

## EU request on providing output on evaluating data accuracy (precision and bias) for design-based estimation at a national level in the form of a report

### Summary

ICES aims to support EU Member States in evaluating the accuracy of their catch sampling data, where accuracy refers to the closeness of statistical estimates to their true values. ICES considers data accuracy in terms of two components: precision and bias. Random uncertainties inherent in sampling are described by data precision, while systematic differences between an estimate and a true value are described by bias. Since this is a complex subject and sampling programmes are usually implemented differently in different countries, the tools presented relate only to national probabilistic sampling and design-based estimation. To use the tools, Member States will need to convert their national data to the format of the Regional Database and Estimation System (RDBES), which stores commercial fisheries data.

ICES evaluates the data precision using two complementary techniques. For relatively simple sampling designs it is possible to use analytical functions to calculate the precision (or a related statistical measure such as variance) of a statistical estimate. The calculations and implementations are written in R code. For more complicated sampling designs, the use of analytical functions is usually not feasible. In these cases, it is necessary to evaluate precision using a numerical technique known as bootstrapping. The elaborated discussion concerning when bootstrapping is appropriate is given in the report underpinning this Technical Service (ICES, 2020), along with a number of worked examples describing how bootstrapping can be applied in different cases.

The evaluation of bias is a difficult subject and is hard to quantify. The approach used builds on previous work available in ICES literature to identify and enumerate common potential sources of bias in catch sampling programmes. As presented in Annex 4 of the report (ICES, 2020), these sources of bias were first collated and then evaluated to see whether data stored using the RDBES format could inform about that bias source. Reports are presented to help Member States identify deviations in their sampling programmes and sampling variability that can potentially lead to bias in catch estimates.

This service is a first step towards providing Member States with a set of tools that can be used to characterize the precision of and bias in their catch sampling data. The aim is to provide a solid foundation which, while immediately useful in itself, has greater value as a building block for future work. A summary of the further activity that is required to extend this work to other scenarios (such as regional sampling programmes) is presented in the report, along with a roadmap.

### Request

*ICES is requested to provide output on evaluating data accuracy (precision and bias) for design-based estimation at a national level in the form of a report covering the following subjects:*

- *Definition of the prerequisites that a MS will need to meet to be able to use the tools (e.g. MS data will need to be in the RDBES data format; the MS will need to be carrying out probabilistic sampling and recording certain data)*
- *Specification of the statistical functions to allow MS to evaluate bias and estimate precision for design-based estimation. These can either be implemented in the statistical language R and delivered alongside the report, or clearly specified in pseudo-code so that the future implementation of them in R is straightforward.*
- *Identification of further functions that would be required in the future to evaluate data accuracy for other type of estimation, and for regional data estimation*
- *Recommendations for further work and a roadmap of how to extend the advice to other types of bias and precision estimation.*

### Background

*The annual national work-plans and reports for data collection of MS are an important record of the data quality processes that are applied at national level - specifically this information is summarised in table 5A of the EU-MAP. This table typically asks whether documentation on a subject exists and, if so, where that documentation can be found. The subjects covered include sampling design, quality checks at the point of data capture, evaluation of precision and bias, and editing and imputation methods. The contents of these tables have been analysed during inter-sessional work of the RCGs and it has*

been seen that MS have difficulty answering some of these questions since there is a lack of guidance or tools available on the subject.

In particular the documentation around data accuracy, bias and precision has been observed to be one of the weaker areas - specifically related to the following questions:

- "Are processes to evaluate data accuracy (bias and precision) documented?"
- "Where can documentation on processes to evaluate accuracy be found?"

When completing this table one MS commented "Presently, we do not evaluate bias and precision of our data because we are not aware of routine tools available for such estimates on a national level. As soon as routines are available we will use these. (...)"

Tools to evaluate data accuracy relating to bias and precision at a national level are required. Evaluation of this bias and precision at a national level will also be relevant to ICES and the Commission since these data feed into stock assessments and can affect the accuracy of their outputs. To enable this advice to be used by all MS it should be based on a common data format from which statistical bias and precision can be correctly calculated. The new RDBES data model provides that format since it provides a common structure to describe both the detailed sampling data and, importantly, the sampling design underlying how those data were obtained. Still, just having data in a sophisticated data structure like the RDBES is not enough: the very estimation of precision and bias for individual programmes is a complex subject frequently found diversely implemented in different countries. For example, there are a number of different estimation techniques which can be used to create inputs for stock assessment from biological data - broadly these can be categorised as "model-based" and "design-based" estimations. (Model based estimations are in common use but involve assumptions on nature which can be difficult to verify whereas design-based estimation involves assumptions on sampling which are in principle controllable and easier to scrutinise.)

To resolve this, it is proposed that in the first instance the tools should relate specifically to design-based estimation since further work will be required for it to be applied to other types of estimation - a roadmap will be needed for the work required to extend the tools to these other types of estimation in the future.

### Elaboration on the service

The methods suggested in this Technical Service will make it possible for more Member States to calculate the precision of and evaluate potential biases in their estimates e.g. of discard amounts. The methods and the output will hereby make it clearer as to where the sampling designs could be improved, which designs would potentially lead to a higher quality of sampling data, and which designs are used for the stock advice. Besides their more direct, intended use, these methods can also be beneficial for implementation in the Transparent Assessment Framework (TAF), where they can be used to calculate the precision of and evaluate potential biases in catch estimates, including age or length distribution used in assessments.

### Links to reports from the meetings

ICES. 2020. Background document for response to special request regarding precision and bias based on RDBES format. Available online as Annex 3 of the coming Report of the Second Workshop on Estimation with the RDBES data model (WKRDB-EST2). 77 pp.

[https://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/EOSG/2020/Annex%203\\_WKRDBES\\_T2\\_2020.pdf](https://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/EOSG/2020/Annex%203_WKRDBES_T2_2020.pdf)

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