ICES PGDATA REPORT 2016

SCICOM/ACOM STEERING GROUP ON INTEGRATED ECOSYSTEM OBSERVATION AND MONITORING (SSGIEOM)

ICES CM 2016/SSGIEOM:06

REF. ACOM & SCICOM

Report of the Working Group on Data Needs for Assessments and Advice (PGDATA)

29 February –4 March 2016

San Sebastian, Spain

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

Recommended format for purposes of citation:

ICES. 2016. Report of the Working Group on Data Needs for Assessments and Advice (PGDATA), 29 February –4 March 2016, San Sebastian, Spain. ICES CM 2016/SSGIEOM:06. 84 pp. https://doi.org/10.17895/ices.pub.8671

Contents

Executive summary

The **Planning Group on Data Needs for Assessments and Advice** (PGDATA), meeting was hosted in San Sebastian Spain from the 29 of February–4 of March 2016 and had 14 participants from 10 countries and was chaired by Mike Armstrong, UK, and Marie Storr-Paulsen, Denmark

The main output of the meeting was to start a process establishing a cost–benefit framework operating alongside a quality assurance framework (with which it is closely linked). A cost–benefit framework should be implemented as a component of all data collection programmes to ensure that data collection programmes are closely aligned with end-user needs, deliver data of sufficient quality to meet these needs, and make most efficient use of available human resources and funding. A framework is needed to ensure that the decision processes are fully transparent and objective, and follow clearly established procedures and guidelines and not taken as ad – hoc decisions for example in response to budget cuts. This is especially important in a time where institutes are facing budget cutbacks, new end-users demands and therefore prioritization between different data collection programs may be needed. It is therefore important to consider how to identify the contribution of different datasets to the uncertainty in assessments, and hence identify areas of data collection that could best be targeted for improvements in cost-efficiency. For example, there may be many different datasets used in an assessment. An important question is if the quality of the assessments and advice could be improved and carried out more cost efficiently by (for example) improving the quality of catch-at-age data, or the quality of survey data, or addition of new surveys. It should also be evaluated if the same quality could be maintained at lower cost by optimizing the design. The costs of scientific monitoring and the fishery regulatory system also have to be considered in relation to the value of the fishery and the short and long-term risks to the stocks. There will be pressures to make these activities as cost efficient as possible. PGDATA in 2015 established a Workshop on Cost Benefit of Data Collection in Support of Stock Assessment and Fishery Management (WKCOSTBEN) to be held in July 2016. PGDATA 2016 spent time planning this workshop and developing supporting information to help define and implement a cost–benefit framework and proposing case studies to demonstrate the process. PGDATA also carried out planning for the related 2016 ICES Annual Science Conference theme session O entitled "When is enough, enough: Methods for optimizing, evaluating, and prioritizing of marine data collection "

PGDATA discussed at this year's meeting its future role within the ICES Steering Group on Integrated Ecosystem Observation and Monitoring (SSGIEOM). In recent years, SSGIEOM has included 21 working groups comprising many that are responsible for coordination and design of fishery-independent surveys, and smaller numbers of groups dealing with fishery-dependent data, biological parameters and fishing technology. The SSGIEOM has made some important advances in relation to surveys, particularly the documentation of survey protocols and data products, but it has become clear that the scope of the SSGIEOM expert groups has increased to a point where a different, strategic approach is needed to ensure ICES has high-quality data to support delivery of its science and advisory plans and its commitments to clients. It is proposed that PGDATA is reformed as a team of experts drawn from the SSGIEOM data groups to achieve the most appropriate balance of statistical and other key skills across the different areas of data collection that in combination support ICES science and advisory work. The revised PGDATA would interact closely with the ICES Data Expert

Groups (WGCATCH, WGRFS, WGBIOP etc.), the other Steering Groups and ICES expert groups which are end-users of data for stock assessments, multispecies or mixed fishery modelling, and regional ecosystem assessments, to develop and implement strategies for improving the data needed for these purposes. In this proposed new structure, chairs of the existing Working Group on Improving Use of Survey data in Assessments and Advice (WGISDAA), and the chairs from Working Group on Integrating Surveys for the Ecosystem Approach (WGISUR) would be represented in PGDATA and would also coordinate the activities of the many fishery-independent survey EGs taking over this role from the present SSGIEOM chair.

1 Introduction and detailed Terms of Reference

The PGDATA meeting was hosted in San Sebastian Spain and had 14 participants from 10 countries.

PGDATA evolved from the ICES Planning Group on Commercial Catches, Discards and Biological sampling following the splitting of the bulk of the PGCCDBS work into two separate expert groups, one dealing with collection, interpretation and quality assurance of data on commercial catches (WGCATCH: ICES, 2014) and the other on biological parameters (WGBIOP: ICES, 2015). The remit of PGDATA differs from these two EGs in focusing on end-user needs for data and information on data quality.

The background and three-year ToRs and workplan for PGDATA are given in Annex 1, and the detailed ToRs for the 2016 meeting are included in the "Summary of the Work Plan" section of the annex and extracted below. The agenda for the meeting is given in Annex 2. The participation at the second meeting (Annex 3) reflected the large focus on cost benefit analysis and the starting of this new approach within the ICES system. In this PGDATA report, we scope out a general framework for cost–benefit analysis, and then look in more detail at several key aspects of cost-efficiency of scientific data collection in support of stock assessments in preparation for the June/July 2016 Workshop on Cost Benefit of Data Collection in Support of Stock Assessment and Fishery Management (WKCOSTBEN). PGDATA also reports on planning for the related 2016 ICES Annual Science Conference theme session O entitled "When is enough, enough: Methods for optimizing, evaluating, and prioritizing of marine data collection " A number of intersessional information gathering exercises are defined to expand the information available for WKCOSTBEN, such as describing the detailed staff time allocation to all tasks carried out within RV surveys, and other information about the surveys related to the data they provide.

Participants in PGDATA 2016 included chairs of the Regional Coordination Meetings (RCMs), WGCATCH, WGBIOP and some scientific survey groups, and people with detailed knowledge of the statistical design, implementation and analysis of fishery sampling programmes and research vessel surveys. As one of the ToRs focused on the structure and cooperation between PGDATA, SSGEIOM and WGISDAA, a skype meeting was arranged on the third day with the chair of SSGEIOM.

Detailed ToRs for PGDATA 2016:

Terms of Reference for the second annual meeting of PGDATA will be:

i) Plan the June 2016 PGDATA Workshop on cost benefit analysis of data collection in support of stock assessment and fishery management (WKCOSTBEN), taking into account outcomes of the EU project DG MARE/2014/19 "Strengthening Regional Cooperation in the Area of Fisheries Data Collection"

ii) Review outcomes of consultations, to be done prior to PGDATA meeting, with ICES SSGIEOM chair and EGs on implementing the SSGIEOM ToR to "Promote the development within EGs of standards and guidelines for good practice in data collection covering the design and implementation of surveys, fishery and other related data collection programmes, the archiving and interpretation of data and samples, the analysis of data, provision of data quality indicators, and the documentation of procedures".

iii) Using the 2015 benchmark data evaluation meeting for the Irish Sea (WKIRISH) as a test case, work with the assessment team to identify / and

review the benchmark process and modify the guidelines for benchmark data evaluation meetings if required. [Note: The Irish Sea Benchmark was postponed to the fall 2016 and the process could therefore not be followed up in this year's PGDATA meeting]

iv) Develop actions in response to pre-meeting consultations with end-users on PGDATA role, including the potential roles for PGDATA to provide expert support to the Regional Coordination Group process under the revised Data Collection Framework

v) Respond to recommendations and requests for advice from other ICES Expert Groups, RCMs or other bodies.

vi) Plan the ASC theme session on "when is enough – enough" in connection to the ongoing activities in PGDATA.

vii) Map the skills required for the PGDATA future work programme.

viii) Develop a strategy for collaboration between PGDATA and WGISDAA (ICES WG on integrating survey data in assessments and advice) on topics of common interest.

ix) Develop the PGDATA workplan for 2017.

2 Planning of WKCOSTBEN

2.1 Introduction to cost benefit analysis

The ToR (i) is to: "Plan the June 2016 PGDATA Workshop on cost benefit analysis of data collection in support of stock assessment and fishery management (WKCOSTBEN), taking into account outcomes of the EU project DG MARE/2014/19 "Strengthening Regional Cooperation in the Area of Fisheries Data Collection"

The reference to the EU project DG MARE/2014/19 (called "fishPi" for short) is to include information from case studies examining how sampling of fishery landings and discards could be made more cost-efficient by adoption of statistically sound sampling schemes, and by optimizing the amount of sampling between countries according to (for example) the landings in each country and national port or harbour. Brief presentations were given to PGDATA on case studies in the fishPi project: sampling of pelagic fisheries; demersal fisheries for hake, recreational and small-scale commercial fisheries, and additional requirements for estimating bycatches of protected, endangered and threatened species (Section2.4).

To make the sampling design more cost–efficient on a regional scale, a regional database in which all regional fisheries-dependent data are stored in common formats, will constitute a core tool for a regional sampling plan, ensuring transparency, data quality and consistent standards for data aggregation/estimation and data dissemination facilities across Member States. Further, the regional databases have substantial potential to support countries in calculating/estimating national biological data, landings and effort for e.g. ICES stock assessment and other bodies such as STECF. This means that regional databases have a key role to improve cost-efficient use of resources spent in calculating/estimating data for answering data calls. Currently, ICES already hosts one such RDB (RDB/Fishframe). The RDB has been built and refined with input of many ICES experts on fishery-dependent data and already allows a significant number of analysis, but needs improvement, particularly in what regards inclusion of sampling design and sampling probabilities.

PGDATA supports the further development of the RDB hosted by ICES

The ToRs of WKCOSTBEN, which meets at ICES HQ from 28 June–1 July 2016 are to:

a) Propose options and analytical methods for framework to evaluate the benefitsvs.costs of datasets used to support stock assessment and fishery management advice, where the benefits are in terms of accuracy (bias and precision) of assessment results and derived management variables, and risks to stocks.

b) Identify case studies, including data-rich and data-poor stocks, for identifying how simulations of the sampling schemes could be used to relate precision to sampling intensity and costs.

c) Develop a proposal for a longer term (3-year) project.

d) Identify the need for follow-up workshops.

In the remainder of this section of the PGDATA report, we scope out a general framework for cost–benefit analysis, and then look in more detail at several key aspects of cost-efficiency of scientific data collection in support of stock assessments, to provide a body of information to help WKCOSTBEN. A number of intersessional information gathering exercises are defined to expand the information available for the workshop, such as describing the detailed staff time allocation to all tasks carried out within RV

surveys, and other information about the surveys related to the data they provide. Furthermore, this section will deal with:

- Establishing a general framework for cost–benefit analysis
- Regional coordination / sampling
- What data are currently collected for stock assessment and what is used for the different stocks
- Calculating the cost
- Estimating the benefits of existing data collection programmes
- Improving cost–benefits
- Tools for evaluating improvement of cost–benefit:

2.2 Establishing a general framework for cost-benefit analysis

2.2.1 Do we need a cost-benefit framework for data collection?

The ICES document on "Implementing the ICES strategic plan 2014–2018" (ICES, 2014b) states that the main objectives of the ICES Integrated Ecosystem Observation and Monitoring programme include the need to "Identify and prioritize ICES monitoring and data collection needs" and to "Implement integrated monitoring programmes in the ICES area". The implementation document identifies a need to:

- Identify monitoring requirements for science and advisory needs in collaboration with data product users, including a description of variables and data products, spatial and temporal resolution needs, and the desired quality of data and estimates.
- Develop a cost–benefit framework to evaluate and optimize monitoring strategies in the context of the capabilities of, and requests from, ICES Member Countries and clients.
- Allocate and coordinate observation and monitoring requests to appropriate expert groups on fishery-independent and fishery-dependent surveys and sampling, and monitor the quality and delivery of data products
- Ensure the development of best practices through establishment of guidelines and quality standards for: (a) surveys and other sampling and data collection systems; (b) external peer reviews of data collection programmes; and (c) training and capacity-building opportunities for monitoring activities.

A wide range of ICES expert groups are involved in implementing these tasks. These include survey expert groups falling under SCICOM, and expert groups on fishery and biological sampling falling jointly under SCICOM and ACOM. The PGDATA addresses the end-use of data from fisheries sampling and surveys, with a large focus on supporting the ICES advisory process. It evolved from the ICES Planning Group on Commercial Catches, Discards and Biological Sampling (PGCCDBS) which was instrumental in establishing an ICES Quality Assurance Framework for biological sampling. Workshops and other Expert Groups initiated by PGCCDBS, such as WKPICS, SGPIDS and WGRFS, and the evolution of PGCCDBS into WGCATCH, WGBIOP and PGDATA, have established guidelines and quality standards for statistically sound designs for fishery and biological sampling programmes, and for assuring and reporting on data quality to end-users.

The survey groups falling under SSGIEOM are also developing quality assurance procedures including full documentation of surveys, survey protocols and data products. More recently, the need to make more cost-effective use of research vessels to collect data for regional integrated ecosystem assessments, as well as delivering existing abundance indices for stock assessments, has led to establishment of expert groups such as WGISUR and WKPIMP which are evaluating how this can be achieved. The outcome of a recent EFARO[1]/ICES Meeting on Cooperation in Surveys and Data Collection in 2016 proposes pilot studies on optimization of the collection of fisheries independent data needed to support ICES and national advisory work, building on existing national and international studies. A summary of the EFARO imitative can be found in Annex 5

Central to all these initiatives is a need to ensure the quality and continuity of data needed for stock assessment, whereas extending the capability of existing sampling platforms to collect additional data needed for an ecosystem approach to fisheries management, and working within existing or even decreasing budgets. The WKCOSTBEN workshop was set up by PGDATA to explore how a cost–benefit framework for data collection could be established and operated over time, and to use a limited number of case studies to demonstrate implementation. The ultimate goal would be to establish a cost–benefit framework operating alongside a quality assurance framework (with which it is closely linked). A cost–benefit framework should be implemented as a component of all data collection programmes to ensure that the programmes are closely aligned with end-user needs, deliver data of sufficient quality to meet these needs, and make most efficient use of available human resources and funding. A framework is needed to ensure that the decision processes are fully transparent and objective, and follow clearly established procedures and guidelines and not taken as ad hoc decisions as response to budget cuts.

A cost benefit framework is also needed by other groups tasked with evaluating data needs and delivery, such as the EU Regional Coordination Groups (RCGs) to be set up in 2017 to coordinate regional data collection under the revised Data Collection Framework. The RCGs will evolve from the current RCMs, and are expected to deal with greater end-user flexibility to request new data collection (potentially involving new data collection schemes) or amend or terminate existing data collection schemes, under the new DCF. This can only be achieved if there is a well-defined and operational cost–benefit framework to inform decisions. The STECF EWG 13-02 meeting on revision of the DCF proposed an objective framework for evaluating such requests (Table 2.1), and this includes the evaluation of cost benefit. The second column of the table includes end-users, expert groups, RCGs and PGECON as being responsible for providing the justifications against each of the criteria, depending on the type of data, though it would seem more appropriate to the end-user requesting the change to the data to provide the full justification for all seven criteria.

1 The European Fisheries and Aquaculture Research Organisation (EFARO) is an association of the Directors of the main European Research Institutes involved in fisheries, aquaculture and its interaction with the marine environment. http://www.efaro.eu/default.asp?ZNT=S0T1O265

2.2.2 Definition of cost–benefit framework

Several terms are used widely in this context, including cost–benefit, cost-effectiveness and cost-efficiency. There is also a related concept of risk-benefit.

A typical cost–benefit analysis in the business world starts with proposing a range of options for a new project. The costs of setting these up and running them in future are established in considerable detail. Market research may be carried out to help predict the future revenues and profits for each option, and these would be adjusted for inflation to give the net present value (NPV). If the NPV of future benefits exceed costs, the project may be considered "cost-effective", but there would also be an evaluation of which options are most "cost-efficient", i.e. providing the greatest benefits for the same or lower costs. We have used the term cost- benefit-framework (CBF) in our report.

Fisheries management represents a complex system of costs and benefits. In the absence of any effective controls, establishment of fisheries in the past has often resulted in a "race to fish" where maximization of short-term profits has been the main driver, and entry to the fishery continues as long as there is a potential profit to be made. Eventually overexploitation occurs and the decline in stocks leads to profits approaching zero. Modern fisheries management attempts to avoid this and achieve sustainable fishing using a system of stock assessments and scientific advice (such as provided by ICES), a regulatory system establishing fishing opportunities in line with (for example) advice based on the MSY approach, and a system of fishery surveillance and control to incentivise and monitor compliance (Figure 2.1). Fishers have to bear compliance costs of the control system, including alteration of gears, effort limitation or exclusion from new MPAs, and have to face uncertainties in future catches and profits due to changes in stock size and market prices. The costs of the scientific monitoring and the regulatory system also have to be considered in relation to the benefits from the fishery and the risks to the stocks. There are pressures to make these activities as cost efficient as possible, but if there is a reduction in quality of scientific data, or less compliance due to reduced fishery inspection, there will be increased risk of overfishing.

There are therefore several dimensions to cost–benefit analysis of a fishery system:

- profitsvs.costs for the fishery, including compliance costs;
- the relationship between expenditure on fishery surveillance and control, and the level of compliance with fishery management measures imposed.
- the relationship between expenditure on scientific monitoring and assessment, and the bias / precision in estimates of management targets and thresholds (e.g. F_{MSY}, $MSYB_{trigger}$, B_{lim} and F_{lim}) and of estimates of stock status relative to these.

The European Commission has developed guidelines for evaluating the cost–benefit of regulatory systems (EC tool #52: methods to assess costs and benefits http://ec.europa.eu/smart-regulation/guidelines/tool_52_en.htm which advises on how costs can be evaluated, and how benefits can be looked at in terms of direct benefits, and indirect benefits. The website describes how different methodological approaches can be used to estimate costs and benefits *ex ante* (within impact assessment work) or *ex post* (in retrospective evaluation/fitness check work). The most appropriate choice will depend on several factors including the nature of the initiative and the availability of data.

The relationship between expenditure on scientific monitoring and assessment, and the risk of overfishing and stock depletion due to less accurate assessments and advice, can only be evaluated using information on the overall accuracy of scientific assess-

ments, such as confidence ranges around management variables such as SSB (e.g. Figure 2.2). The ICES Precautionary Approach has attempted to include assessment uncertainty into management advice in various ways, such as defining precautionary values for SSB and fishing mortality (B_{pa} and F_{pa}) to reduce risks when using uncertain point estimates to give advice, or development of harvest control rules that have been simulation tested using management strategy evaluations incorporating uncertainty in assessment results as well as other sources of variability such as in annual recruitment.

WKCOSTBEN will not deal specifically with the defining the relationship between accuracy of assessment and risks to stocks, but will consider how to identify the contribution of different datasets to the uncertainty in assessments, and hence identify areas of data collection that could best be targeted for improvements in cost-efficiency as there may be many different datasets used in an assessment (Figure 2.2 is an example for sea bass in ICES areas 4 and 6). Throughout WKCOSTBEN, uncertainty in the choice and tuning of the final assessment models will not be addressed, i.e. uncertainty and quality of assessments is only evaluated in respect to the input data. An important question is if the quality of the current assessments and advice could be improved most cost efficiently by (for example) improving the quality of catch-at-age data, or the quality of survey data, or addition of new surveys. In each case, it is necessary to quantify the expected effect on accuracy of the stock assessment of adjusting the amount and/or quality of data in each dataset independently, or the effect of adding a new dataset such as a survey or an annually varying maturity ogive. In some cases, the changes in data collection may have a major effect on assessment quality, whereas other changes may have only a minor impact. If the costs of these changes in data can be quantified, then cost-efficiency metrics can be provided to identify where resources would best be allocated to improve the assessment.

2.2.3 Options for improving cost-efficiency

The cost efficiency of scientific monitoring of stocks, could be viewed in relation to single-species assessments, multispecies assessments, mixed fishery assessments or integrated regional ecosystem assessments where these influence the annual decisions on fishing opportunities. The WKCOSTBEN will focus mainly on single-species assessments, but will consider the multispecies dimension in relation to data collection methods such as trawl surveys and fishery sampling where a survey will deliver data from more than one species or stock.

Cost efficiency can be improved in several ways:

- Better sampling design and implementation (e.g. improved coverage; more statistically sound and efficient stratification and sample selection; optimization of sample allocation between strata; reducing sampling at primary sampling units - such as reduced tow duration on surveys if this can lead to more accurate estimates due to providing time for additional tows or if it leads to more accurate sampling of catches);
- Reducing staff time in obtaining data (e.g. using electronic data entry; automated data collection or sample processing; optimized RV survey tracks);
- Improving accuracy of measurements (e.g. better training and protocols; quality assurance framework; age calibration studies etc.)
- Reallocation of resources between different data types according to the contribution of the data to overall benefits. e.g. relative investment in fishery-independent surveysvs.sampling fish catches at sea or on shore.

- Development of databases and software tools to streamline the tasks of data quality assurance, data analysis and reporting.

WKCOSTBEN will explore these different aspects of improving cost efficiency. More detailed background information is given in the subsequent sections.

Table 2.1. Seven suggested criteria for evaluation of proposed changes to dataseries in DCF (STECF 2013: EWG 13-02).

Topic	Responsibility	Addition of new data series	Amendments to existing data series	Cessation of existing data series
Need and Relevance	End user	Reasons and legal basis for the need or relevance	Reasons for change to need or relevance	Reasons for change to need or relevance
Impacts	RCG; PGECON or Expert Groups	Expected improvements for end user purposes. Precision needed to deliver expected improvements. Impacts on ability to maintain existing data series	Impacts on data quality and end use Impacts on ability to maintain existing data series	Impacts on ability to respond to end user needs
Feasibility	RCG; PGECON	Feasibility of collecting the data, especially to required precision and accuracy	Feasibility of collecting the data, especially to required precision and accuracy	
Methods	RCG; PGECON	Sampling designs and data collection methods needed; Who will implement the schemes; Anticipated sampling rates in relation to desired precision.	Changes to sampling designs, methods, sampling rates and costs.	
Costs	RCG; PGECON	Cost – benefit analysis	Cost – benefit analysis	Cost – benefit analysis
Data quality	RCG; PGECON	Data archiving and quality assurance; Quality indicators for the data	Data archiving and quality assurance; Quality indicators for the data	
Data use	RCG; PGECON / Expert Groups	Process and methods for analysis of the data (models etc.) and application of the results	Process and methods for analysis of the altered data (models etc.) and application of the results	

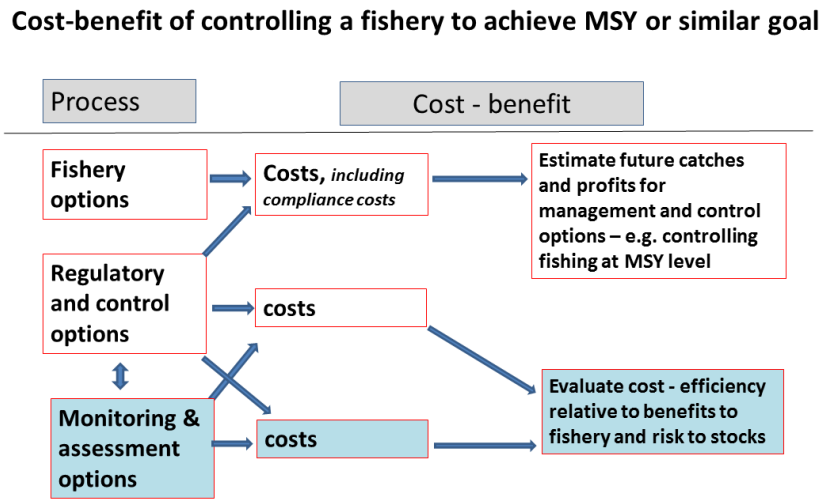
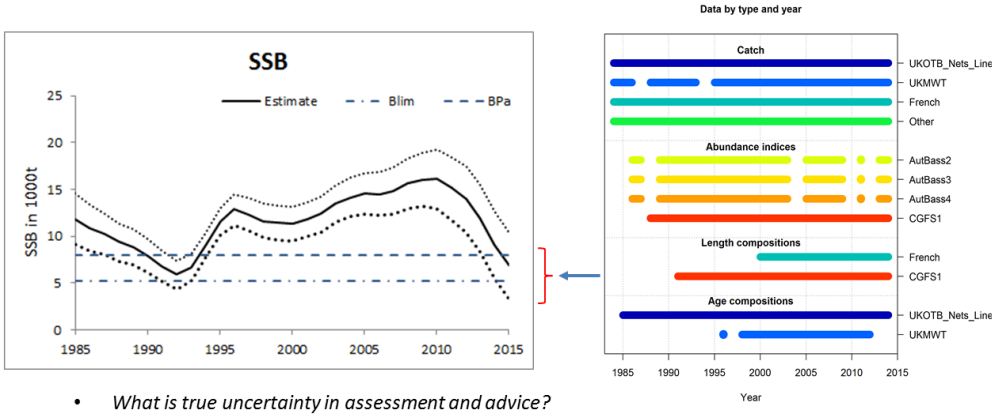


Figure 2.1. Managing a fishery to achieve a goal such as MSY. Benefits to the fishery are long-term profits (expressed as net present value) after costs of fishing are deducted. There are also costs associated with assessing the state of the stock and providing fishing opportunities advice, and implementing a regulatory and control system to ensure management is effective. There will be pressure to make this as cost efficient as possible, but reductions in effectiveness increase uncertainty in assessments, poorer compliance, and increased risk to stocks.



- *What is true uncertainty in assessment and advice?*
- *Which data are main contributors to uncertainty, and what do they cost?*
- *Which data are best value for money for improving fishery management?*

Figure 2.2. Trends in spawning-stock biomass of European sea bass in areas 4 and 6, with 95% confidence intervals derived from the statistical assessment model Stock Synthesis, and the datasets used in the assessment (from ICES WGCSE, 2016b).

2.3 Analytical approaches for cost-benefit analysis

The premise for reducing uncertainty in stock assessments is that sources of errors in input-data and modelling errors can be quantified. If the precision of the data are unknown it will not be possible to calculate the effect of an improved data collection. The stock assessment needs to take account of the uncertainties, however for many commercially important stocks in Europe, only the point estimates of stock parameters (e.g., SSB, F) are given by assessment EGs, with no measures of uncertainty, and annual catch recommendations usually consist of a single number with no reference to uncertainty in this (Dankel *et al*. 2016). Furthermore, a process working towards minimizing the errors in stock-assessment for the smallest cost with the highest benefit for the end-users (managers, fishery, assessment scientist) must have the end-user defined prior to setting up the objectives for any analyses in this respect.

The sources of uncertainty in fisheries advice and management are complex and compounded, but it is essential to be able to estimate the magnitude of this uncertainty and how it affects the various steps in the advisory process, leading up to management decisions: observation of stock status, stock assessment, stock projection and stock advice. Gudmundsson (1994), Aanes *et al* (2007), Gudmundsson and Gunnlaugsson (2012), and Nielsen and Berg (2014) (and references therein) provide alternative statistical assessment models (SAMs) that can provide measures of uncertainty in estimated stock-parameters.

The precision in estimates of fish abundance (from samples in surveys or catch) can be found by bootstrap simulations of age-based data using resampling of the existing age datasets for estimating abundance by age class. This analysis assumes the available data has been randomly sampled , following probabilistic rules and in sufficient sample size and is one of the simplest cost benefit analysis which can lead to an estimation of the number of stations/samples necessary for a certain agreed precision level. Such an exercise can also prove rather useful to get rid of unnecessary high sampling frequency.

The re-sampling of data and sending them through the entire assessment process will then show the uncertainty in the assessment results due to data sampling error, and the necessary level of sampling to reach an acceptable level of uncertainty in assessment results. Finding the adequate monitoring effort to get an acceptable precision of age-disaggregated input data will always be a balance between the numbers of survey samples and catch samples.

This can be set up to show how precision in stock assessment outputs (e.g., spawning stock, using mature abundance as proxy) varies as a function of the precision in input data from fisheries-independent surveys and catch sampling programs. With precision in input related to the cost, the optimal allocation of sampling effort among the two sources can be found (Figure 2.3).

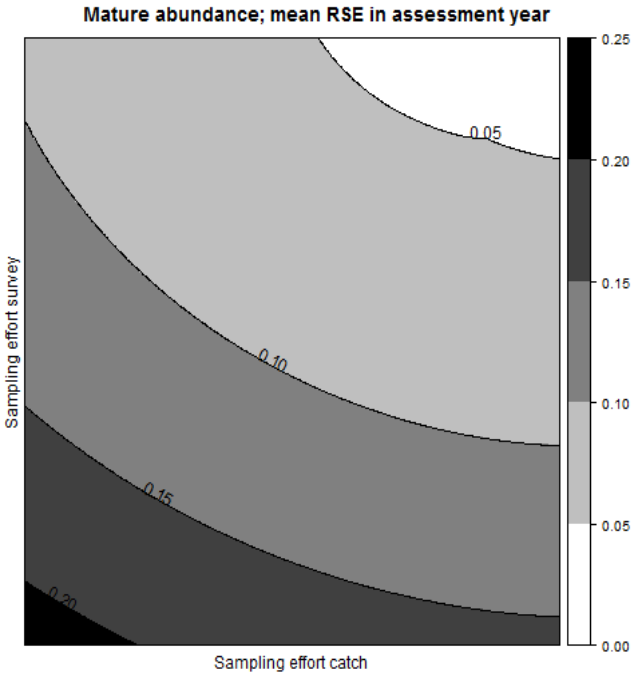


Figure 2.3. Precision in input data related to the cost. The optimal allocation of sampling effort among the two sources, scientific surveys and catch sampling, can be found

A recommendation for a model could be XSAM (a development of SAM) which gives the opportunity to model a sampling error in the input dataseries (catch and survey) which gives the necessary flexibility. Using the whole covariance matrix in the assessment model will enable a more precise estimation of SSB, F, etc., and provide the option to include the confidence intervals in the harvest control rule (HCR) for the individual stock (Dankel *et la*., 2015).

Analysis of sample data has revealed that errors in data (both catch and abundance indices) are significant with complex error structures (Aanes and Pennington 2003, Hirst *et al* 2012, Aanes and Vølstad 2015) including data for NSS herring, which emphasize the importance of specifying the observation model appropriately.

In June, 2016, the Institute of Marine Research (IMR) in Norway started a new 4 year project REDUS to reduce uncertainty in stock assessments. In work packages WP1 and WP2 of REDUS an important goal is to develop R-libraries for analysing input-data to stock assessments from fisheries-dependent surveys (R-ECA) and fisheries-independent surveys (R-StoX), as well as an R-library for the statistical assessment model XSAM. The software package StoX is being adjusted and implemented in ICES under the AtlantOS project. The output from the StoX software from R-StoX is currently used as input to the stock assessment models for Norwegian Spring-spawning Herring (NSSH). The framework will be extended in the REDUS project to other modules like the assessment models and HCR, offering an efficient infrastructure for the whole REDUS data and estimation processing pipeline.

IMR uses the ECA ("Estimating Catch-at-age) (Hirst *et al*. 2012) procedure for analysis of catch sampling data from commercial fisheries. The ECA model is currently being implemented as an R-package (R-ECA) that runs within the STOX framework at IMR. In the REDUS project IMR intends to expand the R-ECA model to also include design-based estimators that will support the estimation of catch-at-age and catch-at-length for the four design classes of at-sea and onshore catch sampling programs described in

ICES Expert Group Practical Implementation of Statistically Sound Catch Sampling Programmes (WKPICS, ICES 2014).

Example with the Norwegian Spring-spawning Herring (NSS herring)

For the 2016 Benchmark assessment of NSS herring, Sondre Aanes (Norwegian Computing Centre) presented an extended statistical assessment model (XSAM) based on state-space and structural time-series models that can account for complex sampling errors in the input data from catch sampling programs and acoustic surveys. The XSAM model is applied to NSS herring with multiple data sources and results are compared to estimates obtained by other models. The XSAM model gives similar estimates of stock parameters compared to other available estimates and appears to give realistic measures of uncertainty given the quality of the available data. The XSAM builds on Gudmundsson (1994) to create a general and flexible template model that will include other documented statistical assessment models such as DTU Aqua's SAM model as a special cases. Modifications to be considered include 1) replacing the random walks for fishing mortality F with an autoregressive model that allows for autocorrelation in time (AR(1)) and 2) expanding the observation model so that the complex errors in input data from multistage surveys can be specified. The sources of variability include cluster-correlated sampling errors resulting from multistage sampling (e.g., Lehtonen and Pahkinen 2004, Nielson 2014; Aanes and Vølstad 2015), but also variability in key-parameters for stochastic processes in population dynamics such as recruitment and mortality.

Management Strategy Evaluation

A Management Strategy Evaluation combines an "operating model" (a simulation model for the real world) with an "assessment model" to simulate the assessment and advice cycle as accurately as possible. "Data" on surveys and catches are taken from the operating model, with errors assigned. These are then used to tune an assessment model, which gives an estimate of stock size. This estimate is then applied to the harvest control rule (HCR) in order to produce a quota, which in turn is input into the operating model (possibly with implementation errors), and the cycle repeated. Such a system allows for HCRs to be evaluated in a realistic setting, but also allows for the performance of the assessment model and the impact of various sources of error to be investigated. In many cases around the world today a slightly simplified version of this procedure is used, with the "assessment model" replaced by exact knowledge of the stock (to which errors can be added).

In the REDUS project, WP3 will develop and implement an MSE framework that will be tested on Northeast Artic (NEA) cod and other species. This will be developed in collaboration with NOAA, USA. Currently IMR employs an operating model tool called "PROST" to evaluate harvest control rules (HCRs), but this tool does not offer full MSE (PROST does not include an assessment model). Such simplified procedures are simpler to develop than "full MSE simulations", and are able to evaluate HCRs provided that the assessment model in use is simple. However they apply errors to output of the assessment model, not to the inputs (e.g. survey indices, fisheries data, age determination), and hence are not suited to evaluating more complex assessment models or evaluating how such models behave when given knowledge of uncertainties in different input datasets. Nor do the tools currently in use allow for multispecies or ecosystem operating models, and therefore cannot incorporate uncertainties that arise from multispecies interactions. A particular challenge to address is to allow for com-

plex correlated input-data resulting from multistage sampling, where variance-covariance matrices for catch-at-age and abundance indices at age will be estimated and included in the statistical assessment modelling.

The results of the MSE are a comparison between the true and estimated population abundance as well as the realized fishing mortality rate and the rate determined by the control rule. For example, the MSE program has been used with the VPA and AgePro settings to examine the utility of splitting survey time-series in response to a strong retrospective pattern caused by changes in catch reporting or misspecification of the natural mortality rate. The program also allows the user to examine issues arising from low sampling of catch or surveys, as well as changes in biological characteristics such as the length-weight relationship.

2.4 Regional coordination of sampling to improve cost-efficiency

One way to improve the sampling without necessarily increasing the number of total sampling events is to coordinate and conduct sampling design on a regional level. First attempts to improve sampling on a regional level has been introduced in "FishPi" - an EU project on how to strengthen regional cooperation for fisheries data collection (MARE/2014/19**).** The FishPi project has examined how sampling of fishery landings and discards can be made more cost-efficient by adoption of statistically sound sampling schemes, and by optimizing the amount of sampling between countries according to (for example) the landings in each country and national port or harbour.

The specific objective of the FishPi project has been to:

- • Identify how member states can agree on what data are to be collected at the regional level.
- • Cooperate in the planning of how data are to be collected, processed and stored at the regional level.
- • Facilitate cooperation between member states in the evaluation of the quality of the data at the national and regional level.
- • Explore how member states can cooperate in trials for the collection of new data at the regional level.
- The project was still ongoing however some of the preliminary results were presented to PGDATA.

One of the main aims of the project was to reach agreement on the mechanizms to determine where, how and in what manner data are collected, and which data are collected. For the latter, the FishPi has investigated the possibility of collecting additional data over and above a set of core data that are currently collected. This could relate to, for example, more or fewer species, more or fewer otoliths, length or age data, etc. Therefore there has been a need to engage with end-users, explore their priorities, determine the feasibility of data collection and the utility of the data itself; above all establish a mechanizm for decision-making. These considerations put a particular emphasis on collecting data in a cost-effective efficient and versatile manner.

In order to achieve these objectives of regional cooperation the project has used case studies to investigate the abilities to produce a regional sampling scheme for shared stocks within a regional sea. The case studies have analysed regional sampling plans based on many different simulations on how to conduct the most optimal sampling scheme and have tested the effect of different scenarios. At PGDATA three of these case studies were presented: Case study 1: Small Pelagic fisheries operating in the North Sea and North Atlantic, and Case study 4: Fisheries operating on Northern &

Southern hake stocks and ecosystem impact: Data not currently collected (stomach contents/PETS/Recreational and Small Scale fisheries)

2.4.1 Case Study 1: small pelagic fisheries in the North Sea and North Atlantic

The pelagic case study in FishPi only focused on four stocks: North Sea herring, mackerel, and sprat in Kattegat-Skagerrak and in the North Sea. Data from all involved countries was used to investigate where the main part of the catch was landed by country and harbour. This relatively simple exercise revealed that for North Sea herring 90% of the total landings of the stock could be accessed within 10 different harbours across all involved countries. For mackerel the number of harbours was a little larger, however this stock covers a much larger area and here 15 harbours covered 90% of the landings (Figure 2.4). For this stock, however, the landing share of the stock outside the EU is relatively large and not included in the case study. For the two sprat stocks very few harbours covered the main part of the landings (3 and 4, respectively).

The same number of sampling events currently conducted by the participating member states were used in the analysis and as the base run where the samples were distributed randomly among the harbours and vessels. Twenty different scenarios were conducted, and for each scenario the effects on the stock sampled were investigated with respect to area cover, coverage by quarters and by country. First the effect of vessel size was investigated and it was found that for herring and mackerel more than 95% of the landings could be covered by sampling the vessels above 40 meters (Figure 2.5). Therefore the vessel length was used as one strata (above and below 40 meters) where vessels above were sampled with a much higher frequency or even with census and vessels below 40 meter were sampled with a much lower frequency.

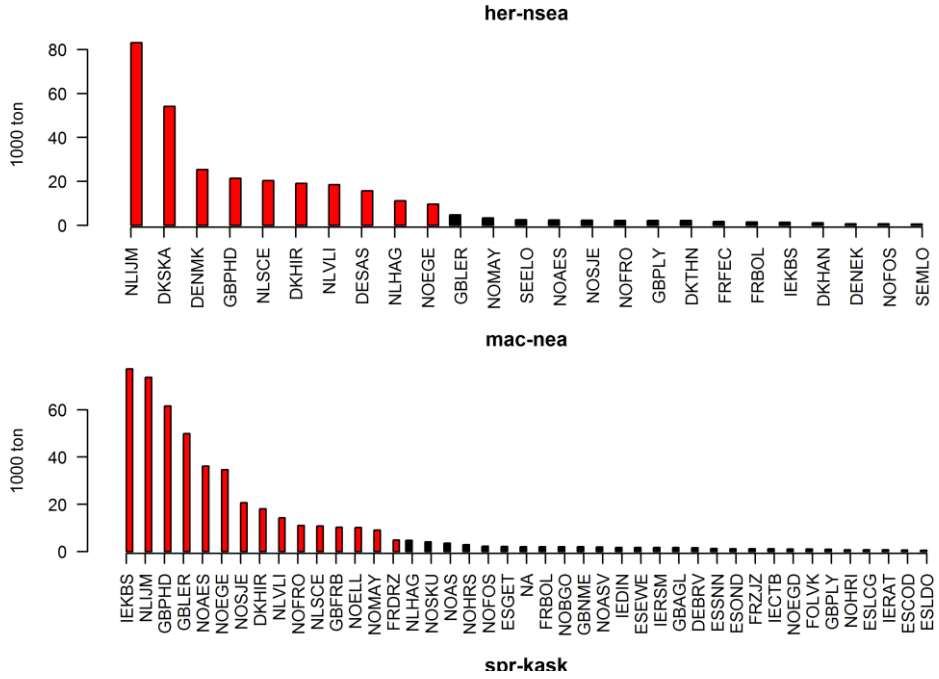


Figure 2.4. Harbours where 90% of the landings have taken place (red bars) for the north Sea Herring stock (top figure) and the mackerel stock (lower figure).

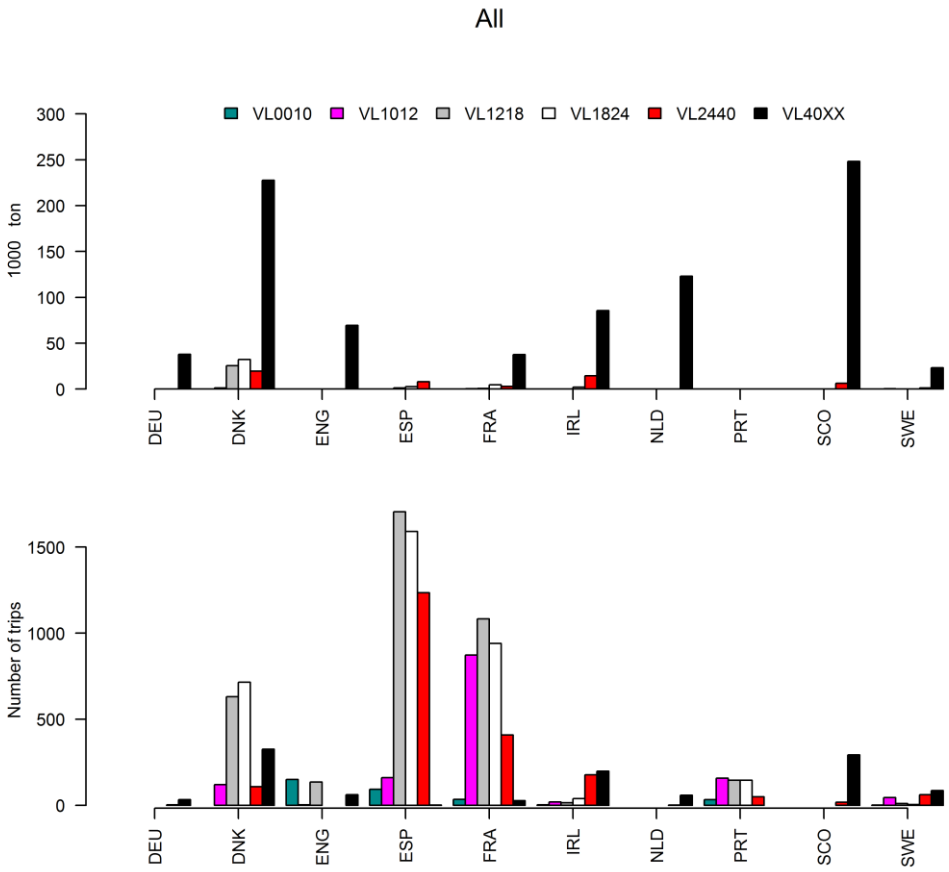


Figure 2.5. Landings for all 4 stocks in respect to the vessel length (different colours represent different vessel length) in tons and with number of trips. Black bars indicate vessel above 40 meters.

Another scenario investigated was to redistribute the effort according to the landed weight. An effect of this would be to distribute effort from one country to another as all country do not sample according to the total amount of landings. One result of this case study was that the effective sample size could be very much improved with the same amount of samples if the samples were stratified according to:

- The harbours where the main part of the international catches were landed
- If effort were reallocated between countries
- If vessels above 40 m were sampled with a larger effort than smaller vessels.

The study also highlighted that this analysis has to be conducted on a stock basis as not all stocks would be covered by larger vessels only. The small inshore sprat stock in Kattegat- Skagerrak was only covered partly by larger vessels and would have to have an alternative sampling design to fulfil the overall goal.

2.4.2 Case study 4: fisheries on Northern and Southern hake

Due to inconsistencies in data submission, CS4 was split in two: CS4-total (both hake stocks but only positive trips) and CS4-shake (only southern hake stock but all the Atlantic Iberian trips). Both sub-case studies were analysed under a variety of sampling design scenarios, from simple random sampling to a different combination of stratified sampling designs (by country, by port, by quarter). The respective results were compared regarding bias and precision, in order to obtain objective parameters to choose the best approach. CS4-total gave their best precision estimates in scenarios stratified

by port and, secondary, stratified by port and country. CS4-shke gave their best results for scenarios stratified by port and by port and quarter. The general conclusion, i.e. that the current sampling design stratified by country could be statistically optimized adopting a regional approach stratified by port, was then discussed under other points of view to give a feasibility perspective. Besides statistical considerations, coverage by country and also by domain (stock) can be compromised. For instance, countries with small landings of hake might see reduced their respective sampling plans, compromising other requirements for advice, as those related to other stocks or local management measures established by national governments. Hence further analyses are being considered that integrate biometrics (length sampling), cost–benefit analyses, and concurrent or single-stock sampling.

2.4.3 FishPi ecosystem impact data not currently collected (stomach contents/PETS/Recreational and Small Scale fisheries)

The main objective of this WP is to define a future regional sampling plan to collect data on bycatch of PETS (Protected, Endangered and Threatened Species) species, stomach content of fish and small scale and recreational fisheries. Nowadays, PETS and stomach contents are collected outside of the DCF umbrella. This means that sampling and data collection are not mandatory for MS or institutes under their DCF national work programmes, although Member States should report bycatch of cetaceans under Regulation 812/2004. So, coordination of the sampling and data collection of these variables has never been discussed and analysed yet.

In the case of small scale and recreational fisheries, these two fisheries are already included in the DCF. However, due to their special characteristics, these fisheries are quite difficult to sample, they are not recorded exhaustively and they must be estimated from sampling surveys. Probably different MS and institutes are using different approaches without any regionally coordinated approach.

The collection of these data has important implications both in the implementation of the regional work programmes and the added cost of them. Under this WP, different methodologies have been identified to collect data on the mentioned variables. Once the end-users needs are defined (i.e. data and estimates need, precision and accuracy etc.), these possible methodologies should be analysed, considering the strengths and weakness of them. Finally, cost–benefit analysis should define the best methodologies to adopt. Good communications among end-users, data providers and regional coordination of different MS and institutes is essential in the whole process to reach to the aim defined.

2.5 Data presently used in stock assessment

As an overview PGDATA conducted a list from the ICES master stock table on all the stocks assessed within ICES and listed the assessments according to the type of assessment used, if it was based on survey trends only or if the assessment was a full analytic assessment based on age or length. This information is of course of interest if optimizations of the data collection are calculated. The list was further divided according to if the assessment had access to discard information and if this information was used in the assessment.

According to the ICES guidance on data limited stocks (ICES 2012), the assessed stocks in ICES should be categorized in one of 6 main categories:

- Category 1: Data-rich stocks (quantitative assessments)

- Category 2: Stocks with analytical assessments and forecasts that are only treated qualitatively
- Category 3: Stocks for which survey-based assessments indicate trends
- Category 4: Stocks for which reliable catch data are available
- Category 5: Data-poor stocks – only landing data are available
- Category 6: Negligible landings stocks and stocks caught in minor amounts as bycatch

Results from all ICES master stock table

Of the 313 stocks recorded in the ICES master table from 2014, 92 stocks were assessed as a category 1 assessment where the main part was conducted as age based assessment (60) using information from both the commercial catch and from a scientific survey. The main part of the assessments included the discard information in the assessment or considered the discard to be negligible.

Category 1 stocks assessed within the ICES system:

AGE BASED MODELS	60
Production/biomass models	9
Length based models	6
Age based on survey only	1
Underwater TV	14
Total	92

Use of discards data for the category 1 stocks:

ALL CATCHES ARE ASSUMED LANDED	4
Discarding is known to take place but cannot be quantified	4
Discarding included in assessment	33
Discarding considered negligible	40
Not included in assessment or advice	1
Used to provide advice, but not included in the assessment	6
Unknown discard status	4
Total	92

Only one stock was listed as a category 2 stock using an age- length structured model with an analytical assessment, where the assessment and forecast is only trends based.

Use of discards data for category 3 stocks:

UNKNOWN DISCARD STATUS	43
Discarding is known to take place but cannot be quantified	12
Included in assessment	4
Considered negligible	20
Used to provide advice, but not included in the assessment	18
Total	97

Use of discards data for Category 4 stocks assessed in ICES:

DLS APPROACH, DISCARD USED IN THE ADVICE	4
DLS approach, discard considered negligible	1
DLS approach, discard included	1
DLS approach, discard not included	3
Total	9

Most of the category 1 stocks have an age based assessment, and either the discard information was included or considered negligible in the main part of these stocks. This indicates that both ages and discard information is of course very important to conduct a full analytic assessment but also that the amount of data needed is relatively large.

Presently only very few stocks have included information on recreational fisheries in the stock assessment but the demand on these data will probably increase in future.

Suggestion for ICES master stock table.

To be able to conduct a full analysis it would be beneficial if the master stock table from ICES included the survey name used for the assessment. Presently it is not possible to see how many stock assessments a given survey is supporting.

Use drop down box as it is difficult to use the information that is not standardized. This is both the case for assessment type and for discard information. Include information on the survey acronym used in the assessment

2.6 Calculating the costs

For estimating direct costs, from design of data collection through implementation, lab analysis such as ageing, data archiving and QA, information on time/ or money spent on different work task is needed. Furthermore to see the effect of these different data input an analysis of the data's influence on the stock assessment is needed.

To start this process, templates are needed for defined stock assessment case studies, for people to fill in the time spent collecting data on specific data collection programmes such as RV surveys; port sampling; shore sampling. Examples for information needed is:

- staff numbers involved and time spent collecting and processing samples from the primary sampling units such as a trawl stations, ports, vessels sampled at sea, and time required for travelling to and from sampling sites
- Break down of staff time required for specific data collection at stations, ports, vessel trips and at lab, such as catch sorting, length measurements, otolith cutting and reading, maturity identification, collection of other samples, etc.)
- Staff time required for trip planning, data entry, QA.
- Some costs cover all species being sampled, such as daily RV costs – need to consider how to deal with this.

During PGDATA, detailed questionnaires were developed for each survey type (bottom-trawl survey, acoustic survey and egg survey) and then modified after the meeting, and can be found in annex 7.

In some countries there have already been some case studies on how to conduct more efficient sampling and in Norway there has been an attempt to optimize the survey time by analysing the towing time and haul duration. Other countries have analysed the time spent on reading otoliths to be able to compare the cost of different methods.

2.6.1 Norwegian model for calculating cost on survey time

In IMR in Norway a model for how to calculate survey cost has been developed. The model is estimating the benefits of reducing tow duration and increasing the numbers of stations. To do this exercise it is of course important to have information on travel duration between stations.

A model for survey cost (Pennington and Volstad 1991)

For a random survey with fixed cost, C, the number of stations, n_t, that can be sampled if standard tows of fixed duration t are taken at each location, is approximately determined by

$$C = (c_1 + t) \cdot n_t + c_2 \sqrt{n_t} \tag{0.1}$$

or

$$n_t = \left[\left\{ (c_2 + 4 \cdot (c_1 + t) \cdot C)^{1/2} - c_2 \right\} / 2 \cdot (c_1 + t) \right]^2 \tag{0.2}$$

where c_2 is a constant which depends on the survey area and the cruising speed between stations (see also Cochran 1977, p244; Pennington and Vølstad 1991). If the survey design is a grid of equally spaced stations, then the travel time will also be approximately proportional to $\sqrt{n_t}$ (Hansen, Hurwitz, and Madow 1953, p. 273), and formula (1.2) will hold.

2.6.2 Calculating cost from different age reading methods

Storage, processing, and ageing of calcified structures is obviously associated with a cost in terms of time. A range of different materials for storage and techniques for preparing calcified structures for age determination are applied across species. For several species, the choice of preparation method differs between laboratories within the same ecoregion and even within laboratories the methodology can differ between stocks of the same species. Each line of storage-processing-reading is associated with a certain time consumption depending on processing method, stock, reading method, and experience of the reader. When determining the costs of number of age-readings, the entire line must be included in the estimation and in this respect; it would be helpful for WKCOSTBEN to have an overview over costs by stock in the selected case-study surveys.

WKNARC1 (2011) made an overview of the processing and reading method by stock for all European institutes (Annex 11 in ICES 2011); this table could advantageously be expanded with the associated time for each step (where the reader experience must be considered 'average'). A way then to compile the cost by stock by survey could be to follow the system developed by the Institute for Agricultural and Fisheries Research (ILVO), where the actual step in the preparation is pinned out, so the actual cost in time by stock can be assembled (Figure 2.6)

Tasks for sectioning otoliths	Equipment	Time	per 100
Administration			0:40:00
Cleaning containers sea going observers	1 min per bak 70 st	0:01:00	0:01:00
Data handling & initial input in database	100 st	0:01:00	0:01:00
Make labels & stick on enveloppes (otoliths)	100 st	0:20:00	0:20:00
1st layer epoxy-hars	2 blokken (1 mal) +/-100 st	0:10:00	0:10:00
Embedding	150 st	1:30:00	1:00:00
Toplayer epoxy hars	2 blokken (1 mal) +/- 100 st	0:10:00	0:10:00
Mark blocks with line	2 blokken (1 mal) +/- 100 st	0:20:00	0:20:00
Cust & stick	2 blokken (1 mal) +/- 100 st	0:30:00	0:30:00
Digital image	150 st	1:45:00	1:10:00
Reading	150 st	2:00:00	1:20:00
Ages in database	100 st	0:03:00	0:03:00
Take epoxy out		0:05:00	0:05:00
Cleaning cutting device			0:05:00
Prepare for sending (when relevant)			0:30:00
Quality check on age (2 persons)			0:30:00

Figure 2.6 – an example of a detailed time-budget for storage-processing-reading of otoliths (ILVO)

Another example was provided from Cefas were numbers of otolith processed by day was given for all stocks, with different method applied. For the same species in different areas, very different times were spent on age reading per otolith due to different methods of preparation of the otolith and presumably some regional differences in the ease of interpretation of the annual marks (Figure 2.7).

Method	Otoliths processed per day
Sectioned and Stained (sole and turbot)	100
Sectioned	120
Pelagic	300

Species	Area	no/day
ANF	106/7	100
POL	107d	500
BSE	107e/h	150
BSE	107a	100
BSE	107f/g	100
BSE	107d	100
COD	107a	500
COD	107d	400
COD	107e-k	500
HAD	107e-k	150
HKE	107	150
LIN	107	300
LEM	107e/k	60
MAC	107	300
MEG	107e-k	100
PLE	107d	400
PLE	107f/g	400
PLE	107a	100
PLE	107e	80
SOL	107f/g	400
SOL	107e	400
SOL	107h-k	80
SOL	107a	400
SOL	107d	400
WHG	107e-k	300
Species	Area	no/day
BSE	104	150
COD	104	400
HAD	104	150
HER	104c	300
LEM	104	60
PLE	104	400
POK	104	300
SOL	104c	150
TUR	104	200
WHG	104	250

Figure 2.7. Numbers of otolith reading a day from different stocks conducted by Cefas

PGDATA suggests that the laboratories involved in the selected survey case-studies in WKCOSTBEN update the overview table compiled by WKNARC1 in order to estimate the costs related to age-reading in the surveys. WGBIOP could then be asked to review the various methods applied and provide an estimate of the uncertainty associated with each combination of storage-processing-reading by stock.

2.7 Improving cost-benefits

It was decided that although it was important to look at the overall contribution of data (both commercial and scientific) to the assessment and advice, the WKCOSTBEN should go into more detail on how research surveys could be optimized in respect to the stock assessment and advice.

Research surveys can be improved in several ways:

Better sampling design and implementation (e.g. improved coverage; more statistically sound and efficient stratification and sample selection; optimization of sample allocation between strata): Reducing sampling at primary sampling units - such as reduced tow duration on surveys – when this can lead to more accurate estimates by providing time for additional tows or allowing more accurate sampling of catches. PGDATA discussed how cluster sampling effects could be avoided or reduced. It was highlighted that it is important to define strata and allocate survey effort according to expected variation (high abundance -> high variation) and to avoid haul stations being too close together. For the latter problem, examples from the International Bottom Trawl Survey (IBTS) and Baltic International Trawl Surveys (BITS) were mentioned. In the IBTS Manual (ICES 2012), however, it is stated that "Vessels are free to choose any positions in the rectangles that they are surveying if hauls are sufficiently far apart from each other: In rectangles or strata that are to be sampled more than once by the same vessel it is recommended that valid hauls are separated by at least one day or by at least 10 miles wherever this is possible. Tows in adjacent rectangles should also be separated by at least 10 miles." PGDATA suggests that there could be a general "buffer zone" around a taken haul in which no subsequent haul (may it be in the same rectangle/stratum or in adjacent area) should be taken. With regard to total survey effort spent on trawls only, there is some potential to reduce tow duration without decreasing precision of the estimates (see, e.g., Pennington & Vølstad 1991) while at the same time freeing time available for, e.g., sampling of other ecosystem variables or increasing the number of stations.

There are several additional simple possibilities for gaining efficiency, e.g., to make best use of survey day, by for example adjusting the timing of sampling to daylight/night conditions instead of adhering to fixed working times; or to use salinity/temperature sensors attached to the gear instead of full CTD probe casts (if sufficient data quality can be assured).

Taking into account other initiatives on improving surveys (WGISUR, WGISDAA, WKPIMP, EIMSD, etc.), **PGDATA proposes that survey planning groups critically analyse their survey design with regard to efficiency of the effort spent on surveys.**

Reducing staff time in obtaining data (e.g. using electronic data entry; automated data collection or sample processing; optimized RV survey tracks): It could also reduce staff time if a proper calculation were conducted on how many fish per station and species actually need to be measured to meet the requirement of the assessment and advice. If increased precision is not reached although 1000 (or more) fish are sampled due to cluster effect, staff time would probably be more wisely spent if allocated to other parts of the survey. Furthermore, former PGCCDBS work shows that a wide range of technical improvements for recording biological and vessel or gear parameters, such as digital measuring boards, electronic recording devices for station and fish data etc., have been discussed and reported on. PGDATA was made aware of several recent developments that may be taken into account when considering improvements for data

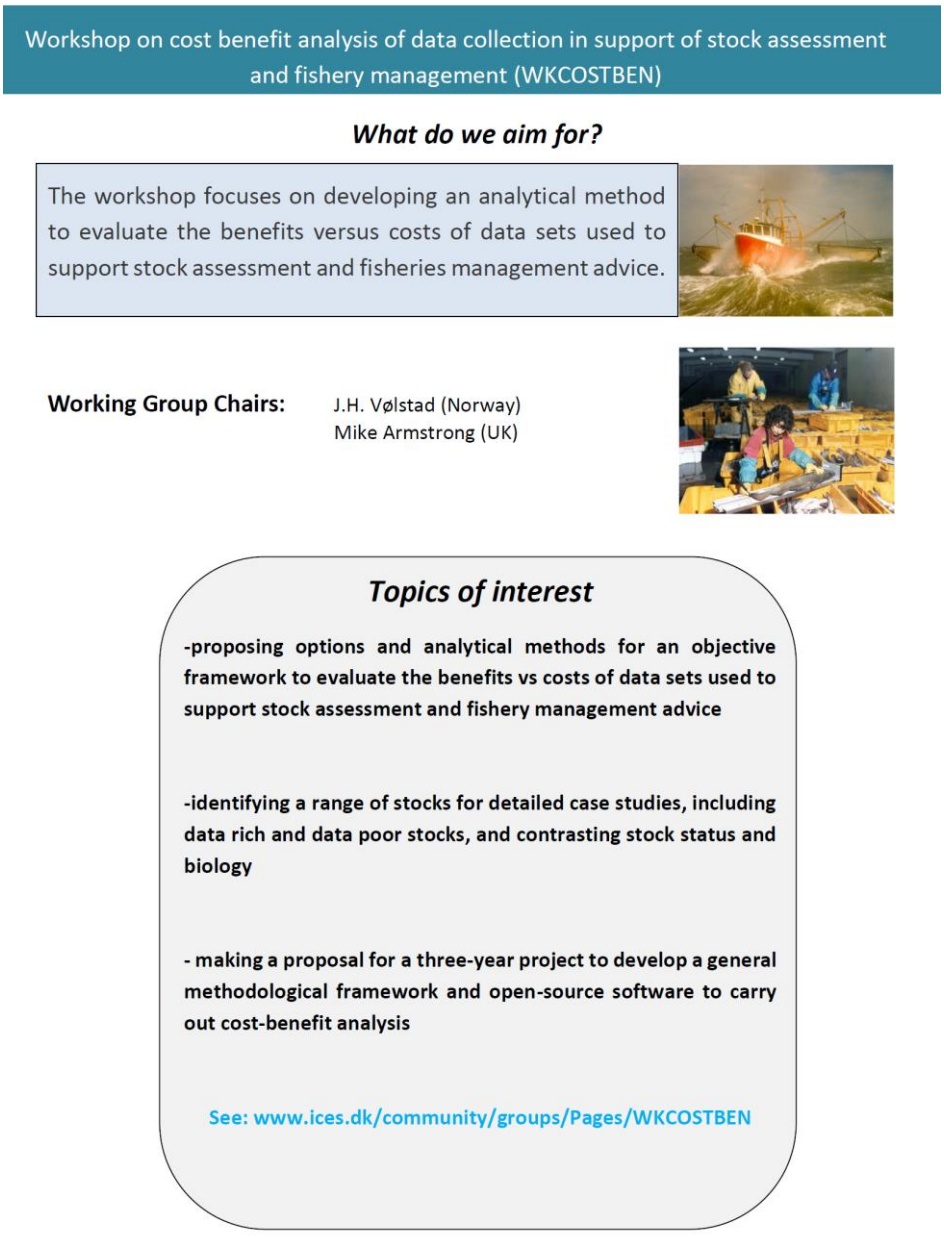
collection on research vessels. In this respect, **PGDATA would welcome a workshop on technological developments for data collection and data processing at sea**.

Improving accuracy of measurements: Aspects like image analysis and increased exchange of calcified structures and calibration workshops should also be considered as means to improve accuracy of final data.). This is an important area for improving cost efficiency by reducing errors in data.

Development of databases and software tools to streamline the tasks of data quality assurance, data analysis and reporting: To do proper cost benefit analysis it is very important that data are stored in a database that can be accessed by end-users. Not all international coordinated surveys are presently hosted in an international database and this needs to be developed. However, it is likely to be not the most cost-effective approach to have hard-wired, inflexible code for all the quality assurance or even index calculations with information on uncertainties for the surveys. This part could be placed outside the database in an open source environment were scientist could contribute to the development of the software tools to do the analysis and calculations. A depository for coding that could be used for all kind of data quality analysis (effective sampling size etc.) could be hosted by ICES. This depository could also include the ICES approved code for calculation etc. survey indices on DATRAS format. This would facilitate an environment where scientist would develop and share software coding that could be beneficial in quality evaluation and optimization.

2.8 Structure of WKCOSTBEN workshop

To attract scientist to the workshop a flyer was developed and circulated in the ICES community.



2.9 Planning of ICES theme session on "When is enough, enough".

One of the ToRs in this year's PGDATA was to plan the 2016 ASC Annual Theme session on data sampling "when is enough, enough? Methods for optimizing, evaluating, and prioritizing of marine data collection" in connection to the ongoing activities in PGDATA. The theme session is very closely linked to the CostBen workshop and as with the workshop a flyer was developed to circulate in the ICES environment.

http://www.ices.dk/news-and-events/asc/ASC2016/Pages/Theme-session-O.aspx

ICES ASC theme session O

"When is enough, enough?"

Methods for optimising, evaluating, and prioritising of marine data collection

What do we aim for?

This session aims to bring together fisheries scientists and statisticians with expertise in survey sampling design and analysis, practical experience with data collections, stock assessment modelling, cost benefit analysis, simulation studies, and statistical analysis to assess our current ability to quantify uncertainty in input data, and to track how uncertainty in input data propagates through stock assessment models to affect harvest rules.

Conveners: J.H. Vølstad (Norway)
Mike Armstrong (UK)
Marie Storr-

Papers welcome!

-Objective methods to identify and prioritize data needs and evaluate the quality of datasets

-Data collection programs and simulation studies to support the ecosystem approach with cost effective designs and documented quality

-Sampling and analysis methods that follow best scientific practice

- Methods that reflect assessment uncertainty

-Incorporation of sampling errors in input data in the assessment model and evaluation of model fit to observation data

-Demonstration of how management decisions are affected by uncertainty in survey data and stock assessment

See: www.ices.dk/news-and-events/asc/ASC2016/Pages/Theme-session-O

Co-sponsored by

PICES

In support of:

Assessments and advice

ICES CIEM

Marine spatial planners

Ecosystems scientists: NGOs

3 Collaboration with SSGIEOM / WGISDAA ToR ii and VIII

The PGDATA 2016 meeting addressed four separate terms of reference which relate to the role of the PG in relation to the other expert groups falling within the ICES Steering Group on Integrated Observation and Monitoring, and in relation to end-users of data. The relevant ToRs are given below:

ToR (ii): Review outcomes of consultations, to be done prior to PGDATA meeting, with ICES SSGIEOM chair and EGs on implementing the SSGIEOM ToR to "Promote the development within EGs of standards and guidelines for good practice in data collection covering the design and implementation of surveys, fishery and other related data collection programmes, the archiving and interpretation of data and samples, the analysis of data, provision of data quality indicators, and the documentation of procedures".

ToR (iv) Develop actions in response to pre-meeting consultations with end-users on PGDATA role, including the potential roles for PGDATA to provide expert support to the Regional Coordination Group process under the revised Data Collection Framework

ToR (vii) Map the skills required for the PGDATA future work programme.

ToR (viii): Develop a strategy for collaboration between PGDATA and WGISDAA (ICES WG on improving use of survey data in assessments and advice) on topics of common interest.

These ToRs were addressed together in this report section, as they all relate to how PGDATA should operate in its second 3-year period from 2017 – 2020. Proposals for future collaboration between PGDATA and WGISDAA (ToR viii) also relate to the continuation of these expert groups beyond their present 3-year terms, i.e. from 2017 onwards. The report section is structured as follows:

- The current structure and goals of SSGIEOM
- Consultation with chair of SSGIEOM
- Review of PGDATA's contribution to SSGIEOM in its first two years
- Options for future role and operation of PGDATA

3.1 SSGIEOM structure and goals

SSGIEOM is one of five ICES Steering Groups set up to help ICES implement its science and advisory strategy (Figure 3.1). It is a joint ACOM/SCICOM steering group with (currently) 21 working groups and planning groups dealing with survey planning and operations, survey methods and development, recreational and commercial fishery catches, fishing technology and fish behaviour, and overall data needs and delivery for supporting ICES advice (Table 3.1). These include PGDATA and WGISDAA which both address end-user needs for data products and supporting information, particularly (but not exclusively) in support of stock assessments. A related EG, WGISUR, focuses on how research vessel surveys could best be altered to support end-user needs for data supporting regional ecosystem assessments. The current ToRs for these three groups are given in Table 3.2. There are also 13 workshops currently listed in the ICES website as falling under SSGIEOM.

Table 3.1. Working groups and planning groups under umbrella of SSGIEOM. Excludes workshops (see Annex 9 for list of acronyms and full names)

TYPE OF EXPERT GROUP	ACRONYMS	N
Survey Planning and operations	WGALES, WGMEGS, WGACEGG, WGEGGS2 WGIDEEPS, WGNEACS, IBTSWG, WGIPS, WGBIFS, WGBEAM, WGNEPS	11
Integrated surveys for ecosystem approach	WGISUR	1
Design of surveys and use of data	WGISDAA	1
Acoustic survey methods and technology	WGFAST, WGTC	2
Fishing technology	WGFTFB, WGELECTRA	2
Data collection from commercial fishery catches	WGCATCH	1
Recreational fishery surveys	WGRFS	1
Biological parameters	WGBIOP	1
ICES data needs and end use	PGDATA	1

Table 3.2 Overall ToRs for 1-3 years of WGISDAA and WGISUR

3-year ToRs of PGDATA
a. Design and test a Quality Assurance Framework for assessment EGs to evaluate data quality and its impact on assessments, particularly within the benchmarking process, and test this in regional case studies
b. Develop and test analytical methods for identifying improvements in data quality, or collections of new data, that have the greatest impacts on the quality of advice
c. engage with end-users to raise awareness of what types and resolution of management decisions (e.g. by fleet or area) can realistically be supported by present or proposed data collections
d. Advise on objective methods for evaluating requests by end-users for new or amended data collections within the new DCF/DC-MAP
e. Plan workshops and studies focused on specific methodological development needs
3-year ToRs of WGISDAA
a. To work together with assessment working groups to provide resolution to assessment issues prioritized by the assessment working groups
b. To work together with survey working groups to provide resolution to problems associated with index calculations, survey design changes (proposed or realized) to ensure efficient and effective use of survey resources
c. Initiate with ACOM and secretariat a process to identify upcoming issues associated with the use of survey data in benchmarks. This should be initiated as soon as the benchmark process is started
3-year ToRs of WGISUR
a. Provide guidance on the adaptation of existing surveys to provide ecosystem data
b. Provide guidance on the development of an ICES ecosystem survey approach
c. Identify issues common to all surveys, set up workshops and manage them as appropriate.
d. Liaise with IEA groups, and others as appropriate (e.g. CWGMSFD), over data product needs and specification

The three-year plan for SSGIEOM includes the following tasks (Table 3.3), which are also reflected in the main objectives of the SSGIEOM element in the ICES Implementation plan for its Strategic Plan, under the goal to " *Identify and prioritize ICES monitoring and data collection needs":*

Table 3.3. The objectives for SSGIEOM as laid out in the ICES Science Plan

ICES Integrated Ecosystem Observation and Monitoring Programme (IEOM)	Identify and prioritize ICES monitoring and data collection needs	1.1 Identify monitoring requirements for science and advisory needs in collaboration with data product users, including a description of variables and data products, spatial and temporal resolution needs, and the desired quality of data and estimates. 1.2 Develop a cost–benefit framework to evaluate and optimize monitoring strategies in the context of the capabilities of, and requests from, ICES Member Countries and clients.
	Develop further the methodology for the observation and monitoring of marine ecosystems in the ICES area.	2.1 Identify knowledge and methodological monitoring gaps, and develop strategies to fill these gaps. 2.2 Promote new technologies and opportunities to observation and monitoring, and assess their capabilities in the ICES context.
	Implement integrated monitoring programmes in the ICES area.	3.1 Allocate and coordinate observation and monitoring requests to appropriate survey expert groups, on fishery-independent and fishery-dependent surveys and sampling, and monitor the quality and delivery of data products. 3.2 Ensure the development of best practices through establishment of guidelines and quality standards for each aspect of surveys or other sampling and data collections, external peer reviews of the data collection programmes, training, and capacity-building opportunities across expert groups.

These objectives are wide ranging and could be met most effectively if the expert group system is steered by a strategic group of experts with experience in statistical and other aspects of data collection that is balanced across the landscape of data needed to support ICES advisory role, as well as knowledge of how these data are used, and by whom. Experience so far has shown that this strategic role cannot be performed effectively by a single SSGIEOM chair interacting with a large number of constituent EG chairs each of whom is focused on a relatively narrow data collection topic such as an individual survey programme. The current system has worked for some specific and clearly focused tasks such as developing survey overviews and protocols and lists of survey data products, but extending beyond this has proved difficult. This is discussed in more detail in the following section.

3.2 Consultation with SSGIEOM chair

The PGDATA chairs and SSGIEOM chair discussed the current structure and achievements of the SSGIEOM Expert Groups and the main problems that have been encountered in delivering the goals of the SSG, particularly in relation to the quality assurance, optimization and delivery of data products. The discussion focused mainly on survey EGs, as these are the ones which the current SSG chair is most familiar with and has most interaction with.

It was noted that good progress has been made in documentation of surveys and survey protocols (Series of ICES Survey Protocols - SISPs). This addresses part of SSGIEOM goal 3.2 (Table 3.2)

The main problems identified were communication issues between survey EGs and stock assessment EGs, and identifying the types of information that survey EGs should

deliver to stock assessment EGs for annual update assessments as well as for benchmark assessments. Clear guidelines to the survey EGs and assessment EGs are needed for this. Chairs of EGs under SSGIEOM have been asked what skills their groups lacked – in some cases the need for people with more analytical skills was identified, but in other cases that was not seen as an issue.

In relation to communication, the discussion with the SSGIEOM chair concluded that:

- There are many EGs under the SSG, but people involved in stock assessment are not always aware of the groups and what they deliver.
- The survey EGs do not get much feedback from the stock assessment EGs in relation to use of the data or why data are not used for any reason following a benchmark.

In relation to delivery:

- Assessment EGs would like, in addition to the survey indices, information about surveys that can be used directly in the assessment or for describing data quality issues. This could include changes in survey design from previous year, factors that may lead to unusual results such as disruption due to weather, other survey quality indicators such as CVs or other metrics.

PGDATA discussed these problems and had the following responses:

Communication

A brief presentation from the Secretariat at the start of each assessment EG meeting could be a simple means or raising awareness of SSGIEOM and its constituent EGs, what they can deliver, and where to find out more information. This should point to where on the ICES website people can find out more information. Links to the SSGIEOM web page could be improved to make the page easier to find. The information on the page should be revised to provide more information to assessment EGs and other end-users about what the SSG covers and the data products provided by its constituent EGs, including survey overviews and who to contact for information they need, with links to survey data portals such as Datras or pointing to sources of other survey data not on Datras.

A procedure is needed for assessment EGs to provide feedback to the relevant SSGIEOM EGs on the end use of data. A guideline for this should be drawn up and be part of the standard assessment EG and benchmark reports. As a starting point the feedback to the EG could be a list of all surveys used in the stock assessment with information on years used, age groups and maturity.

PGDATA has proposed a new way in which the SSGIEOM and its supporting EGs could be structured and how they would operate. This is described in Section 3.4. This restructuring would help the flow of information from data EGs to end-users and back again.

Delivery: roles and responsibilities

The SSGIEOM and WGISDAA chairs believe that the survey EGs should be responsible for supplying survey indices and associated quality metrics directly to assessment EGs. The survey groups have the best knowledge of the survey characteristics and the implementation of the surveys each year, and should be able to interpret any unusual changes in calculated indices and length or age compositions. This indicates that although the indices in some cases are calculated directly in Datras it is the responsibility of the survey working group that the results are quality

The provision of abundance indices or estimates for use in stock assessments varies between survey EGs, and the main factor is whether or not the data are in Datras, which has inbuilt routines for computing indices. The annual IBTSWG reports provide detail on coordination activities, and results such as basic distribution maps. The abundance indices or precision values are obtained at a later stage by stock assessment scientists using the options on the Datras site. In some cases the assessment scientists may also have close involvement in the surveys and understand the survey design and any issues with implementation, however there will be cases where stock coordinators or assessors obtain the indices from Datras but do not have the knowledge of the surveys to allow any *a priori* evaluation of data quality behind the indices. Furthermore, the Datras SAS routines for calculating abundance indices, particularly by age, may not be transparent or fully reviewed. The IBTSWG is planning to collaborate with WGISDAA in development of a swept-area based abundance index which would require new code and peer review.

For acoustic and egg production surveys, the people designing and running the surveys are generally more closely involved in the analysis procedures and therefore provide the abundance indices or estimates directly to assessment working groups, along with any estimates of precision and size or age compositions. For example, scientists involved in egg production surveys are involved in calculating biomass from egg production, fecundity and (for DEPM) spawning fraction data collected in the surveys, and these are reported by EGs such as WGMEGS. Similarly, countries involved in designing and running acoustic surveys are more likely to be involved in computation of biomass estimates which are reported directly by the acoustic survey EGS (e.g. WGIPS). ICES is currently at an advanced stage in developing a database for acoustic survey data.

The WGISDAA and its future evolution could play a key role in ensuring that production of survey abundance indices follows the design of the surveys, and that all such analysis routines are peer reviewed. There would be large benefits in developing a library of tested and reviewed open-source software such as R to develop analysis routines, including codes that could be adapted to a wide variety of surveys which have fundamentally the same design structure. If not already available, code is needed to provide plots and other diagnostics needed to help in evaluation of survey data prior to calculation of abundance indices as well as to inform end-users about the data from a survey. This has been the approach in Norway using the StoX code developed there. Code of this type is needed for routine application by ICES survey EGs to provide diagnostics, indices and quality indicators, and this could be coordinated by WGISDAA or equivalent group of experts in the future. Available through an ICES page (Datras). This means that the survey EGs themselves do not necessarily need extensive statistical expertise to deliver abundance indices and data quality indicators where these can easily be derived by them using agreed and tested code. However they should have members with sufficient understanding of statistical survey design and implementation, and how to interpret diagnostics and advise assessment EGs on specific quality issues.

They must be able to provide assessment EGs with stock assessment inputs (abundance indices, length or age compositions, precision estimates or other metrics such as sample sizes for composition data), together with distribution plots and other information needed to inform stock assessors about data quality issues.

Currently, the SSGIEOM survey planning groups have extensive expertise in implementation, but in some cases less expertise in statistical survey design, data analysis and calculation of precision etc. The recent WGISDAA expert group is intended to have the expertise in survey design and analysis to improve how survey data are supplied to and used by stock assessment EGs, particularly in the benchmark assessment process. The WGISUR also has a role in survey design and supply of data products, focusing on supply of data and estimates needed for ecosystem based assessments. PGDATA proposes a different SSGIEOM structure in which a group such as WGISDAA linking closely with WGISUR (to include the extension of surveys to include a greater ecosystem focus), acts as a core survey design and advisory group which has all the survey planning groups under its umbrella. Together they can deliver on:

1) Survey design and optimization
2) Survey implementation
3) Data quality assurance and archiving
4) Data analysis
5) Supply of estimates and additional quality information requested by end-users, such as CVs or other information on survey performance that will affect the end use.

Delivery of specific data products to end-users

Stock assessment EGs are just one end-user of survey data. They want information about surveys that is of direct use, as well as the survey indices, such as changes in survey design from previous year, factors that may lead to unusual results such as disruption due to weather, other survey quality indicators such as CVs or other metrics.

There are several routes for survey EGs to support the ICES assessment process:

- The benchmark assessment process (mainly the data compilation/evaluation process but also the stock assessment process where advice is needed). The Annex 4 of PGDATA 2015 (ICES 2016) gives detailed guidelines on what must be presented and evaluated for each data type in the data evaluation process, including data from RV surveys. The survey EGs should have a major input into this process in describing survey designs, coverage, sampling levels, analysis methods, time-series of indices and quality evaluation of the data.
- Annual update stock assessments. The requirement is to provide the updated indices, together with additional information that may be used in the assessment (such as CVs of indices, survey maps at various resolution), or that is needed to indicate other factors causing potentially large bias in the most recent updated indices, such as partial coverage due to bad weather or vessel problems, changes in survey design, other factors affecting catch rates, and calibration study results where vessels or gears have been changed.

- Regional integrated ecosystem assessments. This will be an increasing role as surveys are adapted to deliver a wider range of environmental and ecosystem data. The need for clear information on data quality applies to all such data products.

The survey EGs need clear guidelines on what information must be provided to the assessment EGs requiring the data for the annually updated assessments. The forthcoming Workshop to establish reporting guidelines from survey groups (WKSUREP) will focus on creating a data reporting guideline document from the survey groups, by:

- interacting with the survey expert groups to ensure that the guidelines comply with the current requirements from the survey groups
- interacting with the data users to ensure that the guidelines include key information for the use of the data, including a brief summary of time-series changes, precision estimates, survey overview tables etc.
- gathering input from WGISDAA and PGDATA
- developing guidelines for survey group reporting that standardize the content of survey reports.

Timing of data delivery by survey EGs

The timing of delivery of survey data products must align with the dates of the assessment process. Benchmark assessments are usually working with the data used by the previous update assessment, but update assessments need the latest survey data. The survey EGs can only provide abundance indices once any onshore work such as fish ageing, acoustic data analysis or fecundity estimates have been completed and all data have been entered and quality assured. The final abundance indices must be available far enough ahead of the assessment EG meeting to allow completion of pre-meeting assessment runs, and also to allow time for the assessment scientists to decide how to handle any issues that have arisen with the latest survey. Regional ecosystem assessments may also require other types of data collected from surveys which involve laboratory analysis of samples or data processing on shore.

Training needs

The capability of survey EGs can be enhanced by training in skills such as survey design and analysis. Courses on survey design have been run by ICES. The survey EGs need to map their expertise and advise the SSGIEOM of training needs so that training courses can be organized when sufficient need arises.

3.3 Review of PGDATA's contribution to SSGIEOM in its first two years

The 3-year ToRs of PGDATA (Table 3.2) focus on data needs and end use. This includes ensuring the implementation of quality assurance frameworks to improve the quality of data supplied to end-users, developing methods of evaluating cost–benefit of data collection, and working with end-users to ensure that data needs and data supply are aligned as effectively as possible. This means that quality of data should be well documented and understood before use, and that any requests by end-users (including groups carrying out scientific assessments) for new data or changes in amount of data or the way existing data are supplied (e.g. resolution) should take into account feasibility, costs, impacts on assessment results and other criteria as identified by STECF EWG 13-02 (see Table 2.1).

In 2015, PGDATA (ICES 2016) drew up detailed guidelines for how data should be evaluated in the ICES benchmark stock assessment process, addressing the fundamental need for quality assurance and transparency in evaluating the quality of data before they are used. These guidelines are already proving to be valuable in the preparation for the delayed September 2016 data evaluation workshop for the WKIRISH benchmark stock assessments of Irish Sea cod, whiting, haddock, plaice and herring. During 2016, the focus of PGDATA shifted to the development of a cost–benefit framework for data collection, including planning for the June 2016 WKCOSTBEN and the 2016 ICES ASC theme session on the same general topic ("When is enough, enough?"). The third year of PGDATA will largely consolidate the progress on these two topics.

3.4 Options for future role and operation of PGDATA

Mapping of PGDATA with SSGIEOM goals

The PGDATA 3-year workplan has strongly addressed SSGIEOM goals 1.2 and 3.2 (Table 3.3), focusing on quality assurance of data quality applied in assessments, particularly in the benchmark process, and beginning to develop a cost benefit framework for identifying improvements in data quality, or collections of new data, that have the greatest impacts on the quality of advice. The SSGIEOM goals 2.1, 2.2 and 3.2 are clearly within the remit of the SSGIEOM expert groups dealing with the design and implementation of data collection programmes such as RV surveys, fishery sampling and collection of data on biological parameters.

The remaining SSGIEOM goals 1.1 and 3.1 imply the need for a cross-cutting group of experts tasked with identifying ICES science and advisory needs for data, identifying how these could be met through quality-assured and cost-effective programmes of data collection, and working with ICES data EGs and other end-users of data products to develop appropriate terms of reference for ICES EGs to address delivery of the data and its quality assurance. The PGDATA has a potential role in this process as it differs from the other EGs within SSGIEOM in having no specific focus on particular types of data- it addresses the higher-level goals of SSGIEOM that are common to all the individual data groups. PGDATA has annual meetings currently attended by chairs and other experts from end-user groups such as RCMs, STECF, stock assessment EGs, and from the ICES data groups WGCATCH, WGRFS, WGBIOP and some of the survey EGs. The ToRs of PGDATA and WGISDAA (Working Group on improving survey data for assessments and advice) overlap in relation to working with the ICES stock assessment benchmark process to improve the evaluation and use of data (Table 3.2), which led to the addition of PGDATA ToR viii to "Develop a strategy for collaboration between PGDATA and WGISDAA".

Possible change in structure and functioning of SSGIEOM and PGDATA

PGDATA discussed at this year's meeting an alternative structure for the SSGIEOM and PGDATA in the future. Presently, SSGIEOM includes a diverse collection of 26 Working Groups dealing with fishery, survey and biological data collection and fishing gear technology, plus a series of related workshops. The working groups dealing with RV surveys far outnumber those dealing with fishery data collection and biological parameters (WGCATCH, WGRFS and WGBIOP) which are more recent additions to the SSGIEOM. The SSG chair is tasked with delivering the steering group goals through consultation with the WG and WK chairs. The SSGIEOM has not held many physical meetings but has worked by correspondence (WebEx / skype) and the main focus has been on the scientific surveys. Given the large number of EG chairs, physical meetings with full representation are extremely difficult. The process has however been successful in fulfilling the task of preparing survey overviews and protocols as an important contribution to quality assurance and availability of documentation to end-users. A strategic overview of broader ICES data needs and translating this into EG ToRs has however not been achieved.

PGDATA considered alternative models for steering the work of the SSGIEOM expert groups for supporting delivery the ICES science and advisory goals. Continuation of the present system of a chair of SSGIEOM dealing directly with a large number of WG and WK chairs was considered a poor option given the current diversity of the group. A better option would be to develop a Steering Group process achieving a better balance between the different types of data used in assessments, with increased focus on longer term strategic development and how these should translate into the ToRs for each EG, and facilitating communication on data aresues within the SSGIEOM, and between SSGIEOM, SCICOM, ACOM and other end-users of data products.

The Memorandum of Understanding between ICES and the European Commission defines ICES role in helping achieve the goals of the EU Common Fisheries Policy, which includes delivering expert advice and data products derived from datasets mandated under the EU Data Collection Framework. The annual Liaison Meeting involving the European Commission, ICES Secretariat, and chairs of STECF, Regional Coordination Meetings and ICES data Expert Groups such as PGDATA, has reviewed annual achievements and recommendations in relation to the DCF and indicates a key ICES role in continuous development of data collection designs and related analytical procedures supporting end-user needs within and outside ICES itself. The SSGIEOM occupies a pivotal position helping ICES fulfil this role, and can only be fully effective if it can consider the breadth of data needed by ICES and be able to give strategic advice on data needs.

The SSGIEOM structure proposed by PGData are shown in Figure 3.1. In this model, the steering process would be carried out by a group of experts which could be considered analogous to the current PGDATA (though not necessarily its present make up). Its membership would comprise a group of people with the following expertise:

- types of data collection processes required for integrated ecosystem observation and monitoring (including single-stock assessments);
- statistical design, implementation and analysis of data collection schemes
- data archiving and management within ICES;
- how the data are used in assessment and provision of advice for stocks and ecosystems, and what are the main data needs and gaps.

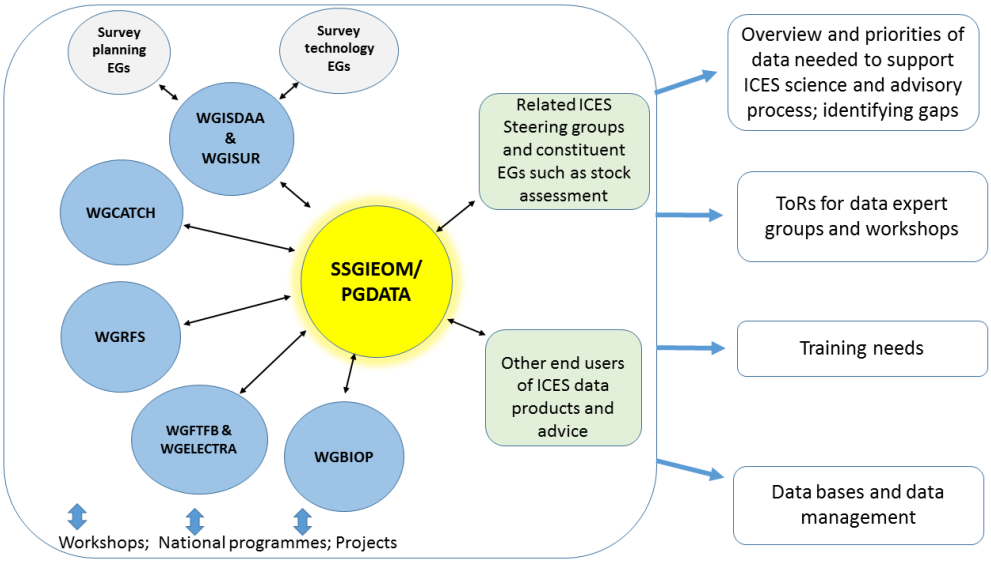


Figure 3.2. Suggestion by PGDATA on how SSGIEOM could be re-organized as a strategic data advisory group with membership derived from chairs (or other members with required skills) of constituent and related data EGs and end-users of data.

In practice, this membership could comprise representation from all the groups shown in Figure 3.2, so that SSGIEOM is not a separate entity but rather a group drawing expertise from relevant EGs and Steering Groups, to develop clearer evaluation of existing data needs and strategic view on future needs. It could include the current chairs of the data EGs within SSGIEOM; the chair of the ICES Data and Information Group; chairs of the other steering groups shown in Figure 3.2, and chairs of regional stock assessment EGs, or other members of those groups with the necessary experience and skills. Chairs of other key end-user groups outside of ICES such as EU Regional Coordination Groups should also ideally be involved. In this model, the SSGIEOM might appear to overlap substantially with the existing WGCHAIRS, but should be considered as a linked process as discussed later.

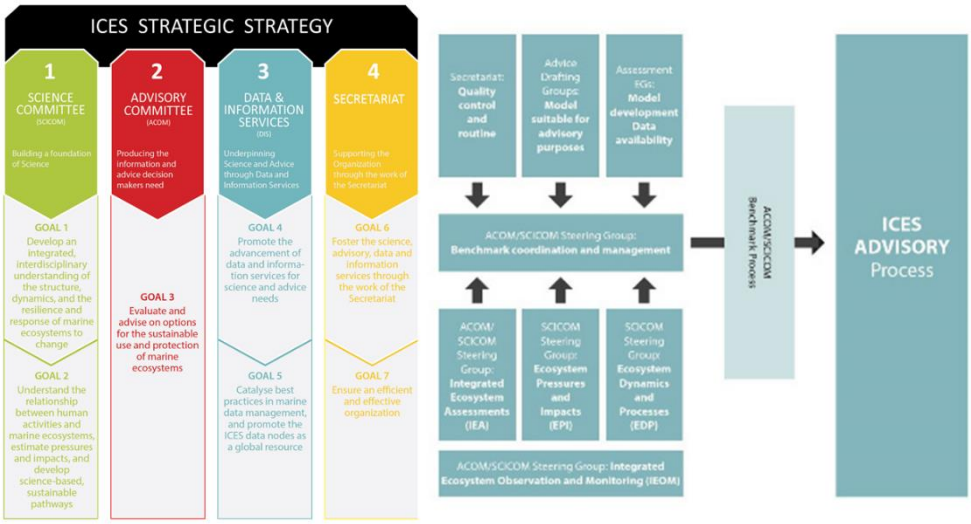


Figure 3.2. Goals of ICES strategic plan, and Steering Group structure. SSGIEOM and PGDATA fall under the science and advisory committees.

Due to the large number of technical survey EGs, it would not be feasible for the chairs of all of these to be members of the proposed new SSGIEOM/PGDATA steering group. It is proposed instead that the roles of WGISDAA and WGISUR are linked more strongly and that these groups take on a steering responsibility for the technical scientific survey EGs, essentially replacing the role that the current SSGIEOM chair has had in recent years. They would interact with the technical survey EGs to ensure that they are delivering quality assured data and supporting information that best meet ICES data needs, and that the annual ToRs of the groups reflect ICES needs for addressing its science and advisory strategy. The chairs or other key members of WGISDAA/WGISUR would be members of the proposed new Steering Group. WGISDAA could also support the scientific surveys EGs by advising on, and contributing to, the development of software tools (e.g. R scripts) for the survey groups to improve the survey diagnostics and quality indicators provided to stock assessment groups and other end-users and could be responsible for the review of survey designs and associated analysis. The current tasks of WGISDAA related to end-use of survey data in benchmark assessments (by stock or ecoregion) should continue, and the WG should promote the ongoing development of ICES survey databases (presently only IBTS bottom-trawl surveys are hosted by ICES).

WGISDAA and WGISUR should also be encouraged to review how the present structure of the technical survey EGs should be organized to best serve end-user needs and facilitate the steering process (this is currently being considered by the WGISDAA chair). Two basic approaches are to:

i) adopt a regional ecosystem approach and consider all the different types of surveys in the region (e.g. otter trawl, beam trawl, acoustics, egg and larva surveys) and how they could be better coordinated to support an integrated regional ecosystem assessment as well as single-species stock assessments(e.g. WGBFAS); or

ii) the approach with survey coordination groups for individual survey methods across regions (e.g. IBTSWG or WGIPS) or where there are stand-alone groups dealing with a single survey (e.g. WGMEGS). The survey type approach helps develop standardized approaches to surveys, databases and reporting for the same types of surveys, and is appropriate to development of time-series of abundance indices for stock assessments, but is less efficient for considering how surveys in a region could be adapted to give the best information on the different components of the ecosystem state such as abundance of benthos, demersal fish, pelagic fish and plankton, and more coordinated collection of data on ecosystem processes.

iii) a hybrid approach could be considered in which the traditional survey planning, coordination and technical development responsibilities for specific survey types is done on a multi-annual basis rather than annual, whereas an ecoregion based, multi-survey evaluation is conducted in intervening years to address needs for regional integrated ecosystem assessments.

In later discussion with the ICES Secretariat after PGDATA, there was support for the idea of a regional approach, where the overarching SSGIEOM/PGDATA steering committee could form task groups of experts to work with regional benchmarking processes to ensure a full review and evaluation of existing data and consider future data

needs as described by PGDATA 2015 (ICES 2016) in its guidelines for benchmark data compilation and evaluation processes.

The other main data EGs contributing to the proposed new Steering Group process are focused on fisheries data collection (commercial and recreational) and biological sampling of stocks. The current roles of these EGs are described below.

Working Group on Commercial Catches, WGCATCH

The WGCATCH is a relatively new group, which documents national fishery sampling schemes on shore and at sea, establishes best practice and guidelines on sampling and estimation procedures, and provides advice on other uses of fishery data. It builds on advances made in earlier expert groups including PGCCDBS and workshops developed by it (WKACCU, WKPRECISE, WKMERGE, SGPIDS and WKPICS). The WG also evaluates how new data collection regulations, or management measures (such as the landings obligation) will alter how data need to be collected and provide guidelines about biases and disruptions this may induce in time-series of commercial data. WGCATCH develops and promotes the use of a range of indicators of fishery data quality for different types of end-users, and also includes a focus on the science behind different aspects of fishery data collection and estimation each year, such as data collection issues for small-scale fisheries (2015 meeting), regional sampling designs (2015 meeting), estimation and catch-per-unit-effort data (2016 meeting). The development of sampling designs that follow the principles of statistically sound sampling has been an ongoing process by WGCATCH and preceding workshops and study groups since the late 2000s. An additional topic covered by this EG is the improvement data collection on rarer species and PETS on board commercial fishing vessels, a topic that is addressed in collaboration with WGBYC (2015 and 2016 meetings).

If a given country/ institute is not participating in WGCATCH or ICES training courses, there is a reduced likelihood that it will develop their sampling programme according to the guidelines for good practice. To reduce this possibility, PGDATA considers that WGCATCH could in future identify these possibilities and plan further workshops on fishery sampling design where such countries / institutes are encouraged to attend and which also provide additional training opportunities for existing or new staff in countries already participating in WGCATCH. This could be planned in the same way that WGBIOP plans age and maturity workshops to standardize the age readings and maturity stages between countries. To support its continuing role, PGDATA sees the Regional Database (RDB) for fishery sampling data (currently hosted at ICES but requiring further development of functionality) as the main database to hold the commercial data at a level where data quality can be assessed, and that a strong link between the ICES RDB steering group and WGCATCH should be maintained, including also the linkage of InterCatch and RDB development.

Working Group on Biological Parameters (WGBIOP)

WGBIOP took over the responsibilities of PGCCDBS (Planning Group on Commercial Catches, Discards and Biological Sampling) on coordination of a practical implementation of quality assured and statistically sound data collection methods, and associated standards and guidelines, for the provision of accurate biological parameters for stock assessment purposes. The group also focuses on accuracy in life-history parameter estimations to support stock assessment, and how parameters may change over time and related causal factors. WGBIOP provides a bridge between the data collectors and end-users that has often been lacking. Considering the broadened tasks, the group

strongly depends on participation and experts from different disciplines (e.g. statisticians/biologists/ stock assessors, survey expert, National coordinators of age-and maturity-staging) and who will be invited in relation to the specific ToRs. As with WGCATCH, WGBIOP covers sampling in all countries, and is presently functioning very well with workshops specific for groups of fish or areas, and most European countries are participating in workshops relevant to them. In more recent years the WebGR software tool has functioned as a database were the quality of the data can be assessed and this has also improved the possibilities to conduct analysis where participants do not have to come to physical meetings. However, the WebGR is presently stored by AZTI (Spain) and needs to be further developed to be fully functional and this needs to be solved for BIOP to be fully functional.

Working Group on Recreational Fisheries Surveys (WGRFS)

WGRFS is the ICES forum for planning and coordination of marine recreational fishery data collection for stock assessment purposes, supplying recreational fishery data and estimates into the ICES stock assessment and advisory process, developing a quality assurance framework for the data and responding to the requirements of the EU Data Collection Framework (DCF) and other drivers. As with WGCATCH, quality assurance addresses the design, implementation, data archiving, and analysis methods to provide estimates and quality indicators. WGRFS builds extensively on experiences gained within and beyond the EU, and participants come from most European member states as well as Norway, USA, and Australia. The WGRFS also includes ToRs on other scientific aspects of data collection such as post-release survival and estimating economic value. Although WGRFS has participation from many European countries that carry out surveys, there is also the challenge that if a country of institute is not participating in the WG the country may not develop their sampling strategy according to best practices. Therefore PGDATA suggest WGRFS could adopt the same approach suggested for WGCATCH to consider further workshops on sampling design where countries / institutes not participating in the WG are encouraged to attend and which also provide additional training opportunities for existing or new staff in countries already participating. There is currently no ICES or other international database to hold national recreational fishery survey data. Although there are similarities with some sampling schemes for small-scale commercial fisheries, recreational fishery data are usually organized very differently from commercial fishery data and cannot be easily included in the Regional Database and national databases feeding into this. PGDATA suggests that this issue should be discussed in WGRFS and included in the SSGIEOM steering process.

Working Group on Fishing Technology and Fish Behaviour (WGFTFB)

The WGFTFB studies measurements and observations relating to scientific and commercial fishing gears, design and statistical methods and operations, and fish behaviour in relation to fishing, and therefore cuts across scientific research vessel surveys as well as interpretation of commercial fishery data including selectivity. It is concerned with all aspects of the design, planning, and testing of fishing gears used in abundance estimation, selective fishing gears for bycatch and discard reduction, as well as environmentally benign fishing gears and methods with reduced effect on the seabed and other non-target ecosystem components. The Working Group on Electrical Trawling (WGELECTRA) is closely aligned with WGFTFB and works on improving knowledge of the effects of electrical or pulse fishing on the marine environment.

3.5 Working Practices for the proposed new SSGIEOM structure

The major issue to be addressed with both the current implementation of the ICES expert group and steering group process, and for any proposed changes, is that ICES cannot force countries and laboratories to participate in any meetings or intersessional work. In some cases, for example responses to ICES data calls, countries are mandated under the EU Data Collection Framework to supply data. Although EU countries may cost part of ICES meeting attendance and intersessional work to their European Maritime and Fisheries Fund annual work programmes for the DCF, there is no longer a list of eligible meetings for funding, and attendance is at the discretion of each country and laboratory. Without any increase in national funding within ICES countries, the initiation of new expert groups, meetings and any associated non-mandatory intersessional work requirements will face major problems of attracting the people and skills that are needed. It is a major issue for ICES Expert Groups, particularly where there are cuts in funding for national institutes and laboratories that should participate in ICES meetings.

The revised SSGIEOM structure shown in Figure 3.1 implies that funding currently supporting PGDATA attendance and any intersessional work would also be available to support operation of a restructured PGDATA/SSGIEOM as described in the previous section. A major difference with the current PGData are that the membership of the restructured PGDATA/SSGIEOM would be predefined according to the chairs and key experts of the participating expert groups and other steering groups, and would not be open for countries to send national representatives as is done for WGCATCH, WGBIOP and WGRFS for example. A request for experts could be send as an annual ToR (from PGDATA/SSGIEOM) to the expert groups WGCATCH, WGBIOP, WGISDAA, etc. so they can contribute to the discussion. It would operate in a similar way to the annual WGCHAIRS meeting. Those EG chairs that would be invited to the new PGDATA/SSGIEOM may include some people already attending PGDATA, but would also include people for whom this would represent an additional meeting or intersessional work. The restructuring also implies that much of the SSGIEOM work with survey EGs carried out by the current SSG chair would be devolved to WGISDAA and WGISUR, which may require additional work by these groups.

A possible annual work programme for the restructured PGDATA/SSGIEOM could be as follows (this would need to be discussed and amended through more detailed discussions within ICES):

1) PGDATA/SSGIEOM members attend the annual WGCHAIRS meeting where (for example) a day is spent reporting back and discussing specific ToRs on data aresues, drafting ToRs for key-expert selection participating in PGDATA/SSGIEOM and strategic planning, which in turn can inform the issues to be addressed by SSGIEOM during the year. RCM chairs also usually have input to WGCHAIRS. Chairs of SSGIEOM data EGs (WGCATCH, WGBIOP, WGRFS, WGISDAA, WGISUR, WGFTFB & Electra), or experts from within these groups standing in for the chairs, would provide a review of their responses to their ToRs in the previous year and any recommendations arising.

2) An additional, dedicated PGDATA/SSGIEOM meeting could be considered possibly as a couple of days back-to-back with WGCHAIRS, or as a standalone meeting depending on costs and availability of members.

3) Assessment EG meetings during the year to be given a specific ToR to provide a brief report identifying key data quality issues affecting assessments

and advice, and any recommendations for new or altered data collection (in a standard format), to be forwarded by the chair to the new PGDATA/SSGIEOM via the Secretariat.

4) A small number of PGDATA/SSGIEOM Skype conferences (e.g. quarterly or timed according to timing of assessment EG meetings) to be held during the year to discuss the data aresues arising from assessment EGs (or groups of EGs), and to identify where new ToRs for data EGs within SSGIEOM are needed to address any of these.

5) PGDATA/SSGIEOM Meeting to be scheduled at the ICES ASC as part of the Steering Group meeting agenda to review the work done during the year and to take a forward look to the next year.

6) Consideration could be given to a post-PGDATA suggestion by ICES secretariat that the overarching PGDATA/SSGIEOM group or other equivalent data steering group could form task groups of experts to work closely with regional benchmarking processes, which also has significant time implications.

4 Response to recommendations

PGDATA received 3 recommendations from other working group. The first two recommendations were from the ICES Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK) and the last from Working Group on Southern Horse Mackerel, Anchovy, and Sardine (WGHANSA).

4.1.1 Recommendation 1 and PGDATA response.

Recommendation 1: *This year extra information on discard quality was provided in EXCEL spreadsheets that had to be sent to ICES Accessions. However, to ask for information on discard quality inside the Intercatch framework would make analyses and the creation of overviews much more efficient. It also ensures that the information on data quality is available at the same time as the data themselves (what was not the case this year). It avoids the many e-mails from ICES Accessions.*

PGDATA Response:

PGDATA fully agrees that if the data can be incorporated in InterCatch this would be preferable.

Adding more information is possible using some character string field used to provide general fleet information. An R script based on this format is proposed to generate a data quality assessment (sampling scheme and variability) report that can be provided easily to end-users.

InterCatch file version 1 provides some information on the data quality provided by the state members to the ices InterCatch database. A summary of the fields requested by the format is given in the Annex 8.

The species information table (SI) brings information on the variance of the landings or discards estimates (field 21, varCATON).

The species data table (SD) brings information on the realized sampling scheme and the variability of the estimators (number at length or age). Regarding the sampling scheme, the fields SampledCatch (field 18) is an integer number where the definition is up to the stock coordinator, giving the weight of the total catch for the given stratum or a sampling rate. General information are given by the total number of sample events for length (NumSamplesLngt, field 19) and age (NumSamplesAge, field 20), measurements and the total number of length (NumLngtMeas, field 20) or age (NumAgeMeas, field 20) readings. Variance of number of fish landed, variance of weight and length (fields varNumLanded, varWgtLanded and varLgtLanded).

Currently none of these fields are mandatory for the data call and some of them are not implemented in the current version of the format (i.e. fields values cannot be provided).

Some information can be added to the file using a character string placed in the information related field of the SD table (InfoFleet, InfoStockCoordinator or Infogeneral). The character string as to by precisely formatted, in order to parse easily the object to extract the requested information. For example, to add to the stratum the number of vessels n1 and the sampled one n2, with the trips t1 and the sampled trips t2, the character string can be formatted as follows:

v: n1-n2/t: t1-t2

With this coding, "v: 34-23/t: 298-12" means that 23 vessels of 34 for the given stratum were sampled during 12 selected trips out of a total at 298 trips.

A dummy dataset was generated to illustrate the use of the existing information to provide to end-user a short data quality assessment of the data provided by the member states. This example represents the numbers at length for landings, for 2 countries in 2014 and 2015 regarding one fleet.

To read the InterCatch csv file, the following script is used:

```
#library
library(dplyr,warn=F)
library(ggplot2)
library(pander)
#read the file
ic<-
read.csv("/home/moi/ifremer/pgdata/2016/test.csv",sep=",",header=F,stringsAsFactors=
F)
HI<-ic%>%filter(V1=="HI")
SI<-ic%>%filter(V1=="SI")
SD<-ic%>%filter(V1=="SD")
```

From the added information in the FleetInfo field, a table providing vessels and trips statistics with the sampling rates can be elaborated :

```
#parsing new fields in the SI table
aa<-SI%>%mutate(v=gsub("n:","",substr(V22,1,regexpr("/",V22)-
1)),t=gsub("t:","",substr(V22,regexpr("/",V22)+1,nchar(V22))))%>%
    mutate(vtot=as.numeric(substr(v,1,regexpr("-",v)-
1)),vsamp=as.numeric(substr(v,regexpr("-",v)+1,nchar(v))),
       ttot=as.numeric(substr(t,1,regexpr("-",t)-
1)),tsamp=as.numeric(substr(t,regexpr("-",t)+1,nchar(t))))
tab1<-aa%>%transmute(country=V2,year=V3,'nb of vessel'=vtot,'nb of sampled
vessel'=vsamp,'vessel sampling rate'=paste0(100*round(vsamp/vtot,2),"%"),
                'nb of trip'=ttot,'nb of sampled trip'=tsamp,'trip sampling
rate'=paste0(100*round(tsamp/ttot,2),"%"))
#print sampling rate
pander(tab1)
```

country	year	nb of vessel	nb of sampled vessel
Country1	2014	3	2
Country1	2015	6	1
Country2	2014	2	2
Country2	2015	5	4

Table continues below

vessel sampling rate	nb of trip	nb of sampled trip
67%	10	3
17%	15	2
100%	23	9
80%	12	2

Table continues below

trip sampling rate
30%
13%
39%
17%

Then, landings and associated standard deviation can be plotted (in our example, the 2015 landings of the country 1 have a larger standard deviation than the other declaration) :

```
#landings variability
dat1<-aa%>%transmute(country=V2,year=as.character(V3),caton=V19,varcaton=V21)
ggplot(dat1,aes(x=year,y=caton,group=country))+geom_point()+
   geom_line()+
     geom_errorbar(data=dat1,aes(x=year,y=caton,
     ymin=caton-sqrt(varcaton),ymax=caton+sqrt(varcaton)))+
     facet_wrap(~country)+ylab("landings (t)")
```

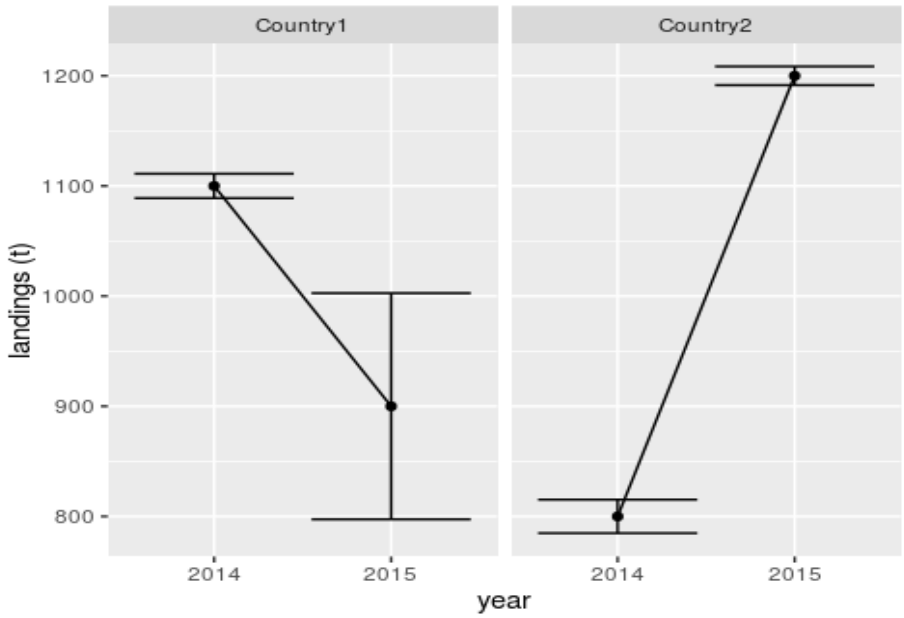


Figure 4.1. Landings and associated standard deviation the 2015 landings of country 1 have a larger standard deviation than country 2.

For the length distribution, a table can summarized the information used to compute the distribution :

```
#sd example
dat1<-SD%>%transmute(country=V2,year=as.character(V3),
                     'sample weight'=V18,'nb of fish measured'=V19)%>%distinct()
pander(dat1)
```

country	year	sample weight	nb of fish measured
Country1	2014	1100	1000
Country1	2015	800	1200
Country2	2014	900	900
Country2	2015	1200	900

The length distributions can be plotted with the standard deviation for each length class :

```
dat1<-
SD%>%transmute(country=V2,year=as.character(V3),length=V16,nb=V28,varnb=V31)#,V19
,varcaton=V21)
p1<-
ggplot(dat1,aes(x=length,y=nb))+geom_bar(stat="identity")+#geom_point()+geom_line(
)+
```

```
   geom_errorbar(data=dat1,aes(x=length,y=nb,ymin= nb- sqrt(varnb), ymax = nb+
sqrt(varnb)))+
   facet_wrap(year~country)+ylab("nb (x1000)")
   print(p1)
```

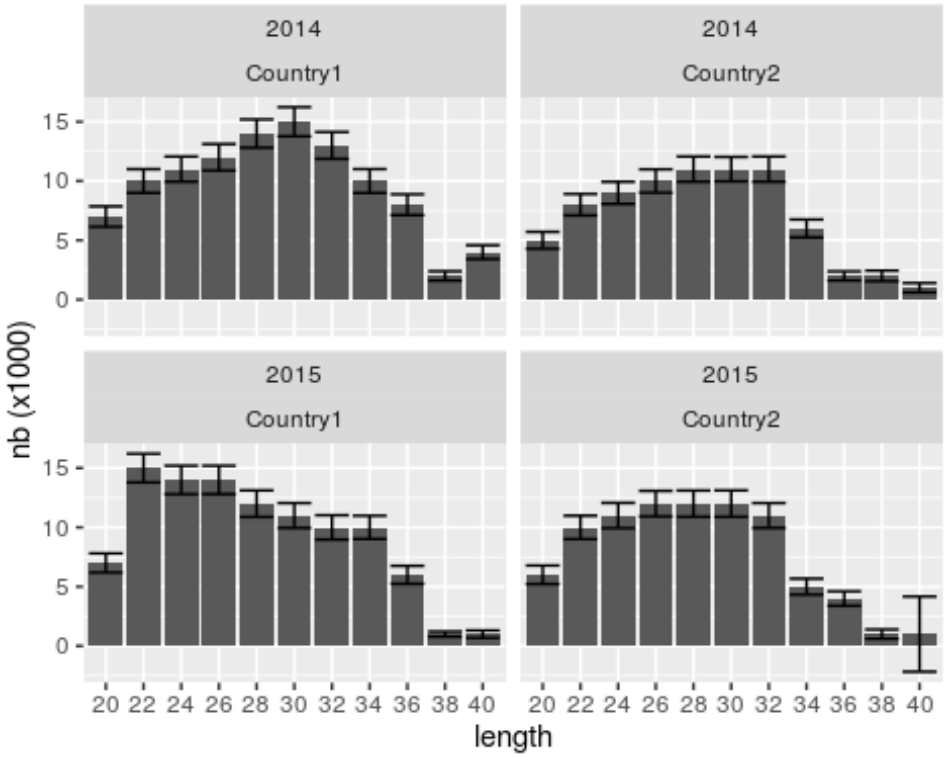


Figure 4.2. Length distributions with standard deviation for each length class and country.

4.1.2 Recommendation 2 and PGDATA respons.

Recommendation 2.

WGNSSK recommends that point estimates based on sampling routines (e.g., catch-at-age, survey indices) and delivered to assessment working groups for use as input information should be presented with estimates of sampling error together with a short description of the sampling design, sample size and estimation technique. This is not necessarily a straightforward task, but such information will be very useful when evaluating the quality of input data and hence quality of the stock assessment itself. This year information on discard quality was provided as first step. Uncertainty of survey indices could be provided as standard DATRAS output next to the survey indices (ICES Data Centre). To improve the situation further the regional database for the North Sea needs to be made operational as soon as possible (ICES Data Centre). For biological samples merged into census data (i.e. landings at age) appropriate methods to calculate associated uncertainties are essential (PGDATA). It is necessary to develop and review models that allow input of uncertainty around point estimates (Methods working group). Finally, the information on uncertainty in input data can be used to inform MSE simulations that are currently often based on rough assumptions.

PGDATA Response:

PGDATA agrees with WGNSSK that having uncertainty estimates around the data inputs to assessment would improve the estimation of the final assessment. PGDATA notes that quite a lot of material, guidelines and methods already exist in relation to estimation of both uncertainty and identification of potential biases of estimates of biological parameters (age, WKSABCAL) and commercial catch (WKPICS 1–3), including discards (SGPIDS), and recreational fisheries (WGRFS). Much of this work was put forward under the by umbrella of PGCCDBS and presently, WGBIOP, WGCATCH and WGISDAA collectively outline a quality assurance framework under PGDATA and SSGIEOM.

PGDATA aims to strengthen end-user knowledge of both the uncertainty and potential biases of estimates. The two aspects, uncertainty and bias must always be considered together since it is perfectly possible to have narrow confidence intervals on biased estimates and it is almost always preferable to have wider confidence intervals on unbiased estimates.

Both uncertainty and biases in input data should be routinely communicated and analysed by data providers, stock coordinators and stock assessors. From a PGDATA point of view, such communication and analysis should take place in two distinct timings: comprehensive re-evaluations, involving in-depth knowledge of the estimation procedures and long-term biases of estimates are more likely to be carried out within the benchmark process when long-term characteristics of the data can be analysed; but it is also important that, on an annual basis the main uncertainties and biases are communicated to stock assessment, even if simplified form to alleviate time constrains from those involved.

Comprehensive guidelines were developed by PGDATA in 2015 (ICES 2015) to provide ICES benchmark data evaluation teams with suggestions for tasks that should be completed prior to and during the benchmark data evaluation meeting. The guidelines cover all types of data and biological parameters commonly used in stock assessments and contain topics on bias and uncertainty. For some benchmark assessments, only some of the data types and parameters will require full evaluation depending on the issues list for the benchmark, or if previous benchmark data evaluation workshops have carried out a full evaluation which only requires an update with more recent data.

The guideline can be found in the PGDATA 2015 report as Annex 4 (ICES 2015). It is to be expected that during the benchmark process, decisions are made on standardized bias and precision indicators and how they are included into stock assessment models, leading to the routine submission and evaluation of these indicators in the following annual updates. Expert groups like WGCATCH or WGBIOP have some knowledge of the historical changes of sampling designs and methodologies used by different countries and may help advice the benchmark process.

In relation to the annual update assessment and the provision of a quality indicator and uncertainty around the point estimate, major sources of uncertainty can already be reported through the InterCatch and/or the annual ICES datacall should WGs request them (including precision indicators). It is, however, also important that major changes to sampling programs and methodologies and major departures from expected implementation can be reported to stock coordinators and stock assessment groups and feedback on impacts detected and decisions made on the data communicated back to data-providers. In ensuring these, it is important to emphasize that "major changes and departures" in this context really signifies "changes and departures expected to significantly impact EGs work" because the reporting of all routine minor changes and departures will overburden EGs to a point where reporting efforts are wasted by information no being analysed. PGDATA suggest that such input should be delivered to EGs through the Data Call system. Such input and its analyses cannot, due to time limitations, be as extensive as the one provided in the benchmark process. PGDATA developed a draft online template for a questionnaire aiming to ensure the fast reporting and analyses of major quality issues in annual data updates (Figure 4.3). The template will be tested in WGBFAS 2017 and the outcomes analysed in PGDATA 2017. When fully implemented in the ICES system such information should be included in Data Quality section of the reports of Assessment Working Groups so that data shortcomings and decisions made to handle these will become more transparent.

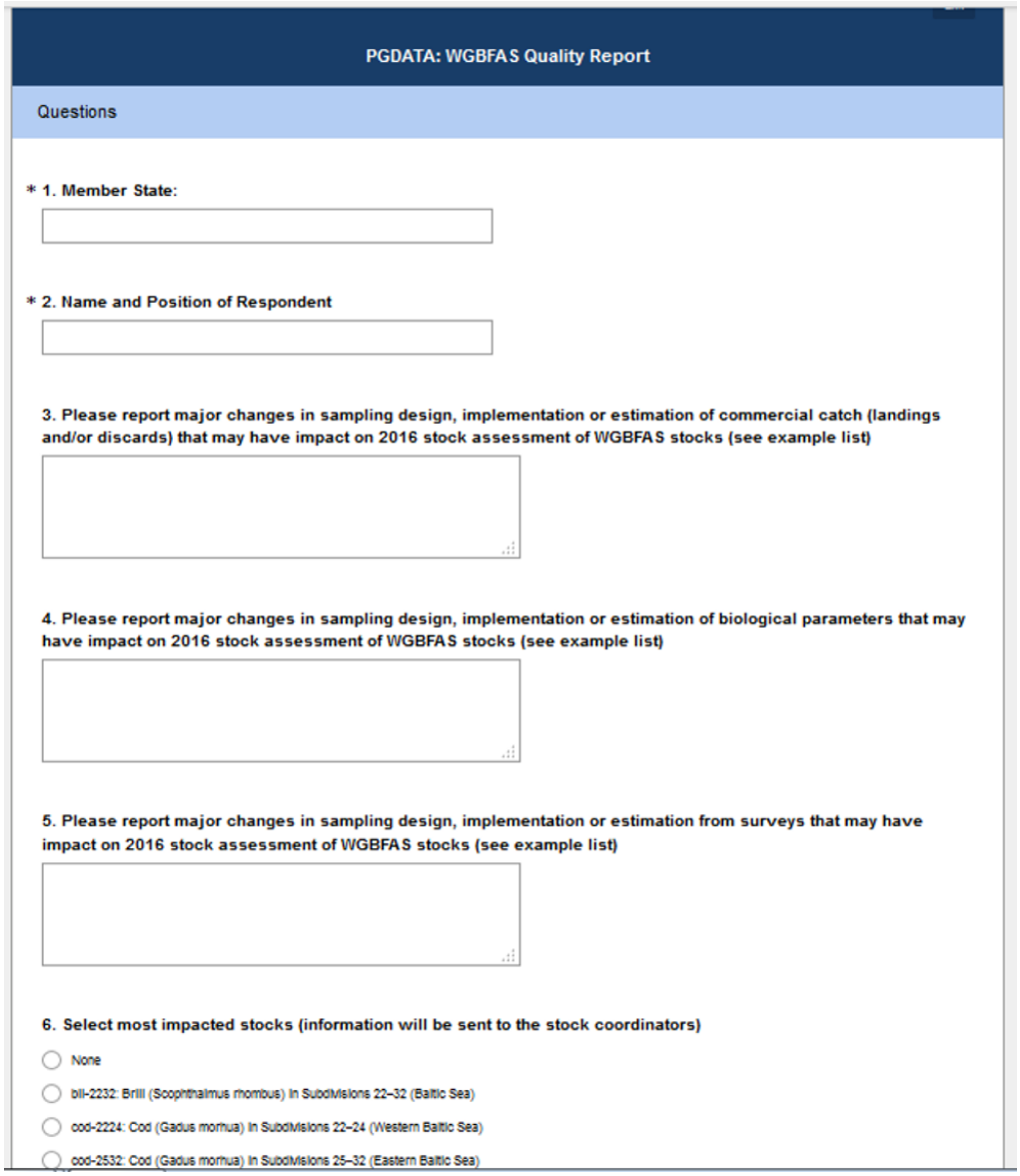


Figure 4.3. Slide-shot of the annual questionnaire on major changes to sampling programs and methodologies and departures from implementation developed during PGDATA 2016.

4.1.3 Recommendation 3 and PGDATA response

Recommendation 3:

The WGHANSA recommends that anchovy catches in the western part of Division IXa are sampled whenever an outburst of the population in the area is detected. The WGHANSA considers each of the survey series directly assessing anchovy in Division IXa as an essential tool for the direct assessment of the population in their respective survey areas (Subdivisions) and recommends their continuity in time, mainly in those series that are suffering of interruptions through its recent history. The WGHANSA recommends the extension of the BIOMAN survey to the north to cover the potential area of sardine spawners in VIIIa. This extension should be funded by DCMAP. The WGHANSA recommends a pelagic survey to be carried out on an annual basis in Autumn in the western Portuguese coast to provide information on the recruitment of small pelagics (particularly sardine and anchovy) in that region. The WGHANSA recommends a pelagic survey to be carried out on an annual basis in spring in the English Channel (7.d, 7.e) to provide information on the status of small pelagics (particularly sardine and anchovy) in that region.

PGDATA response

PGDATA confirmed the two countries sampling in Division IXa are carrying out a concurrent sampling for all the métiers operating in the area (RCM NA 2015 report). Any outburst of the population should be reflected in the sampling information collected. This situation seems to be, in both countries, an improvement compared to the sampling network before to 2009 where sampling targets by species where put just during the months where anchovy catches were more frequent.

Following the data in 2014 in Division IXa Spain accomplished 39 trips where anchovy was sampled as part of its onshore sampling programme while Portugal did 4 onshore and 4 at sea.

Regarding the extension of the BIOMAN survey and new annual basis pelagic surveys in western Portuguese coast in autumn and in the English Channel (7.d, 7.e): PGDATA's opinion is that discussion is needed between the assessment expert group as WGHANSA and surveys expert groups as WGACEGG and WGALES involved in these stocks. The need of such extensions needs to be justified in terms of how these could improve the assessment. Different alternatives should be analysed taking into account different surveys carried out targeting these stocks. Cost–benefit analysis and possible coordination need also to be considered between surveys.

General opinion about surveys on PGData are that a fully and independent evaluation of the surveys must be carried out similar to the SGRN 10-03.

4.1.4 Recommendation 4 and PGDATA response

Recommendation 4:

WKSUREP provided PGDATA with a first draft of a template to be used by the scientific survey groups to provide the assessment groups with more detailed survey information that can be used in stock assessment. The PGDATA recognized the need for a better communication between the research survey groups and the stock assessment groups and welcome the initiative. The group underlined however that it is important the information in the template is quantitative as poorly descriptive information cannot be used directly in the stock assessment.

5 References

Aanes, S., Engen, S, Sæther, B.-E. and Aanes, R. 2007. Estimation of fish stock dynamical parameters from catch-at-age data and indices of abundance: can natural and fishing mortality be separated? Canadian journal of fisheries and aquatic sciences, 64: 1130-1142.

Aanes, S., and Pennington, M. 2003. On estimating the age composition of the commercial catch of Northeast Arctic cod from a sample of clusters. ICES J. Mar. Sci. 60: 297–303.

Aanes, S., and Vølstad J.H. 2015. Efficient statistical estimators and sampling strategies for estimating the age composition of fish. Canadian journal of fisheries and aquatic sciences 72 (6): 938-953.

Dankel,D.J., Volstad, J.H. and Aanes, S. 2016. Communicating uncertainty in quota advice: a case for confidence interval harvest control rules (CI-HCRs) for fisheries. Can. J. Fish. Aquat. Sci. 73: 309–317.

Gudmundsson, G., 1994. Time-series analysis of catch-at-age observations. Journal of the Royal Statistical Society: Series C (Applied Statistics) 43, 117–126.

Gudmundsson, G., Gunnlaugsson, T., 2012. Selection and estimation of sequentialcatch-at-age models. Canadian Journal of Fisheries and Aquatic Sciences 69,1760.

Hirst, D., Storvik, G., Rognebakke, H., Aldrin, M., Aanes, S., and Volstad, J.H. 2012. A Bayesian modelling framework for the estimation of catch-at-age of commercially harvested fish species. Can. J. Fish. Aquat. Sci. 69(12): 2064– 2076.

ICES. 2012a. ICES Implementation of Advice for Data-limited Stocks in 2012 in its 2012 Advice. ICES CM 2012/ACOM 68. 83 pp.

ICES. 2012b. Manual for the International Bottom Trawl Surveys. Series of ICES Survey Protocols. SISP 1-IBTS VIII. 68 pp.

ICES. 2013. Report of the Second Workshop of National Age Readings Coordinators (WKNARC2), 13 - 17 May 2013, Horta, Azores. ICES CM 2013/ACOM:52. 65 pp.

ICES. 2014a. Report of the Planning Group on Commercial Catches, Discards and Bio-logical Sampling (PGCCDBS), 17–21 February 2014, Horta (Azores), Portugal. ICES CM 2014 / ACOM: 34. 103 pp.

ICES. 2014b. Implementing the ICES Strategic Plan 2014–2018. Produced by the ICES Secretariat. 70 pp. Available at the ICES website http://www.ices.dk/explore-us/who-we-are/Pages/council.aspx.

ICES. 2014c. Report of the third Workshop on Practical Implementation of Statistical Sound Catch Sampling Programmes, 19-22 November 2013, ICES HQ, Copenhagen, Denmark. ICES CM2013/ACOM:54. 109 pp.

ICES. 2015a. First Interim Report of the Working Group on Working Group on Biological Parameters (WGBIOP), 7-11 September 2015, Malaga, Spain. ICES CM 2015/SSGIEOM:08. 67 pp.

ICES. 2015b. Report of the Working Group on Commercial Catches (WGCATCH), 10-14 November 2014, ICES HQ, Copenhagen, Denmark. ICES CM 2014\ACOM:36. 295pp.

ICES. 2016a. Report of the Working Group on Data Needs for Assessments and Advice (PGDATA), 30 June–3 July 2015, Lysekil, Sweden. 103 pp.

ICES. 2016b. Report of the Working Group for the Celtic Seas Ecoregion (WGCSE), 12– 21 May 2015, Copenhagen, Denmark. ICES CM 2015/ACOM:12. 1432 pp.

ICES. 2016c. ICES Implementation of Advice for Data-limited Stocks in 2012 in its 2012 Advice. ICES CM 2012/ACOM 68. 84 pp.

Kristensen, K. 2014. TMB: General random effect model builder tool inspired by ADMB. R package version 1.1.

Lehtonen, R., and Pahkinen, E. 2004. Practical methods for design and analysis of complex surveys. John Wiley & Sons.

Nielson, G.A. 2014. Cluster Sampling: a pervasive, yet little recognized survey design in fisheries research. Trans. Am. Fish. Soc. 143: 926–938.

Nielsen, A., and Berg, C.W. 2014. Estimation of time-varying selectivity in stock assessments using state-space models. Fish. Res. 158: 96–101.

Pennington, M. & Vølstad, J.H. 1991. Optimum size of sampling unit for estimating the density of marine populations. Biometrics, 47: 717-723.

Annex 1: List of participants

NAME	ADDRESS	PHONE/FAX	E-MAIL
Mike Armstrong chair	Cefas Pakefield Road Lowestoft Suffolk NR33 0HT UK	+44 1502 524362	mike.armstrong@cefas.co.uk
Lotte Worsøe Clausen	DTU Aqua Jægersborg Allé 1 2920 Charlottenlund Denmark	+45 21362804	law@aqua.dtu.dk
Laurent Dubroca	Ifremer Port-en-Bessin Station PO Box 32 Avenue du Général De Gaulle 14520 Port-en-Bessin France		laurent.dubroca@ifremer.fr
José Castro	Insituto Español de Oceanografía Avda. Beiramar, 37 36202 Vigo Spain	+34 986 213107	jose.castro@vi.ieo.es
Nuno Prista	Havsfiskelaboratoriet Institutionen för akvatiska resurser Sveriges lantbruksuniversitet (SLU) Turistgatan 5 453 30 Lysekil Sweden	+46 725 450 676	nuno.prista@slu.se
Marie Storr-Paulsen chair	DTU Aqua Jægersborg Allé 1 2920 Charlottenlund Denmark	+45 35 88 34 41	msp@aqua.dtu.dk
Els Torreele	ILVO Ankerstraat 1 8400 Oostende Belgium	+32 59569833	els.torreele@ilvo.vlaanderen.be
Sieto Verver	Centre for fisheries research 1970 AB IJmuiden The Netherlands	+31 317 4890045	sieto.verver@wur.nl

NAME	ADDRESS	PHONE/FAX	E-MAIL
Jon Helge Vølstad	Institute of Marine Research PO Box 1870 Nordnes 5817 Bergen Norway	+47 46929039	jonhelge@imr.no
Lucia Zarauz	AZTI Sukarrieta Txatxarramendi ugartea z/g E-48395 Sukarrieta (Bizkaia) Spain	+34-946029400	lzarauz@azti.es
Estanis Mugerza	AZTI Sukarrieta Txatxarramendi ugartea z/g E-48395 Sukarrieta (Bizkaia) Spain		
Wlodzimierz Grygiel	National Marine Fisheries Research Institute Department of Fish Resources ul. Kołłątaja 1 81-332 Gdynia, Poland	+48-58-7356270	wlodzimierz.grygiel@mir.gdynia.pl
Tiit Raid	Estonian Marine Institute, University of Tartu Mäealuse 14, Tallinn EE-12618 Estonia	+372 6718953	tiit.raid@gmail.com
Christoph Stransky	Thünen Institute of Sea Fisheries Palmaille 9 22767 Hamburg Germany	+49 40 38905-228	christoph.stransky@thuenen.de

Annex 2: Agenda

Collaboration with SSGIEOM / WGISDAA ToRs ii and viii:

We will review the scope and ToRs of ICES Steering Group on Integrated Ecosystem Observation and Monitoring (SSGIEOM) and where PGDATA fits with this and what we need to do to ensure the SSG meets its overall goals. Also a strategy for how we must collaborate with the other EGs within SSGIEOM to achieve this, particularly WGISDAA (WG on improving survey data for assessment and advice). Can cover things such as implementing a coherent quality assurance framework and ensuring EGs deliver what their end-users need. Will look at PGDATA input to the forthcoming survey workshop WKSUREP. May return to these ToRs later in week, depending on progress on Monday. Will see if we can arrange a skype with SSGIEOM/WGISDAA people during the meeting.

WKCOSTBEN and ICES theme session (ToR i and vi)

This is a new area of work for us that will be a longer term process, and this year's PGDATA and the WKCOSTBEN and ASC theme session will be scoping the required framework. So PGData are the first step and will not necessarily provide answers but will start to build the framework. We can start with some focus on existing data needs, collections and costs to provide some background information for the Workshop, then move to methodology. When we start to invite people to the workshop they will need to have some good background info which PGDATA can provide. Topics could be:

- Introducing the concept. The key questions to be addressed in the cost–benefit analysis are around how much time and money we are allocating to each data type in an ecoregion in relation to the impact those data have on the assessments and advice, and where poor sampling design is leading to inefficiencies
- For background on existing data needs and how they are being met, a good initial exercise will be to source any existing summaries on the extent of use of each type of data by ICES assessment WGs (looking at it by data rich / data poor stocks), and where there are recurrent claims of data deficiencies (ICES has been through this exercise). Probably limit the exercise to a selection of ecoregions such as North Sea, Baltic, Celtic Seas and Iberian, and also identify some case study stocks or assemblages for a more detailed look. For many stocks there will be age/length/discards/surveys etc., but for many data poor stocks just an abundance index. Some surveys such as IBTS will be providing trends data for many stocks.
- Build up examples of how effort and costs are being spread across different data types. For example how much effort is spent collecting length datavs.age data from fisheries, and the extent of inefficiencies due to cluster sampling (nos. trips sampledvs.numbers of fish measured or aged); or how much effort is spent on surveysvs.fishery sampling in relation to the information provided by each and the impact on assessments and advice. Jon Helge has already provided examples of how survey designs and biological sampling schemes on surveys can be optimized to improve precision (this is where we must collaborate with WGISDAA). We should spend time scoping out all these issues to create the background.
- Get some information for each ecoregion on how much each type of data are costing at least in a relative sense (e.g. surveys; port sampling; observer

schemes; fish ageing). A suitable approach would be for people attending the meeting to bring their national DCF annual report standard tables that document achieved sampling and surveys etc., and the costs sheets that indicate the total eligible spend (we would not publish national figures, but could derive some statistics on the proportion of total spend on data collection that is on surveys, port sampling, discards sampling, fish ageing. If we can try this for a limited subset of data/stocks we could gauge what could be possible for a larger exercise for the workshop. At a finer scale, we could relatively easily get information on survey cost per day, and also get participants to estimate the time spent on e.g. measuring a fish/ cutting an otolith, reading an otolith, sampling a stomach etc. to have some quantitative measure for the extra cost per sample.

- Methodological approaches: i) general concepts around how cost–benefit can be evaluated and presented to managers (e.g. existing studies and books); methods for evaluating relative sensitivity of management advice (e.g. risk of $F>F_{MSY}$ and $B<B_{MSY}$) to precision of different input data types, and the relative costs of collecting the data; ii) what approaches would be most appropriate to ICES stock assessment and advice context, with some examples where we have them. Also need to consider the impact of bias in datasets on quality of advice – no use spending a lot of money on a biased survey that appears to be precise but in fact is prone to substantial variable bias e.g. due to insufficient coverage.
- Develop work plan for the workshop including pre-WK analysis; people to invite; case study datasets to try and get before the meeting;
- Planning for the ASC theme session – structure; invitees etc.

Day	Monday	Tuesday	Wednesday	Thursday	Friday
09:00-11:00	Introduce ToRs and finalise agenda Start 10am today to give people chance to find the place and get set up.	Evaluating cost-benefit of data collection; Planning of WKCOSTBEN and ICES theme session (ToR i and vi)	SSGIEOM (ToR ii and VIII) Niels Olav skype	PGDATA work plan for 2017 and beyond. (ToR ix)	Review text written. Close of meeting Electing new chair
11:00-11:15	Coffee break				
11:15 – 13:00	Review and respond to recommendations to PGDATA (ToR v)	Evaluating cost-benefit of data collection; Planning of WKCOSTBEN and ICES theme session (ToR i and vi)	Evaluating cost-benefit of data collection; Planning of WKCOSTBEN and ICES theme session (ToR i and vi)	Drafting of report text	
13:00-14:15	Lunch				
14:15 – 16:00	Strengthening liaison with SSGIEOM and survey groups on data quality framework (ToR ii and VIII)	Evaluating cost-benefit of data collection; Planning of WKCOSTBEN and ICES theme session (ToR i and vi)	Future development and role of PGDATA, (ToR iv, vii)	Drafting of report text	
16:00 – 16:15	Coffee break				
16:15 – 18:00	Strengthening liaison with SSGIEOM and survey groups on data quality framework (ToR ii and VIII)	Evaluating cost-benefit of data collection; Planning of WKCOSTBEN and ICES theme session (ToR i and vi)	Drafting of report text	Review text written	
Evening			Social event		

Annex 3: PGDATA terms of reference for the next meeting

The **Planning Group on Data Needs for Assessments and Advice** (PGDATA), chaired by Marie Storr-Paulsen, Denmark and XX, will meet in XX, XX, XX to XX 2017, to work on ToRs and generate deliverables as listed in the Table below.

a) Provide a summary of the PGDATA 3-year programme and its achievements in relation to its terms of reference.

b) Using the 2016 benchmark data evaluation meeting for the Irish Sea (WKIRISH2) and Kattegat cod (WKBALT) as examples, work with the data and assessment teams to review the benchmark process and modify the guidelines for benchmark data evaluation meetings where required.

c) Provide an overview of discussions within ICES concerning its data strategies and how the future structure and functioning of PGDATA could be adapted to ensure the most effective steering and implementation of these strategies.

d) Review the outcome of WKCOSTBEN 2016 and the ICES 2016 theme session O ("when is enough, enough?) and identify the tasks, skills and related Terms of Reference needed for future development of WKCOSTBEN in 2017 and 2018.

e) Respond to recommendations and requests for advice from other ICES Expert Groups, RCMs or other bodies.

Annex 4: Recommendations

RECOMMENDATION	ADRESSED TO
1.PGDATA recommends that the data calls include a section on sampling quality, this could be uploaded in InterCatch if more of the non mendatory fields are used, as described by PGDATA 2016, with potential for further development in liaison with WGCATCH in relation to fishery sampling data	ICES secretariat, data calls
SUGGESTIONS	**ADRESSED TO**
1.PGDATA suggest that the master stock table is updated and should include survey acronym used in the assessment. Presently it is not possible to see how many stock assessments a given survey is supporting. Further, it would make the template more user-friendly if a drop down list is used for information presently not standadiced. This is the case for for 'assessment type' and for discard information.	ICES secretariat
2. PGDATA suggest that WGISDAA evaluate if a 'buffer zone' around a taken haul , in which no subsequent haul should be taken, would improve the design of the surveys.	WGISDAA
3. PGDATA suggest that WGCATCH and WGRFS further discuss workshops on sampling designs where countries / institute are encouraged to attend, especially if they have not started the process of implementing a sound sampling design. This WS will also provide additional staff training opportunities.	WGCATCH and WGRFS
4. PGDATA suggest that WGRFS discuss the possibility to develop a database for recreational fishery	WGRFS
5. PGDATA suggest that WGBFAS is testing the data questionnaire of " major changes in design and estimation" presently in Figure 4.3 in this report. The report has to be filled out by every data provider (insitute / country) providing data for a given stock.	WGBFAS

Annex 5: Summary of EFARO imitative on surveys

ICES and EFARO (The European Fisheries and Aquaculture Research Organization) had set up a joint initiative to streamline Scientific-Fishery-Independent Survey design and data collection. The initiative aims at optimize the collection of fisheries independent information needed in ICES advisory process, by addressing issues such as the need to clearly define data needs (quantity and quality) and the most efficient way of collecting these data.

The initiative proposed to set up three regional pilot studies (understood as desk case studies and not to set up new pilot surveys) for developing cooperative data collection plans using vessel surveys. The suggested study areas were: Celtic Seas (to be led by Cefas), Greater North Sea (to be led by IMARES) and Bay of Biscay and the Iberian coast (to be led by IEO). The case studies shall define data needs for the advisory work, include novel survey designs based on a virtual 25–50% reduction in funding relative to current financing, and provide a comparison of the data (in terms of quantity and quality) to be collected with the current and new survey design. The specific objectives may vary between the three studies but overall project coordination and future recommendations are under the leadership of EFARO in cooperation with ICES. Project duration is estimated in 6-8 months starting in early 2017. It was highlighted that duplication of work ongoing in other ICES Working Groups should be avoided.

The three case studies will focus in data needs in support of ICES advisory work and single-stock assessments but won't be limited to it. For example, the ICES-EFARO initiative suggests that guidance on the adaptation of existing surveys to "ICES ecosystem surveys" shall be provided by The Working Group on Integrating Surveys for the Ecosystem Approach (WGISUR).

Annex 6: Summary of presentations

By Wlodzimierz Grygiel, Poland

The presentation entitled "The accomplishment and the costs of annual fish sampling programme in Poland (2015). The time-effort consumption during the Baltic fish routine length measurements and documentation", prepared by W. Grygiel (NMFRI, Gdynia, Poland) was focused on two aspects:

a) evaluation of the effort, expressed in working hours, linked with accomplishment of particular tasks (overall 28 tasks) and groups of tasks in the framework of the National (Polish) Fisheries Data Sampling Programme in 2015; the costs of given groups of tasks realization was also presented,

b) estimation the time-effort needed for the length measurements of the Baltic cod, herring, sprat and flounder, and registration the results, during the Polish BITS surveys on board of the RV "Baltica".

The presented data indicate that, in 2015 the realization of six groups of tasks (e.g. collecting the data, utilization and management, coordination of researches) was achieved on the level of 87–100%. From the total costs and effort (working hours) of the National (Polish) Fisheries Data Sampling Programme in 2015, the highest share, i.e. of 35,6 and 56,0%, respectively was spend for the utilization and management of data. The next position was collecting the biological data from commercial fishery–27,3 and 21,8%, respectively (see the text-table below).

Type of task	[%] of costs	[%] of effort (working hours)
Collecting the biological data from commercial fishery	27,3	21,8
Collecting the data from research surveys	18,7	5,9
Collecting the data concerns ecosystem parameters	2,4	2,9
Utilization and management of data	35,6	56,0
Collecting the economical data	10,2	11,5
Coordination of researches for evaluation of fishery sector	5,7	
Database developing		0,5
Collecting the data from recreational fisheries		1,4
Total	100,0	100,0

Evaluation of the time-effort needed for the length measurements of the Baltic cod, herring, sprat and flounder, and registration the results was based on materials obtained from two experiments conducted on board of the Polish RV "Baltica", in the framework of the BITS surveys in 2008 and 2009. The input data for the above-mentioned task originated from 5 control-catches made with the TV-3#930 ground trawl, totally, eight (4 x 2) persons participated in each experiment, 4 commercial species and bycatch were the subject of experiments, time was measured only for the fish length determination and registration the results. Following conditions were accompanied the experiments:

- fish were already sorted out by species from the catch,
- relatively good weather conditions were appeared during the experiments,

The mean time-effort needed for one fish length measurement and the result registration by two-person team (one person measured fish length and the second person make the notes in the fish protocol sheet) on board of the surveying research vessel:

- cod – 4.5 - 4.8 seconds (experienced team),
- herring – 6.2 - 8.8 seconds (experienced team),
- sprat – 3.8 - 5.3 seconds (somewhat experienced team),

- flounder – 8.2 - 11.8 seconds (somewhat experienced team).
- bycatch (ca. three species) – 12.6 seconds (little experienced team).

Annex 7 Detailed questionnaires for three different survey types.

ICES Workshop on cost benefit analysis of data collection in support of stock assessment and fishery management (WKCOSTBEN: June 2016).

Bottom-trawl survey activity and cost breakdown

The WKCOSTBEN workshop is seeking examples of information that would be needed to investigate how the cost-efficiency of data collection on research surveys could be enhanced – for example to provide more accurate and/or additional data needed by end-users within existing resources, or to meet existing data needs at less cost. This questionnaire is intended to provide an overview of the time spent on various tasks during a bottom-trawl survey. Please provide as much detail as you can – ideally collected directly during a survey this year. If this is not possible, provide an accurate recall of information from the most recent survey.

Data provider

	Name of person completing the questionnaire	
	Laboratory:	
	Contact e-mail:	
	Was the information collected directly during the survey, or recalled afterwards?	

(a) Details of survey and provider

Survey name and acronym:	
Vessel name:	
Country of vessel:	
Year of survey:	
Quarter:	
Total number of scientists and technicians on board at same time	
Number of scientists and technicians involved only in trawl sampling	
Number of scientists and technicians involved only in other sampling such as oceanography, benthos, acoustics etc.	
How many scientist are there room for on the vessel	
Survey working pattern (day time only/ 24h / other)	
Name of handbook / manual for the survey with web link if available	
Was the information collected directly during the survey, or recalled afterwards?	
Is the cost of the survey shared between countries?	

Details of vessel and gear deployment during survey

Total number of days at sea between start and end of cruise.	
Is the order of stations and cruise track between stations optimised, using some form of algorithm, to minimise the time spent at sea? If yes, give some details in the space below this table	
For all bottom trawl haul stations providing stock assessment data:	
Total number of bottom trawl hauls completed	
Standard fishing time (h) or towing distance (km) of individual trawl hauls (state which unit is used).	
Average time spent at each trawl station in survey, from shooting of net to retrieval on board (h)	
For all additional sampling events not providing stock assessment data (e.g. other trawl hauls; CTD, plankton sampling, benthic sampling, cameras, oceanographic sampling):	
Total number of additional sampling events	
Which type of sampling is conducted (plankton, benthic etc)	
Average time spent at these additional sampling events during survey including shooting and hauling of gear (h)	

Total time spent on individual tasks at sea by scientific and technical personnel

Activity	Total time (person-hours for whole survey)	Cost share of total survey budget (%)
Bottom trawling at core stations used for stock assessment data: activities related to sorting, sampling and data recording		
Sorting the catch and recording the catch composition		
Collecting length frequency samples and recording the lengths		
Collecting and storing samples for age determination		
Preparation and reading of age material at sea		
Recording of sex and maturity stage		
Additional biological sample collection e.g. genetics, stomachs, fecundity (provide details in space below table)		
Other data recorded from catches, e.g.marine litter (provide details in space below table)		
Data entry and checking at sea		
Other related tasks		
Totals for bottom trawling:		
Other gears used on station (core stations or additional stations) – time spent on deployment, sample processing, data recording etc.		
Other fishing stations for data collection not used in stock assessments		
Benthos sampling e.g. grabs		
Sampling of fish eggs or larvae (e.g. net hauls)		
Oceanographic data collection (e.g. CTD)		
Underwater camera deployment		
Other gears		
Totals for other gears:		
Underway data collection activities during survey		
Acoustic data		
Underway water sampling		
Seabird or marine mammal observation		
Other data collection activities		
Totals for underway data collection:		
TOTALS FOR ALL DATA COLLECTIONS:		

Explanatory notes:

Additional information on trawl catch sampling

Total catches	
Main species or species groups for which the survey is designed	
Total number of species recorded in survey	
Total number of species for which data collected are used in stock assessment	
Average weight of the total catch (kg) per haul	
What percentage of the total catch volume is sorted to species, on average?	
Are electronic measuring boards or calipers used for collecting length data?	
Length frequency data	
Number of species for which length data were recorded	
Total number of length frequency samples recorded during the survey, for all species (i.e. one sample = all the fish of one species measured from one haul)	
Total number of individual fish measured summed over all species and hauls (actual numbers, not raised based on subsampling).	
Sampling for age determination	
Number of species for which samples were collected for age determination	
Total number of individual fish of all species for which ageing material was collected	
Recording of sex and maturity stages	
Number of species for which maturity was recorded	
Total number of individual fish of all species for which maturity stage was recorded	

Sampling design for collection of age material (select which method applies)

Method	**Species this applies to** ("all" or stated species)
Target number of fish by length class from each haul (e.g. 1 per cm)	
Target number of fish by length class from a region or stratum of the survey	
Target number of fish at random from each haul	
Target number of fish at random from a region or stratum of the survey	
Other method (describe below)	

Additional questions

In the following questions, "improving efficiency" can be taken loosely as meaning changing the way surveys are designed and run so that they can provide more accurate and/or or additional data needed by end-users at minimal additional cost, or even at reduced cost, or to continue meeting existing data needs but at reduced cost.

Q1. What do you consider the primary constraint to improving the efficiency of your survey?

Q2. What would you consider the best option(s) to improve the way data are currently being collected on your survey, given the current set up regarding vessel time and personnel availability?

Q3. What additional data or types of data could be collected to improve the overall value of your survey, once this improvement in efficiency has taken place?

Q4. Do you presently have waiting time at sea because of ongoing work in the fish lab or is it mainly the steaming time between stations that are limiting the numbers of stations fished a day?

ICES Workshop on cost benefit analysis of data collection in support of stock assessment and fishery management (WKCOSTBEN: June 2016).

Acoustic survey activity and cost breakdown

The WKCOSTBEN workshop is seeking examples of information that would be needed to investigate how the cost-efficiency of data collection on research surveys could be enhanced – for example to provide more accurate and/or additional data needed by end-users within existing resources, or to meet existing data needs at less cost. This questionnaire is intended to provide an overview of the time spent on various tasks during the acoustic survey. Please provide as much detail as you can – ideally collected directly during a survey this year. If this is not possible, provide an accurate recall of information from the most recent survey.

Data provider

	Name of person completing the questionnaire	
	Laboratory:	
	Contact e-mail:	
	Was the information collected directly during the survey, or recalled afterwards?	

Details of survey and provider

Survey name and acronym:	
Vessel name:	
Country of vessel:	
Year of survey:	
Quarter:	
Total number of scientists and technicians on board at same time	
Number of scientists and technicians involved only in acoustic sampling	
Number of scientists and technicians involved only in other sampling such as fish sampling or oceanography, etc.	
How many scientists are there rooms for on the vessel	
Survey working pattern (day time only/ 24h / other)	
Name of handbook / manual for the survey with web link if available.	
Was the information given in the questionnaire recorded directly during the survey, or recalled afterwards?	
Is the cost of the survey shared between countries?	

Details of vessel and gear deployment during survey

Total number of days at sea between start and end of cruise.	
Total number of working days at sea during survey.	
Is the order of stations and/ or cruise track optimised, using some form of algorithm, to minimise the time spent at sea? If yes, give some details in the space below this table	
The time spent on technical checking of mounded transducers (h)	
For all survey time spent on providing stock assessment data:	
Length of acoustic transects	
Time spent (h) on calibration of acoustic equipment	
Total number of target -identification hauls completed	
Standard fishing time (h) or towing distance (NM) of individual identification hauls (state which unit is used).	
Average duration of each target identification haul, from shooting of net to retrieval on board (h)	
For all additional sampling events not providing stock assessment data (e.g. other trawl hauls; CTD, plankton sampling, benthic sampling, cameras, oceanographic sampling):	
Total number of additional sampling events	
Which type of sampling is conducted (plankton, benthic etc)	
Average time spent at these additional sampling events during survey including shooting and hauling of gear (h)	

Total time spent on individual tasks at sea by scientific and technical personnel

Activity	Total time (person-hours for whole survey)	Cost share of total survey budget (%)
Identification trawling at core stations used for stock assessment data: activities related to sorting, sampling and data recording		
Sorting the catch by species weighing and recording the catch composition		
Collecting length frequency samples and recording the lengths		
Collecting and storing samples for age determination		
Preparation and reading of age material at sea		
Recording of sex and maturity stage		
Additional biological sample collection e.g. genetics, stomachs, fecundity (provide details in space below table)		
Other data recorded from catches, e.g.marine litter (provide details in space below table)		
Data entry and checking at sea		
Other related tasks		
Totals for trawling:		
Other gears used on station (core stations or additional stations) – time spent on deployment, sample processing, data recording etc.		
Other fishing stations for data collection not used in stock assessments		
Benthos sampling e.g. grabs		
Sampling of fish eggs or larvae (e.g. net hauls)		
Oceanographic data collection (e.g. CTD)		
Underwater camera deployment		
Other gears		
Totals for other gears:		
Underway data collection activities during survey		
Underway water sampling		
Seabird or marine mammals observation		
Other data collection activities		
Totals for underway data collection:		
TOTALS FOR ALL DATA COLLECTIONS:		

Explanatory notes:

Additional information on trawl catch sampling

Total catches	
Main species or species groups for which the survey is designed	
Total number of species recorded in survey	
Total number of species for which data collected are used in stock assessment	
Average weight of the total catch (kg) per haul	
What percentage of the total catch volume is sorted to species, on average?	
Are electronic measuring boards or calipers used for collecting length data?	
Length frequency data	
Number of species for which length data were recorded	
Total number of length frequency samples recorded during the survey, for all species (i.e. one sample = all the fish of one species measured from one haul)	
Total number of individual fish measured summed over all species and hauls (actual numbers, not raised based on subsampling).	
Sampling for age determination	
Number of species for which samples were collected for age determination	
Total number of individual fish of all species for which ageing material was collected	
Recording of sex and maturity stages	
Number of species for which maturity was recorded	
Total number of individual fish of all species for which maturity stage was recorded	

Sampling design for collection of fish age material (select which method applies)

Method	**Species this applies to** ("all" or stated species)
Target number of fish by length class from each haul (e.g. 1 per cm)	
Target number of fish by length class from a region or stratum of the survey	
Target number of fish at random from each haul	
Target number of fish at random from a region or stratum of the survey	
Other method (describe below)	

Additional questions

In the following questions, "improving efficiency" can be taken loosely as meaning changing the way surveys are designed and run so that they can provide more accurate and/or or additional data needed by end-users at minimal additional cost, or even at reduced cost, or to continue meeting existing data needs but at reduced cost.

Q1. What do you consider the primary constraint to improving the efficiency of your survey?

Q2. What would you consider the best option(s) to improve the way data are currently being collected on your survey, given the current set up regarding vessel time and personnel availability?

Q3. What additional data or types of data could be collected to improve the overall value of your survey, once this improvement in efficiency has taken place?

Q4. Average time (if any) needed to halt the survey until the given station has been completely processed?

Annex 8. ICES on the datacall 2016 .Commercial catch and sample data used in InterCatch

Table HI. InterCatch Header Information fields.

Start/Order	Field Name	Width	Mandatory	Data Type
HI Header Information				
1	RecordType	2	✓	char
2	Country	3	✓	char
3	Year	4	✓	char
4	SeasonType	10	✓	char
5	Season	4	✓	char
6	Fleet	60	✓	char
7	AreaType	10	✓	char
8	FishingArea	10	✓	char
9	DepthRange	10		char
10	UnitEffort	3		char
11	Effort	15		decimal4
12	AreaQualifier	20		char

Table SI. InterCatch species information fields.

Start/Order	Field Name	Width	Mandatory	Data Type
SI Species Information				
1	RecordType	2	✓	char
2	Country	3	✓	char
3	Year	4	✓	char
4	SeasonType	10	✓	char
5	Season	4	✓	char
6	Fleet	60	✓	char
7	AreaType	10	✓	char
8	FishingArea	10	✓	char
9	DepthRange	10	✓	char
10	Species	3	✓	char
11	Stock	10	✓	char
12	CatchCategory	2	✓	char
13	ReportingCategory	2	✓	char
14	DataToFrom	10		char
15	Usage	2		char
16	SamplesOrigin	5		char
17	QualityFlag	2		char
18	UnitCATON	2	✓	char
19	CATON	20	✓	decimal12
20	OffLandings	7		int
21	varCATON	20		decimal12
22	InfoFleet	250		char
23	InfoStockCoordinator	250		char
24	InfoGeneral	250		char

Table SD. InterCatch species data fields.

Start/Order	Field Name	Width	Mandatory	Data Type
SD Species Data (Sample Data)				
1	RecordType	2	✓	char
2	Country	3	✓	char
3	Year	4	✓	char
4	SeasonType	10	✓	char
5	Season	4	✓	char
6	Fleet	60	✓	char
7	AreaType	10	✓	char
8	FishingArea	10	✓	char
9	DepthRange	10	✓	char
10	Species	3	✓	char
11	Stock	10	✓	char
12	CatchCategory	2	✓	char
13	ReportingCategory	2	✓	char
14	Sex	2		char
15	CANUMtype	7	✓	char
16	AgeLength	2	✓	int
17	PlusGroup	2		int
18	SampledCatch	5		int
19	NumSamplesLngt	5		int
20	NumLngtMeas	5		int
21	NumSamplesAge	5		int
22	NumAgeMeas	5		int
23	unitMeanWeight	3	✓	char
24	unitCANUM	2	✓	char
25	UnitAgeOrLength	4	✓	char
26	UnitMeanLength	3		char
27	Maturity	2		char
28	NumberCaught	20	✓	decimal12
29	MeanWeight	20	✓	decimal12
30	MeanLength	20		decimal12
31	varNumLanded	20		decimal12
32	varWgtLanded	20		decimal12
33	varLgtLanded	20		decimal12

Annex 9 list of acronyms and full names

ACRONYM	FULL NAME
ACOM	Advisory Committee
DATRAS	Database on Trawl Surveys
EG	Expert Groups
IBTSWG	International Bottom Trawl Survey Working Group
PGDATA	Planning Group on Data Needs for Assessments and Advice
SCICOM	Science Committee
SSGIEOM	Steering Group on Integrated Ecosystem Observation and Monitoring
WGACEGG	Working Group on Acoustic and Egg Surveys for Sardine and Anchovy in ICES Areas VIII and IX
WGALES	Working Group on Atlantic Fish Larvae and Eggs Surveys
WGBEAM	Working Group on Beam Trawl Surveys
WGBIFS	Baltic International Fish Survey Working Group
WGBIOP	Working Group on Biological Parameters
WGCATCH	Working Group on Commercial Catches
WGEGGS2	Working Group 2 on North Sea Cod and Plaice Egg Surveys in the North Sea
WGELECTRA	Working Group on Electrical Trawling
WGFAST	Working Group on Fisheries Acoustics Science and Technology
WGFTFB	ICES-FAO Working Group on Fishing Technology and Fish Behaviour
WGIDEEPS	Working Group on International Deep Pelagic Ecosystem Surveys
WGIPS	Working Group on International Pelagic Surveys
WGISDAA	Working Group on Improving use of Survey Data for Assessment and Advice
WGISUR	Working Group on Integrating Surveys for the Ecosystem Approach
WGMEGS	Working Group on Mackerel and Horse Mackerel Egg Surveys
WGNEACS	Working Group on North-east Atlantic continental slope surveys
WGNEPS	Working Group on Nephrops Surveys
WGRFS	Working Group on Recreational Fisheries Surveys
WKSUREP	Workshop to establish reporting guidelines from survey groups
WGTC	Working Group on Target Classification