz and Hislop 2006		L50 Scotland data
Lophius piscatorius	White anglerfish	North Sea	ang-ivvi	C	61	NA	Thorpe etal 2015		
Nephrops	Shellfish	Biscay-Iberia	nep-2829	M	28.4	NA	WKLIFE_V_2015		NB values in mm
Scyliorhinus canicula	Lesserspotted dogfish	Celtic Seas	syc27.67	F	57	7.9	Ivory *et al.* 2005	Ivory *et al.* 2005	
Scyliorhinus canicula	Lesserspotted dogfish	Biscay-Iberia	syc27.8c	F	59.1	NA	Rodriguez-Cabello 1998		
Mustelus asterias	Starry smoothhound	Widely	sdv.27.nea	F	81.9	NA	McCully-Phillips 2015		
Raja clavata	Thornback ray	Celtic Seas	rjc.27.afg	F	71.8	6.13	Gallagher *et al.* 2005	Gallagher *et al.* 2005	
Raja clavata	Thornback ray	North Sea	rjc.27.347d	F	77.1	NA	Walker 1999		
Sardina pilchardus	Pilchard	Celtic Seas	sardina_pilchardus	C	14.3	NA	Silva *et al.* 2013a		Data from Cantabrian Sea & N Portugal
Zeus faber	John Dory	Celtic Seas	zeus_faber	F	34.5	NA	Dunn 2001		
Chelidonichtys lucerna	Tub gurnard	Celtic Seas	chelidonichtys_lucerna	F	40.1	NA	Baron 1985b		Biscay data, few large old
Spondyliosoma cantharus	Black seabream	Celtic Seas	spondyliosoma_cantharus	F	22	NA	Soletchnik 1982		Channel/W Channel data
Anarchias lupus	Wolffish	North Sea	anarchias_lupus	F	21.5	3.8	Gunnarsson *et al.* 2006	Gunnarsson *et al.* 2006	E Iceland L50
Scophthalmus rhombus	Brill	North Sea	scophthalmus_rhombus	F	31.3	1.6	Van der Hammen *et al.* 2013	Van der Hammen *et al.* 2013	

name	common	area	stock	sex	l50	a50	source.L50	source.A50	Comment
Argentina silus	Greater argentine	Widely	arg-comb-ex5.	C	38	8.2	Magnussen 2007	Magnussen 2007	
Engraulis encrasicolus	Anchovy	Biscay-Iberia	ane-pore	C	16.8	NA	Silva *et al.* 2006		N France, NE Atlantic data
Lophius budegassa	Black anglerfish	Celtic Seas	ang-78ab_2	F	54.8	9	Duarte *et al.* 1998	Duarte *et al.* 1998	VIIIc,Ixa data

Table A6.2a. Findings from comparing maturity parameters used in WKLIFE simulations to source references–sourced DOIs and Stock comments.

stock	doi.L50	doi.A50	Comments.stock
her-nis	doi: 10.1111/2041-210X.12292	NA	
pol-nsea	doi:10.1017/S0025315413000283	NA	Samples from fish markets along the western coast of Galicia (NW Spain)
lin-comb	doi:10.1111/j.1095-8649.2007.01502.x	doi:10.1111/j.1095-8649.2007.01502.x	Data from Faroe Bank in North Atlantic
smn-con	https://journal.nafo.int/Volumes/Articles/ID/133/Reproductive-Cycles-of-Redfishes-emSebastesem-in-Southern-Newfoundland-Waters	NA	Area covers a collection of stocks. Maturity observations collected from southern Newfoundland waters (NAFO Division 3P)
mut-comb	http://dx.doi.org/10.1111/jai.12266	NA	Samples from eastern English Channel and southern North Sea
tur-nsea	https://doi.org/10.1016/j.seares.2013.07.001	https://doi.org/10.1016/j.seares.2013.07.001	
lem-nsea	doi: 10.1111/2041-210X.12292	NA	

stock	doi.L50	doi.A50	Comments.stock
meg-4a6a	https://doi.org/10.1016/j.seares.2013.07.001	https://doi.org/10.1016/j.seares.2013.07.001	Note not an assessed stock in http://stock-data-base.ices.dk/Default.aspx
san-ns4	doi: 10.1111/2041-210X.12292	NA	
ple-celt	https://doi.org/10.1016/j.seares.2009.07.003	NA	Data from landings from the south-eastern North Sea
whg-7e-k	https://core.ac.uk/download/pdf/51064981.pdf	NA	Whiting captured from the Celtic Sea (ICES division VIIg)
had-iris	NA	http://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2007/WGNSDS/WGNSDS_2007.pdf	
ang-78ab	https://doi.org/10.1111/j.1095-8649.1996.tb06065.x	NA	north-west coast of Scotland. ICES Division VIa.
ang-ivvi	doi: 10.1111/2041-210X.12292	NA	
nep-2829	http://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2015/WKLIFEV/wklifeV_2015.pdf	NA	
syc27.67	doi: 10.2960/J.v35. m504	doi: 10.2960/J.v35. m504	Samples from ICES areas VIIa and VIIg
syc27.8c	doi: 10.3989/scimar.1998.62n3187	NA	Cantabrian Sea (north of Spain)
sdv.27.nea	https://doi.org/10.1111/jfb.12826	NA	Samples from Irish Sea, Bristol Channel, English Channel, southern North Sea.
rjc.27.afg	doi:10.2960/J.v35.m527	doi:10.2960/J.v35.m527	Specimens from the Irish Sea (VIIa ICES)

stock	doi.L50	doi.A50	Comments.stock
rjc.27.347d	https://hdl.handle.net/11245/1.162676	NA	Samples from North Sea
sardina_pilchardus	doi: 10.3989/scimar.03852.03A	NA	Atlanto-Iberian sardine stock. L50 from commercial landings on the western Portuguese coast.
zeus_faber	doi:10.1006/jmsc.2000.0993	NA	Samples from Western Approaches and Celtic Sea
chelidonichtys_lucerna	http://sfi-cybium.fr/fr/les-triglidés-téléostéens-scorpaeniformes-de-la-baie-de-douarnenez-ii-la-reproduction-de-eutrigla	NA	Name should be Chelidonichthys lucerna. The location Baie de Douarnenez is in Biscay, Greater North Sea ecoregion
spondyliosoma_cantharus	https://archimer.ifremer.fr/doc/00131/24193/	NA	Area of study is the English Channel
anarchias_lupus	Might be https://doi.org/10.1111/j.0022-1112.2006.00990.x		Name should be Anarhichas lupus. Value used is for east of Iceland.
scophthalmus_rhombus	10.1016/j.seares.2013.07.001	10.1016/j.seares.2013.07.001	North Sea
arg-combex5.	DOI: 10.1111/j.1095-8649.2007.01502.x	DOI: 10.1111/j.1095-8649.2007.01502.x	Data from Faroe Bank in North Atlantic
ane-pore	10.1016/j.icesjms.2006.01.005	NA	Silva *et al.* 2006 refers to sardine not anchovy please replace.
ang-78ab_2	ICES C.M.1998/0:23	ICES C.M.1998/0:23	VIIIc, IXa data from Atlantic Iberian coast

Table A6.2b. Findings from comparing maturity parameters used in WKLIFE simulations to source references – comments on L50, number of samples, sampling dates and A50.

stock	Comments.L50	nsamples.L50	sampledates.L50	Comments.A50
her-nis	As referenced. Not primary source. May be from ICES Assessment WG report. Thorpe refers to Rochet *et al.* 2011 which has Lmat = 25cm and lists parameter sources as Coull *et al.* 1989 for length-weight; ICES 2005b (North Sea working group - WGNSSK); Jennings *et al.* 1998 (does not include herring), Jennings *et al.* 1999 (which has Celtic Sea herring Lmat = 22.1cm and references ICES Assessment WG)			
pol-nsea	Female L50 given. Length at 50% maturity was significantly different between females (47.1 cm) and males (36.1 cm). L50% for the sexes combined was 42.3 cm	622 in total	November 2009 to October 2010	
lin-comb	L50 as referenced. Data were collected by the R/S Magnus Heinason on bottom surveys. L50 derived from A50.	53	April 1994 to March 1996	A50 estimated by method of Chen and Palo-heimo (1994)
smn-con	Paper uses previous scientific name for golden redfish - *S. marinus*. Sex is F. There were too few small males to calculate a maturity curve, the mean length at 50% maturity for females was 40.3 cm. Specimens from otter-trawl catches of research vessels.	780 females	1957 to 1969	
mut-comb	L50 as referenced. Samples from French trawl-ers landing at Boulogne-sur-mer (northern France).	551 females	February to De-cember 2004	L50 corresponds to an estimated age of 1 year
tur-nsea	L50 as referenced. Data from market samples from randomly selected vessels at the major auctions in the Netherlands.		March to July be-tween 2004 and 2010	As referenced.
lem-nsea	L50 as referenced. From Rochet *et al.* 2011 (Can. J. Fish. Aquat. Sci. Vol. 68: 469–486; doi:10.1139/F10-159) which is from Jennings *et al.* 1999 (Journal of Animal Ecology 1999 68:617-627) which is from Rae (1965) (Rae 1965 The Lemon Sole. Fishing News Books Ltd. London.)		Before 1965	
meg-4a6a	L50 as referenced. Jennings *et al.* cite Moguedet & Perez (1988) (which is likely to be growth pa-rameters as reported in Landa and Pineiro 2000 doi:10.1006/jmsc.2000.0702) and unpublished data. Moguedet, P. & Perez, N. (1988) Estima-tion of megrim (Lepidorhombus whiffagonis) growth parameters for males and females from the ICES division VII. International Council for the Exploration of the Seas Committee Meeting G9 mimeo.			

stock	Comments.L50	nsamples.L50	sampledates.L50	Comments.A50
san-ns4	L50 as referenced. Not primary source. May be from ICES Assessment WG. Rochet *et al.* 2011 has L50 = 11cm			
ple-celt	Value of 22.9 used is not the L50. It is the probabilisitic reaction maturity norm (probability of becoming mature) Lp50 of 4 year old females for data from 2000s (Results section 3.1). Data from samples of the commercial landings.		December to February in the 2000s	
whg-7e-k	L50 as referenced. 95% confidence interval for L50 of 27.9 to 33 cm. The fish were caught by commercial vessels, fishing off the Southeast coast of Ireland in the vicinity of Dunmore East at 52.14° N, 6.99° W.	740 females	January 2001 to January 2002	Hehir 2003 also states female whiting reached L50 at 2.7 years of age with 95% CI of 1.3 to 5.3 years of age.
had-iris	Report (p 825) states from a Biological Sampling survey (BBS) in March 2004, parameter estimates of maturity at length indicate the L50 for whiting in VIIa for males and females is 13.65 cm and 19.76 cm, respectively. Also, results from Gerritsen *et al.* (2002) from NI groundfish surveys of the Irish Sea during spawning in spring 1992–2001. Length at 50 maturity average around 19 cm in males and 22 cm in females.			As referenced (p 825) knife edged maturity at age 2.
ang-78ab	Reference year and author spelling is Afonso-Dias and Hislop 1996. It reports L50 = 73.5 cm (se = 0.67) for female Lophius piscatorius not combined sexes (male L50 = 48.9 cm, se = 0.30). Samples from trawl surveys were undertaken by the Scottish Fisheries Research Vessel Scotia.	299 anglerfish (145 males, 154 females)	April 1993	
ang-ivvi	L50 as referenced. From Rochet *et al.* 2011 (Can. J. Fish. Aquat. Sci. Vol. 68: 469–486 ; doi:10.1139/F10-159) which is from Jennings *et al.* 1999 (Journal of Animal Ecology 1999 68:617-627) which is from Alfonso-Dias & Hislop (1996) or Crozier (1989) (Fisheries Research 7: 267-278)			
nep-2829	L50 as referenced (p11). Value is in mm. Source of data not given.			
syc27.67	L50 as referenced. Samples from research and commercial vessels, also 5 hatchling females from aquarium November 2011.	437 females	November 1999 to November 2000	
syc27.8c	L50 = 54.2 cm (Fig 4.) Results state length at sexual maturity of females is between 49.7 - 59.1 cm, these are 95% confidence intervals. Data collected from commercial trawlers.	740 females	January to December 1994 and September and November 1995	

stock	Comments.L50	nsamples.L50	sampledates.L50	Comments.A50
sdv.27.nea	L50 as referenced. Specimens caught from both commercial fisheries and research-vessel surveys.	266 females	2011 to 2015	
rjc.27.afg	L50 as referenced. Specimens from commercial landings and research surveys . Standard error estimate 0.107	90 females	1996 to 1998	As referenced. Standard error estimate 0.039.
rjc.27.347d	L50 as referenced. Material collected during routine trawl surveys by research vessels.	51 females	1991 to 1995	Walker 1999 also gives A50 = 8.78
sardina_pilchardus	L50 as referenced. L50 = 14.3 cm (CV = 8.4%) is mean over the 60 years 1947-2007 (spawning seasons are October to March and refer to the starting year).		1947 to 2007	
zeus_faber	L50 as referenced. From 28 females collected on RV Cirolana cruise of the Western Approaches and Celtic Sea during March 1995. Dunn (2001) states "as the number of samples was small (40 males; 28 females) and from a restricted area there is a high degree of uncertainty in these estimates".	28 females	March 1995	
chelidonichtys_lucerna	L50 as referenced (for Trigla lucerna). McCarthy and Marriot (2018) is a more recent reference with L50 = 27.7 cm and A50 = 2.7 for females (https://doi.org/10.1111/jai.13614).			
spondyliosoma_cantharus	L50 as referenced (p53 of pdf)		1981 to 1982	
anarchias_lupus	Samples from ground fish and commercial landings. Value is for east of Iceland (n = 90, se = 0.5 cm, from Table III). Reference also gives west of Iceland and combined values. Large difference between L50 and A50 when fish is mature (Stage MC1) and L50 and A50 for year it will spawn (Stage MC2 L50 = 72.58 cm, A50 = 13.84). Gunnarsson 2014 (https://doi.org/10.1111/jfb.12288) with data from 2002-2006 may give additional values.	90 females	July to December 2002	Value is for east of Iceland (n = 85, se = 0.52 years)
scophthalmus_rhombus	L50 as referenced. Data from market samples from randomly selected vessels at the major auctions in the Netherlands.		March to July between 2004 and 2010	
arg-combex5.	L50 as referenced. L50 derived from A50. For Argentina silus, this Faroe Bank A50 was 105% above the median of seven previous studies in other areas (page 467, Table VI: from 3.4 S. Ireland Coral Bank to 8.5 Iceland).	209	1994 to 1998	A50 estimated by method of Chen and Paloheimo (1994)

stock	Comments.L50	nsamples.L50	sampledates.L50	Comments.A50
ane-pore	Recommended replacement: (1) ane-pore, F, L50 = 11.50 (Bay of Biscay), A50 = 1, Lucio, P. and A. Uriarte. – 1990. Aspects of the reproductive biology of the anchovy (Engraulis encrasicolus L.) during 1987 and 1988 in the Bay of Biscay. ICES C.M. 1990/H:27; Recommended replacement (2): ane-pore, L50 = 11.20 (Gulf of Cadiz), A50 = 1, Millan 1999 doi.org/10.1016/S0165-7836(99)00010-7			
ang-78ab_2	Instead of ICES CM paper use the updated published paper Duarte *et al.* 2001. https://doi.org/10.1016/S0165-7836(01)00259-4. Sampling July 1996 to June 1997, 615 females. L50 = 53.6 cm, A50 = 9-10 years for females (38% at age 9, 77% at age 10).			

Annex 7: ToR f. additional information

During WGBIOP, the feedback from workshops and age reading coordinators was compiled and presented in the text and table below. Only one age reading workshop supplied feedback (WKSA).

SmartDots during WKIDCLUP2

The ICES Workshop 2 on the Identification of Clupeid Larvae was scheduled to take place as a physical meeting 31 August–4 September 2020 in Bremerhaven, Germany. Following several national measurements to fight the COVID-19 pandemic including restrictions on larger group meetings and international travel, the workshop had to be postponed to 2021. However, because of the importance of the subject—the correct identification of clupeid larvae in the light of increasing overlap in the spatial and temporal overlap of the different species—to have at least a small video conference to allow potential participants to sharpen their expertise.

The original ToRs for WKIDCLUP2 were, for the purpose of the shortened meeting, stripped down to one identification trial and to a quick plenary round on determination of sources of identification errors. For the identification trial, it was suggested to use the SmartDotsWebApi, which was set up originally by a collaboration of ICES, DTU-Aqua, ILVO and IMAR for otolith reading and sex and maturity determination in fish based on images. For ichthyoplankton identification, SmartDots had to be adapted, which was done prior to the event by a collaboration of ICES, DTU-Aqua and WUR during several video sessions. The overall aim was not only to assist this workshop (WKIDCLUP2) but to also prepare SmartDots for other ichthyoplankton identification and staging events, e.g. the fish egg identification and staging workshop which is held prior to each mackerel and horse mackerel egg survey. It is hoped that the adaptation of SmartDots to ichthyoplankton work would enable the scientific community to better harmonize their ichthyoplankton survey work both, nationally and internationally.

For the WKIDCLUP2 meeting, a beta version of SmartDots for ichthyoplankton was launched, a sample file and the respective images uploaded to the SmartDots site and an event created. All workshop participants were invited to use the website and try to identify the fish larvae, which were displayed in the images. Apart from the mandatory naming of the species, in the annotation window, all participants were enabled to measure different features of the larvae as well as to count myotomes. Because of the novelty of the application to most of the participants, it was decided to leave the event open until a week after the official end of the workshop on 2 September.

A first results sheet was submitted to the coordinator of the event on the morning of 2 September. The results could be easily extracted and copied to the original WKIDCLUP evaluation sheet for an overview of the results. It was also possible to extract length measurements, which had been transformed from pixels to mm, and myotome counts, analysis of which enabling for better identification of sources of misidentification of the species.

Overall, the WebApiSmartDots proved to be very useful for holding such events like WKIDCLUP2. Once all images of larvae were available, it was rather easy to upload them to the SmartDots server. During the workshop, I never had the impression that anyone was having serious problems nor problems at all with annotating the images. Support through ICES and the SmartDots support team was excellent.

Table A7.1. Summary of replies from exchange and workshop age reading coordinators regarding feedback on SmartDots.

Source	Name & e-mail	How do you utilize SmartDots Exchanges/Training/Internal QC?	Feedback on the general utilization of SmartDots	Suggestions for improvements of system (GitHub and SmartDots newsletters have the latest updates)	Other general comments
France	Kélig Mahé; kelig.mahe@ifremer.fr	Exchanges	it is a good tool with a very reactive team	1, there are some problems with connection (username, password), consequently, it would be better to use username and password of ices/ 2, each year, a small group of age coordinators could verify and clean the data of the last year to have only good archive	1, it would be good to have some filters (age group, sampling year, sampling area, choose the readers in the list…) to extract only a set of raw data / 2 readers like to have a progress bar with the approved images to know where are they/ 3 readers like if it is possible to select only images without approved age (it will be better than each reader search the images)
Greece Fisheries Research Institute (FRI)	Angeliki Adamdou; adamdou@inale.gr	Exchanges	User friendly / Fast operation	Complicated log in - difficulties with credentials / Ability to take measurements (e.g. otolith and ring radius) / Search filters and ability to shortlist (e.g. the annotations that haven't been approved yet / More filters to enhance or adjust the image	For the age-reading: It would be helpful if after approving one's reading for an image, there could appear a current percentage of agreement on that image. Also, since there is a need to discriminate between readers that annotate the same number of rings (i.e. same age) but don't actually annotate the same rings, there could be an indication for that too (e.g. an exclamation mark).
Germany (Bremerhaven)	Christoph Stransky; christoph.stransky@thuenen.de	Exchanges	Happy that ICES hosts SmartDots and that an active team is developing this valuable tool further.	Login/token procedure is cumbersome.	Default magnification/image size is quite large.
Germany (Rostock)	Uwe Krumme; uwe.krumme@thuenen.de	Exchanges, Training	Really good support by Carlos! Generally good, but partly also cumbersome.	Please update the report template so that the quality of the text is improved (e.g. have a native speaker check the text). The report template should have a Conclusions/Outlook section. If only advanced age readers participate in an exchange, the template should only show the results for this group ("all" would not be necessary).	

Source	Name & e-mail	How do you utilize SmartDots Exchanges/Train-ing/Internal QC?	Feedback on the general utilization of SmartDots	Suggestions for improvements of system (GitHub and SmartDots newsletters have the latest updates)	Other general comments
Spain	Carmen Piñeiro; carmen.pineiro@ieo.es *On behalf of IEO team as age coordinators and readers*	Exchanges and workshops	Smart dots works reasonably well and it is very useful and flexible tool.	Login should be more simple, for example ICES login	1) It would be good to have some filters (age group, sampling year, samplig area, choose the readers in the list…) to extract only a set of raw-data / 2) Readers like to have a progress bar with the aprobed images to know who are they/ 3) Readers like, if it is poissible, to select only im-ages without aprovrouved age (it will be better than each reader search the images); 4) it would be very useful having the possibility to downloading the own readerings as csv for-mat 5) Flexible results extraction, depending on the needs of each stock and that can be obtained di-rectly by the administrator / coordinator of the exchange / calibration / workshop: 6) Being able to change the birthday date in the software. Currently SmartDots automatically give the age of the fish based on the number of ring annotations that you make; this implies that SmartDots already has a pre-established birthday date (1st of January). This has been a problem in the case of the anchovy from Mediterranean area (birthday on 1st of July) and it was necessary to leave the last winter ring unmarked so that the automatic age determination agreed with the one corresponding with birthday date on July 1
Ireland					Annotations on an image can be saved without an age reader assigning an AQ code. Suggest a pop up to remind them re assigning an AQ code Fixing the reading line in the manual is not very clear when setting up exchanges

Source	Name & e-mail	How do you utilize SmartDots Exchanges/Train-ing/Internal QC?	Feedback on the general utilization of SmartDots	Suggestions for improvements of system (GitHub and SmartDots newsletters have the latest updates)	Other general comments
WKSCALLOP			Software stopped working and re-cording when used by multiple users at the same time	Login and start up procedures arte convo-luted and not streamlined Issues with some firewalls for installation	Physical samples need to accompany the images as the images are not high definition In practice physical shells are used but Smartdots provides the benefit of being able to electroni-cally record and report the exchange results Smartdots was a potentially useful tool for re-cording the results of standardised aging of refer-ence shell data sets Difficult to sea the edge in the images compared to the physical shell
Faroe Islands	janarge@hav.fo	Exchange	OK	Login should be more simple, for example ICES login	
AZTI	mkorta@azti.es	Exchanges and workshops	Very useful, flexible and friendly tool	If possible avoid token request	(1) Pop up window asking whether all parameters have been filled in if any of them are missing (not only AQ) before moving on to the next picture or possibility to filter between aproved and not aproved ones for final validation. (2) Possibility to downloading as csv for example your own readerings.
DTU Aqua	Julie Davies; joco@aqua.dtu.dk	Exchanges, Training and Internal QC. All readers are trained in SmartDots. Read-ers take part in a number of interna-tional exchanges. We have a small number of events where we have readers from 2 of our labs reading samples for QC checks. We set up a herring training	It works well and has allowed for huge improve-ments and stand-ardisation of QC procedures	I think the reporting tool needs improve-ment - a 2 reader comparison would be a good addition. I think it should also be eas-ier to compare 2+ readings from a single sample/fish when the otoliths are prepared using 2+ different methods.	

Source	Name & e-mail	How do you utilize SmartDots Exchanges/Training/Internal QC?	Feedback on the general utilization of SmartDots	Suggestions for improvements of system (GitHub and SmartDots newsletters have the latest updates)	Other general comments
		event with Northern Ireland and used it during an reader training session both in Denmark and online.			
Sweden	Annelie Hilvarsson; annelie.hilvarsson@slu.se	We participate in exchanges and training events (organising a few). The long term plan is to use it internally but not there yet.	I still haven't completed an exchange "to the finish line" with a report but the setting up of events is easy and works fine. Most readers are satisfied with how it works. Just a few minor comments below.	When doing the maturity event a "next button" would be good. As it was now when you approved one it jumped to the beginning of the page and you had to scroll down again to find where you were.	I got some input from readers: * I encountered a number of files that gave me an error message when saving annotations *"An explicit value for the identity column in table 'dbo.tblLines' can only be specified when column list is used and IDENTITY INSERT is ON."* *When you open your picture file the red square to the left goes green even though you havn't done any annotations, it is supposed to turn green when you have saved you annotations.

Table A7.2. Compilation of feedback from maturity stagers.

	Access				Images			Sample Information			Input fields						User friendliness				
Stager No.	Access to password	Access to event	Data access	Image access	Image quality	Level of detail	Colour and brightness	Clarity	Units of measure-ments	Appropriateness	Clarity of what is be-ing requested	Relevancy of what is being requested	Layout	Comment field	Editing	Saving	Layout	Navigation between samples/specimens	Navigation between images	Progress overview	Event overview
1					Very poor image quality in many cases	Poor sharpness, difficult to distinguish details	Quality needs to be improved			Some general information for the expected spawning season in the sampling area desirable								Little bit too slow	Time consuming	Should be clearer	Should be clearer

2	Stager No.	
	Access to password	Access
	Access to event	
	Data access	
	Image access	
	Image quality	Images
Images of the gonad in (or next to) fish are better. Then the proportion of gonad to fish is visible. It would be easier for me to stage if one gonad is cut open.	Level of detail	
	Colour and brightness	
	Clarity	Sample Information
	Units of measure-ments	
	Appropriateness	
	Clarity of what is be-ing requested	Input fields
	Relevancy of what is being requested	
	Layout	
	Comment field	
	Editing	
	Saving	
	Layout	User friendliness
Easier if there are previous/next buttons. It's easier to omit a sample, when you have to go back to the gallery to choose the next image.	Navigation between samples/specimens	
	Navigation between images	
	Progress overview	
	Event overview	

3	Stager No.	
	Access to password	Access
	Access to event	
	Data access	
	Image access	
It was hard to stage from these images. Enlarging them (zooming in) didn't help, made them indistinct/grainy.	Image quality	Images
Much better to have a scale than a coin. Especially a coin that not all are using daily and know the exact size of.	Level of detail	
	Colour and brightness	
	Clarity	Sample Information
	Units of measure-ments	
	Appropriateness	
	Clarity of what is be-ing requested	Input fields
	Relevancy of what is being requested	
	Layout	
	Comment field	
	Editing	
	Saving	
	Layout	User friendliness
It would be good with a next button here as well as with the ages.	Navigation between samples/specimens	
It would be good with a next button here as well as with the ages.	Navigation between images	
	Progress overview	
	Event overview	

4	Stager No.	
	Access to password	Access
	Access to event	
	Data access	
	Image access	
	Image quality	Images
Some images were very good, others were of low quality and did not follow the WGBIOP guidelines.	Level of detail	
	Colour and brightness	
	Clarity	Sample Information
	Units of measure-ments	
	Appropriateness	
	Clarity of what is be-ing requested	Input fields
	Relevancy of what is being requested	
	Layout	
	Comment field	
	Editing	
	Saving	
	Layout	User friendliness
	Navigation between samples/specimens	
	Navigation between images	
	Progress overview	
If the country coordinator participates in the event, it is not possible to see if other partici-pants of your institute have already annotated the event. Already an issue on GitHub.	Event overview	

	Access				Images			Sample Information			Input fields						User friendliness				
Stager No.	Access to password	Access to event	Data access	Image access	Image quality	Level of detail	Colour and brightness	Clarity	Units of measure-ments	Appropriateness	Clarity of what is be-ing requested	Relevancy of what is being requested	Layout	Comment field	Editing	Saving	Layout	Navigation between samples/specimens	Navigation between images	Progress overview	Event overview
5								Could be better										not clear where you ended up.	When leaving a photo, you cannot see which last photo you were last working on.		

9	Stager No.	
	Access to password	Access
	Access to event	
	Data access	
	Image access	
They were not totally in focus, which made the zoom function useless in most images.	Image quality	Images
In order to distinguish females in stage B and C you need close up images of the eggs cut out of the gonad, and for males to give a hint as to whether or not the sperm was running[i].	Level of detail	
Not the best, to me it seemed like the colours of the male gonads changes when they were taken out of the fish.	Colour and brightness	
	Clarity	Sample Information
	Units of measure-ments	
	Appropriateness	
	Clarity of what is be-ing requested	Input fields
	Relevancy of what is being requested	
	Layout	
	Comment field	
	Editing	
	Saving	
	Layout	User friendliness
Irritating that when you uploaded annotations, then the next window started with the first images, and not the images you had just done.	Navigation between samples/specimens	
	Navigation between images	
	Progress overview	
	Event overview	

	Access				Images			Sample Information			Input fields						User friendliness				
Stager No.	Access to password	Access to event	Data access	Image access	Image quality	Level of detail	Colour and brightness	Clarity	Units of measure-ments	Appropriateness	Clarity of what is be-ing requested	Relevancy of what is being requested	Layout	Comment field	Editing	Saving	Layout	Navigation between samples/specimens	Navigation between images	Progress overview	Event overview
7						Difficult to distinguish stages when you can't have the gonad in your hands. Espe-cially if you're in doubt whether it is a spawning fish or whether it is a D, E or F.																

	Access				Images			Sample Information			Input fields						User friendliness				
Stager No.	Access to password	Access to event	Data access	Image access	Image quality	Level of detail	Colour and brightness	Clarity	Units of measure-ments	Appropriateness	Clarity of what is be-ing requested	Relevancy of what is being requested	Layout	Comment field	Editing	Saving	Layout	Navigation between samples/specimens	Navigation between images	Progress overview	Event overview
8					Poor image quality																

	Access				Images			Sample Information			Input fields						User friendliness				
Stager No.	Access to password	Access to event	Data access	Image access	Image quality	Level of detail	Colour and brightness	Clarity	Units of measure-ments	Appropriateness	Clarity of what is be-ing requested	Relevancy of what is being requested	Layout	Comment field	Editing	Saving	Layout	Navigation between samples/specimens	Navigation between images	Progress overview	Event overview
9					Poor image quality - photos blurred	Difficult to distinguish stages when you can't have the gonad in your hands. Im-ages rather "scientific" showing dissected gonads in unrealistic circumstances.	Poor light conditions make it difficult to give ultimate judgement of the maturity stage.														

[1] **Not clear on any of the current images. The coin as size scale ref. was not very useful, a ruler or something similar would have been better.**