

Theme Session N

Quality and precision of basic data underlying fish stock assessment and implications for fishery management advice

ICES CM 2009/N:01

Evaluating the effects of uncertainty in age–length keys and tuning indices on analytic assessment and quota recommendations for fish stocks

Jon Helge Vølstad, Dankert Skagen, Sondre Aanes, and Michael Pennington

The reliability of stock assessments and the quality of scientific advice depend on the accuracy of estimated age compositions of commercial catches and of abundance indices from scientific surveys. Data on length and age of fish in commercial catches or in population estimates from scientific surveys are typically obtained by multistage sampling, where fish are nested within primary sampling units, typically defined by stations or trips. As a result of such clustering, the effective sample size with respect to estimates of length and age distributions may be closer to the number of stations or trips than the total number of fish measured. We evaluate the propagation of sampling errors in input data to stock assessments by bootstrapping of the primary sampling units (hauls or trips). Uncertainty in catch predictions according to a simple harvest rule were evaluated by passing data from the bootstrap simulations through assessments using the toolbox TASACS. Uncertainty in stock assessments resulting from sampling errors in age–length keys is evaluated for northeast Arctic cod. We also generated sets of age-structured catch and survey data as input to analytic assessments from a generic artificial population. We study how noise in the input data propagates through the assessment and prediction, and evaluate the effects of alternative survey strategies. Results suggest that systematic errors (year effects) in the survey tuning indices have significantly more impact on the stock assessment than purely random noise. The assessments from VPA-type models and separable models were equally affected.

Keywords: age-structured models, cluster sampling, effective sample size, propagation of errors, age composition.

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A Bayesian hierarchical approach to estimating landings- and discards-at-age

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A Bayesian modelling approach has been implemented in the COST project to estimate landings and discards-at-age, along with length- and weight-at-age. The method takes the various different kinds of data commonly available from sampling of commercial fisheries (i.e. length-only samples, length and age samples, and length stratified age samples), both for discards and landings, and combines them into a single analysis. Because length at given age is modelled explicitly, there is no need to create age–length keys, and modelling of the covariates means that empty “cells” (i.e. combinations of covariates) do not present a problem. The hierarchical nature of the analysis allows data at different stratifications (hauls or trips) to be included, and the uncertainty is fully described in the posterior distributions of the parameters. The modelling approach also allows virtual populations to be simulated, which mean that the results can be compared with known true values and a realistic assessment of the performance made. This performance will be compared with that of the other methods implemented in COST: the bootstrap and an analytical method.

Keywords: Bayesian hierarchical model, COST, catch at age.

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The effect of mortality on the estimation of stock state parameters and derived references for sustainable fishery management

Anna Cheilari and Hans-Joachim Rätz

The present study focuses on sensitivity analyses regarding the effects of various assumptions about the magnitude of natural mortality (M) on resulting stock assessment parameters and derived references for sustainable fishery management. The results revealed that the estimated exploitation rate is decreasing and the stock size is increasing with increasing M . The recommended and internationally agreed fishery management references of sustainable exploitation $F_{0.1}$ and F_{msy} are also found to sensitively react to changes in M . Both $F_{0.1}$ and F_{msy} increase with increasing M . All simulations are based on data from the Baltic sprat (Subdivisions 22–32), which has historically undergone quite large changes in M . Nevertheless, the maximum sustainable yield (MSY) is demonstrated to be a rather robust estimator over a wide range of M , including species at a rather low trophic level. The trend to underestimate fishing mortality and to overestimate the stock size with high M might deliver, compared with actual catches, a positively biased perception of the state of the stock and its productivity. The elevated risk for sustainable fisheries even increases when underestimated fishing mortalities are compared with overestimated management references of exploitation, like $F_{0.1}$ and F_{msy} . It is recommended to base M assumptions on the assessment of exploited resources and the advisory process to fishery management to the longevity of the species concerned, if no quantitative information about M is available. Furthermore, M should account for the different ontogenetic stages and for changes in fish condition if observed.

Keywords: natural mortality, fishery management, stock assessment, Baltic sprat.

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ICES CM 2009/N:04

COST: a generic tool for raising and estimating the properties of statistical estimates in fisheries data

Joël Vigneau

The Common Open Source Tool (COST) is a set of packages developed in R, designed to provide a comprehensive set of methods for raising and estimating properties of statistical estimates used as input in stock assessment models. This project is financed as part of the European Commission Data Collection Framework (DCF), which has provisions for estimating fisheries data parameters and their related precision for each of the variables collected throughout a sampling programme. The tool is designed to provide users with appropriate methods for estimating discards volume, length and age structure of catches and landings, and biological parameters such as growth, maturity, and sex ratio. In order to ensure that one method is available in any sampling situation, three approaches are proposed: an analytical, a resampling, and a Bayesian modelling. The benefits of the project are threefold: (i) it gathers fishery statisticians from nine countries for designing a tool to be used by all European Member States, (ii) it compiles a long history of European projects and workshops tackling the same issues, and (iii) it ensures the accuracy of the proposed methods through an innovative simulation approach. Besides the simulation process, a number of new approaches have been designed specifically for COST in order to render a generic and robust tool, such as common data exchange format specifications and predefined data status upgrading path. Link with end-users is guaranteed through the exportation methods to the ICES database (InterCatch) and to the R environment usually used by stock assessment working groups (FLR).

Keywords: precision, raising, discards, length structure, age structure, biological parameters.

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ICES CM 2009/N:05

Trawl survey designs for reducing uncertainty in biomass estimates for patchily distributed species.

Paul Spencer, Dana Hanselman, and Denise McKelvey

Survey biomass estimates of several Alaskan rockfish species have demonstrated large interannual variations that are generally not consistent with their longevity. These variations can be attributed to sampling variability that reflects the “patchiness” of the spatial distribution of the population, which results in estimation error when high-density patches are either over- or underrepresented in survey trawls. In this study, we developed a spatial survey simulation model to evaluate the influence of spatial aggregation on biomass estimation, and considered alternative trawl survey designs intended to reduce the variability of biomass estimates. Variants of double sampling procedures were simulated in which high-density areas identified in the first sampling phase were then assigned increased trawl sampling densities in the second sampling phase. Acoustic sampling provides a mechanism to inexpensively sample broad areas in the first phase, and can be combined with the second phase trawl sampling in a single pass though the survey area. Geostatistical analyses of hydroacoustic data collected in Alaskan trawl surveys were used to simulate spatial distributions of fish populations. Simulated survey biomass estimates and sampling variability were evaluated as function of several factors, including the spatial aggregation of the population, sampling density, criteria for definition of high-density patches, and errors in identifying patch boundaries. Because current rockfish management in Alaska is based heavily upon survey biomass estimates, the influence of survey biomass uncertainty upon the level of conservation applied to Alaskan rockfish was also evaluated.

Keywords: rockfish, acoustics, survey design, sampling variability, patchily distributed populations, double sampling.

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ICES CM 2009/N:06

Quality assurance framework—the concept of quality assurance applied to fisheries data and its operationalization under the ICES scope

Kjell Nedreaas, Christoph Stransky, Ernesto Jardim, and Joël Vigneau

Quality assurance of input parameters for stock assessment is a major subject promoting the confidence of scientists and stakeholders in the advice provided by ICES. Since 2007, the Planning Group on Commercial Catches, Discards and Biological Sampling (PGCCDBS) has developed a conceptual framework that includes methodological workshops, calibration workshops, sampling protocols, guidelines, and software in a hierarchical structure following the information path from the sampling grounds to advice. The framework is based on the concept of “quality indicators” that constitute meta-information of the relevant parameters. Indicators may be statistics, scorecards, or simple “flags” that contain information about the quality of each parameter and allow decisions regarding the usage of data to be made based on objective criteria. In addition, such a system promotes standardization of procedures and dissemination of results.

Keywords: quality assurance, fisheries data, workshops, protocols, guidelines, standardization.

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ICES CM 2009/N:07

Scaling up and drilling down: tracing data issues for Fraser River sockeye (*Oncorhynchus nerka*) from spawning sites to management aggregates and back

A rich dataset has been assembled for Fraser River sockeye (*Oncorhynchus nerka*), with up to 70 years of abundance estimates for several hundred distinct spawning sites spread throughout most of a 220 000 km² drainage basin. These data are aggregated into 39 conservation units for maintaining biological diversity, 19 stocks for forecasting and production models, and four major run timing aggregates for harvest planning and in-season assessment. At each level of aggregation some important information is lost, but new patterns also emerge. Cumulative issues of data availability and quality in these aggregations translate into substantial implications for management decisions, to the extent where uncertainty in population dynamics has a stronger effect on projected long-term performance than alternative harvest strategies. Data issues that present particular challenges in ongoing stakeholder processes are data-limited conservation units, strong cyclic patterns in 8 of the 19 stocks, and density-dependent productivity changes at very large or very small spawning abundance.

Keywords: Fraser River, sockeye salmon, cyclic dominance, stock assessment.

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Sampling uncertainty associated with western Mediterranean pelagic fish abundance estimates derived from acoustic data

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Acoustic surveys are used worldwide for the assessment of pelagic fish stocks. In the Spanish Mediterranean area acoustic surveys are performed annually in late autumn and cover the entire continental shelf between 30 and 200 m depth. This survey was initiated to obtain estimates of anchovy recruitment (*Engraulis encrasicolus*), but also provides a general overview of the whole pelagic fish community in the study area during the time of the year it is performed. Our study area has a diverse assemblage of small and medium-sized pelagic fish (up to nine species) and thus we rely on the proportion of species obtained in middle-water pelagic fishing trawls to attribute the amount of echo corresponding to each species and estimate their abundance. Although uncertainties may arise from many different sources (e.g. transducer motion, target strength, migration) we focus our study on the estimation of overall sampling uncertainty, one of the main contributors to random error. We apply geostatistical techniques to deal with spatial correlation and discuss benefits and pitfalls in their application. Although transitive geostatistics have seldom been used, most probably owing to their inability to produce spatial maps of abundance and variance estimations, they constitute a powerful tool to routinely estimate sampling variance and its variation in time in a multispecific context. They may also help to assess the effects of varying sampling intensity and could be useful to detect possible processing errors, for example, in echogram scrutinizing. These techniques may therefore potentially help improve both the precision and the accuracy of acoustic data.

Keywords: sampling uncertainty, geostatistics, acoustic surveys, pelagic fish, Mediterranean Sea.

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ICES CM 2009/N:09

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

Ernesto Jardim, William James McCurdy *et al.*

The objective of the WebGR project is to develop a set of web services to support the organization and data analysis of calibration workshops, both for age and maturity information, implemented in a coherent tool installable as a website. The website consists of a repository of images, a set of web forms to run a calibration exercise online, a reporting module with the most common statistical analysis and import/export modules to manage images and results. The software has a creative commons licence (open source) to promote transparency, technology transfer and peer review. It will also allow the scientific community to get involved in further developments, like linkage to statistical analysis engines, or any other specific features. The use of WebGR to carry out calibration workshops will promote the applications of sound statistical analysis to design the experiment and compute workshop results. The results are extracted in a standard format that can easily be sent to scientists doing assessments.

Keywords: WebGR, calibration workshops, age, maturity.

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ICES CM 2009/N:10

Estimation of monkfish absolute abundance from trawl surveys

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Since 2005, stratified random trawl surveys of the monkfish stock that occupies the northern European shelf have been conducted annually to obtain age-structured estimates of absolute abundance for this stock. Survey data are unusual in that almost all fish are aged as well as measured for length. We describe an estimation method which incorporates statistical models for herding, length-based selectivity, and missing age data and incorporates uncertainty from all of these sources in variance estimation. Design-based estimates are presented and model-based methods are investigated as an alternative.

Keywords: monkfish, absolute abundance, size–selection curve, survey estimates, variance estimation.

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ICES CM 2009/N:11

A modelling framework for incorporating uncertainty from catch sampling into inputs and outputs of stock assessment models

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Statistical age-structured models commonly used in fish stock assessments treat commercial catch composition data, such as catch numbers at age, as if they were direct observations from the fishery. However, the actual composition of catches is not directly observed in most fisheries, and catch length or age compositions are instead estimates usually obtained through design-based methods. Proper measures of the uncertainty associated with these estimates must therefore be provided and suitably acknowledged by the stock assessment model. We propose an alternative approach to the traditional stock assessment process, where the usual two-step procedure—catch composition estimation followed by stock assessment—is merged into one integrated modelling framework that explicitly relates stock dynamics parameters to data actually observed from the catch. Such a framework allows for a systematic and statistically consistent propagation of the uncertainty inherent in the actual catch sampling process across the whole stock assessment model and to the resulting estimates (computed here via Bayesian methods). It can also provide a statistical tool to evaluate the effect of sampling design changes on the precision of assessment estimates. We demonstrate our model using a simplified scenario of the Iberian sardine fishery and apply it to simulated and real datasets. A comparison between the traditional approach and our method is also presented.

Keywords: Bayesian, catch composition, catch sampling data, fish stock assessment, model-based estimation, uncertainty propagation.

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ICES CM 2009/N:12

Quality of abundance indices based on international acoustic surveys in the context of input data for stock assessment models: example of Baltic International Acoustic Surveys

S. Kasatkina and P. Gasyukov

The Baltic International Acoustic Surveys (BIAS) provide important information for annual assessments of sprat and herring stocks. The abundance indices by age groups estimated from the data of all vessels–participants of BIAS are used for tuning the fish stock assessment models (e.g. XSA tuning). In this paper, we discuss statistical characteristics (mean, median, variance, 95% confidence intervals) and bias of abundance indices obtained from data of each vessel, as well as all vessels participated in BIAS 2004–2006. Calculations were made by simulation based on the algorithms of BIAS data processing. It appears that sprat and herring abundance indices are accompanied by varying accuracies from survey to survey and from vessel to vessel. The accuracy of abundance indices for each fish species vary considerably by age group. The lowest accuracy is associated with young and old age groups. The highest interannual changes in accuracy also associate with the young age groups used in the recruitment estimation. The bias can amount to 30% and more due to the method adopted in the BIAS for calculating strata frequency distributions of fish length and species structures. The results obtained prove that abundance indices are characterized by variances which depend on the value of the abundance indices themselves; therefore variance is not a constant value by year for each age group. Accounting for this fact, the stock assessment models allow us to estimate sprat and herring stocks more reliably. In addition, it was revealed that analysis of uncertainty in abundance indices provides important information for improving international survey design.

Keywords: abundance indices, acoustic surveys, Baltic Sea, simulating, uncertainty estimates.

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ICES CM 2009/N:13

Statistical variability of Peruvian anchovy abundance for acoustics between the years 2000 and 2008

Ramiro Castillo Valderrama and Francois Gerlotto

Statistical analysis was conducted on acoustic data on anchovy (*Engraulis ringens*) obtained during hydroacoustic evaluation cruises of pelagic resources carried out in Peruvian seas between the years 2000 and 2008. Analyses corresponded to the centre of gravity, variogram, Lorenz's diagrams, and Gini's Index.

Briefly, the centre of gravity of the distribution of the anchovy between 2000 and 2008 at 07 and 11 S. Solo in spring 2001 and has found itself between the latitudes summer of the 2003, the centre of gravity it caught up with its maximum position in Chicama, stops next holding a stable tendency in front of Huarmey of late years.

Structural analysis of the anchovy distribution of each cruise was made by adjusting the densities to a local standardized spherical-type variogram. This showed that, in summer, cruises have maintained a relatively high, in spring and winter cruises have been low. The space distributions have maintained a light decrease of their structure with values of rank between 3 and 8 nm. Microescala's variability has registered values in a status that it comprised because 0.10 and 0.86 of the total variance, with the bigger levels in summers 2005 and 2001, and the minors in winter,

spring 2001 and spring 2006. These values in the variograms parameters bear to describe distribution as anchovy as structured and spacially dependent.

In the results of the diagrams of Lorenz and Gini indices reflect a high variability of the values of anchovy integration, including cruising seasons.

Keywords: anchovy, variability, abundance, acoustic.

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ICES CM 2009/N:14

Robust, cost-effective fisheries catch and discard data with the integration of fishing logbooks, video-based monitoring, and offload monitoring

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The groundfish fixed-gear fishery in British Columbia, Canada uses rights-based management (ITQs) and individual catch accountability (landings and at-sea discards). Monitoring consists of a requirement to keep detailed logbooks, carry video-based electronic monitoring (EM) and have offload events monitored, at a total cost of about 3% of the ex-vessel fishery value. EM serves a dual purpose of auditing the quality of logbook data and creating an unbiased catch estimate. The audit uses a 10% random sample of fishing event imagery and offload data to compare with logbook information to determine whether it meets established data quality standards. A number of disincentives encourage accurate catch reporting and compliance has been high. The 10% random sample of fishing event imagery is also used to provide an independent and unbiased estimate of the mean and variance of catch per fishing event, which is then expanded to estimate the total fishery catch. Because the EM image data are recorded at the moment of capture, the catch estimate is unaffected by misreporting of discards or dumping. This method provides a truly unbiased estimate, rare in fishery monitoring, which can measure the accuracy of logbooks and other catch accounting methods. This dual approach to catch estimation serves the multiple data needs and timelines in the fishery. Audited logbook data are used for near-real time accounting in the fishery, thereby permitting time-sensitive quota management activities to occur with confidence. The unbiased catch estimate is constructed during the fishery and serves stock assessment and other research needs.

Keywords: groundfish, fishery monitoring, fishing logbooks, audit, catch accounting, sustainability, public confidence.

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ICES CM 2009/N:15

Do the regular age reading exercises improve the quality of assessments? The case of Baltic herring

Georgs Kornilovs, Jon Helge Vølstad, Daniel Stepputtis, Dankert Skagen, and Tiit Raid

In 1997, the ICES Baltic Herring Age Reading Study Group (BHARSG) was founded to investigate and enhance the agreement in age determination of Baltic herring between national laboratories. In total nine countries around the Baltic Sea were involved in the work of BHARSG. At the beginning, the different methods used to sample, store, and read the otoliths of Baltic herring were described, followed by the preparation and exchange of herring otolith samples. The first age reading results revealed significant differences between readers. The agreement was around 50% and the coefficient of variation was high. BHARSG had two workshops in 1998 and 2000 and additional regular otolith exchanges. The agreement between readers improved gradually, especially after the workshops, where differences in age determination were thoroughly discussed on a case-by-case basis. The experts decided to continue regular exchanges of otolith samples even after BHARSG was dissolved in 2001. In 2008, a workshop of Baltic herring age reading was held again and the

achieved average agreement in age determinations was 86.9% (CV 6.4%). The improvement of age reading in Baltic herring and its consequences on the precision of XSA stock assessment are presented and discussed.

Keywords: precision, stock assessment, age reading, Baltic herring.

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ICES CM 2009/N:16

Augmentation of length sampling using production by commercial size categories in the *Loligo gahi* fishery off the Falkland Islands: a simple hierarchical Bayesian model

Ignacio Payá

Loligo stock assessment is done by fitting depletion models by areas. These models use the mean length (ML) of the catches per day. With a limited number of scientific observers (SO) aboard vessels, sometimes is difficult to cover all the areas. However all vessels daily report their production by commercial size categories (CSC) by means of electronic logbooks. Therefore the aim of this study was to develop a procedure to estimate ML by area using the production by CSC. Ideally ML by CSC could be estimated from the length frequency using length–CSC keys. However, these keys are not available and only the size ranges by CSC. Using five samples (2170 squids); it was proved that ML estimated using size ranges were equal to ML estimated using length–CSC keys. In all, 217 daily ML estimations based on SO data (MLSO) and on CSC (MLCSC) were computed from 11 fishing trips between 2006 and 2008. A simple regression model, $MLSO = 1.001 * MLCSC$, was found to be statistically significant, but as the data came from different vessels (random effects), a simple hierarchical Bayesian model was fitted using WINBUGS software. The slopes of the regressions of the 11 fishing trips were random samples from a normally distributed meta-population of slopes with an average of 1.004 and standard deviation of 0.0085. As the e-logbooks are daily deliveries, the procedure produces real time estimations of ML that are independent of SO samples. Examples of the use of this procedure in the *Loligo* stock assessment are shown.

Keywords: augmentation, length sampling, commercial size categories, hierarchical Bayesian model.

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ICES CM 2009/N:18

Fully documented fishery—using electronic monitoring to improve industry self-reported data

Jørgen Dalskov, Lotte Kind-Larsen, and Eskild Kirkegaard

Total allowable catch (TAC) is a central concept in the Common Fishery Policy of the European Union. It is, however, generally recognized that the catches counted against the TACs do not reflect the total catches taken but only the part of the catch that is landed and officially registered. This discrepancy between the actual and reported catches may be a result of discarding, highgrading, illegal landings, and area misreporting and may be linked to increasingly complicated and non-transparent regulations. In order to address this discrepancy and to achieve higher accuracy in the data which forms the basis for fishery advice, the Danish Government has proposed a new reporting and quota paradigm based on actual catches rather than reported landings. The foundation for this new paradigm is an obligation for the vessel owners to report total catches by species and not only landings. All catches and discards, as well as landings, will be counted against the TAC. Such a system will provide an incentive for the fishers to target marketable species and

size classes and to avoid discards. The TACs will have to be adjusted to reflect total catches and not only landings. The success of such a system depends on the implementation of an appropriate documentation system to verify the catch figures. To this end an electronic monitoring (EM) system in the form of cameras and logging of fishing operations (GPS, hydraulic sensors, etc.) has been tested by the National Institute for Aquatic Resources, Technical University of Denmark (DTU Aqua). Six representative commercial Danish fishing vessels have been equipped with an EM system and have operated under a vessel-specific catch quota for cod where all catches of cod have been registered and counted against the quota. This paper describes the EM system and the experiences gained during the test period, and provides an evaluation of the extent to which the system can provide a reliable documentation of total catches. Possible impact of the introduction of catch quotas on the operation and behaviour of the six fishing vessels participating in the trials are evaluated.

Keywords: TAC, total catches, full documentation, electronic monitoring, video data.

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ICES CM 2009/N:19

Analysis of intrinsic uncertainty in survey indices in DATRAS

Vaishav Soni, Henrik Sparholt, and Neil Holdsworth

ICES Member Countries conduct fish abundance trawl surveys and submit the data to DATRAS. The data cover several surveys in the Baltic Sea, the North Sea, and western and southern area. The DATRAS system offers a calculation of fish stock abundance indices, which are inputs for routine fish stock assessment work. Bootstrapping is implemented as a routine in DATRAS in order to estimate the intrinsic uncertainties in the indices. Uncertainty estimates are useful for evaluating individual surveys (e.g. related to the *a priori* weight to assign to each index time-series in an assessment model). They can also be useful in judging whether to increase the number of trawl hauls in a given survey in order to improve the overall precision in an assessment. We give here an overview over the intrinsic uncertainties in the DATRAS indices.

Keywords: DATRAS database, intrinsic uncertainty, bootstrapping, trawl survey data.

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ICES CM 2009/N:20

Quality assurance in DATRAS: quality control, data validation, and data-flagging functionality

Vaishav Soni and Neil Holdsworth

For the period 1965 to present day, trawl survey exchange data from the Baltic Sea, the North Sea, western and southern areas, have been collected, submitted, and stored in the DATRAS database in the ICES Secretariat. Every year and for several quarters, Member Countries have reported data to the database through the DATRAS online data screening and submission page. Several quality check procedures are performed before the data are deposited in the database, for example code validation, data point outlier identification, and flagging. The online data screening program allows data submitters to check data submission files, and the resulting information is reported to the user in a real-time environment. These intensive checks cover format types and versions, data ranges and reference codes, which all ensure that the end user submits data that are comparable over time and geography. Outlier plots based on SMALK data give a general evaluation of the quality of data. This is done by creating plots of ALK and MALK with all data included in the survey and an area. A data-flagging functionality is under development within the DATRAS system. The aim will be to provide a quality filter according to a number of standard quality flags,

comparable to the type used in SeaDataNet, for instance. This will allow users the option to select only data that have fulfilled certain quality criteria. Overall, the automated workflow that encompasses quality checking, adherence to references, formats, and accepted procedures in DATRAS version 2.0 provides a good-quality assurance benchmark for all end uses of the data derived from DATRAS.

Keywords: DATRAS database, data validation, quality control, outlier, flagging.

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ICES CM 2009/N:21 Poster

Incorporating survey variance in sequential population analysis

Noel Cadigan

We derive some basic statistics that describe the variability of a survey index derived from stratified random sampling for several Northwest Atlantic fish stocks. The variability is expressed as a function of population abundance and is based on a negative binomial (NB) distribution assumption for trawl catches. Diagnostics that support this assumption are presented. However, maximum likelihood estimates of the NB overdispersion parameter based on a stratum effects model can have severe bias, and an alternative estimator is shown to give much better results. We also show how the survey variance component can be incorporated into stock assessment models such as ADAPT or XSA. Interestingly, this results in an estimation procedure that is more similar to the implicit and intuitive weighting that many fishery scientists use to track cohorts in survey data by focusing on the ages that tend to be caught well, whereas ADAPT or XSA tend to give higher weight to ages not well caught.

Keywords: survey variance, stock assessment models, negative binomial.

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ICES CM/N:22 Poster

DEEPFISHMAN: management and monitoring of deep-sea fisheries and stocks

Pascal Lorange *et al.*

Deep-water fisheries pose particular difficulties for management. Target species are difficult to assess with adequate levels of certainty, they are slow growing and generally vulnerable to overfishing and many of these fisheries reside outside EEZs and, therefore, are not subject to national jurisdictions. The EU project DEEPFISHMAN will develop a range of strategy options for the management of deep-water fisheries in the Northeast Atlantic that will take account of these factors. The primary objective of the project is to identify and develop new and more effective assessment methods, reference points, control rules, and management strategies to be used in the short term. The second objective is to develop a long-term research and management framework in which additional data needs will be specified in order to fill current information gaps to achieve reliable long-term management requirements. This research effort will be supported by a range of case studies selected to reflect the characteristics of the different types of deep-water fisheries found in the Northeast Atlantic. In addition, two case studies outside the Northeast Atlantic are selected to give a wider perception of the management and monitoring of deep-water fisheries in the world. Case studies will collate, store, combine, and raise data to appropriate fisheries/stocks levels. The socio-economic aspect of the fisheries and the expected impact of the management strategy options will be examined. The project outputs will aim to provide robust guidelines for deep-water fisheries management suitable for adoption within the Common Fishery policy.

Keywords: deep-water fisheries, EU project.

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Minimum sampling programmes—How to deal with a plethora of different protocols

Margaret Bell

For many years it has been a task of the Planning Group for Commercial Catch, Discards and Biological Sampling (PGCCDBS) to (i) provide guidance on data collection regarding length sampling of fish and shellfish and (ii) attempt to produce a protocol which would encourage data collection in a standard and coordinated way throughout Europe. During discussions with members from various countries in 2007–2008 it became apparent there were some basic differences in what was actually collected. These posed the questions: were the data comparable, were they biased, and should they be used for assessments in an identical way? In 2008 a minimum sampling protocol was designed as an aid to be used when collecting data. A list of procedures adopted by 21 institutes was compiled and this resulted in some potentially significant differences. For example, many countries include spatial stratification when deciding their annual sampling targets but other countries sample from the same location at all times. Also, the procedures used to create missing data for unsampled strata can differ considerably between countries. A number of proposals to address more standardized ways of compiling datasets and illustrating their accuracy are being developed.

Keywords: fish sampling, protocol, data accuracy.

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ICES calibration workshops—extracting the juice from bonny structures and gonads

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Age and maturity stage calibration workshops are an acknowledged valuable mechanism for the improvement of the quality of the population structure data that are available to assessment working groups. Additional benefits include the establishment of active peer networking, including continued contact between participants after workshops and the age reader/age coordinators' Google group. This has led to improvement in the self-confidence of the participants and has also given them an increased understanding of their importance of their unique role within the overall management of the marine ecosystem, including calibration workshops, terms of reference, and reports. Workshop networking is especially important for age readers, many of whom work in small groups. The terms of reference for calibration workshops have evolved in parallel with the role of the ICES Planning Group on Commercial Catch, Discards and Biological Sampling, as a pushing mechanism regarding the improvement of data quality. Calibration workshops have moved beyond the study age and sexual maturity in isolation and the prospect of age reader interaction with stock assessors and other experts is very interesting. Calibration workshop reports are now available in the PGCCDBS documents repository and the publication of a series of ICES Cooperative Research Reports for age calibration workshops is bringing this work to the attention of the scientific community and recognizing the merit of the scientists involved.

Keywords: calibration workshops, WKAC.

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Sources of uncertainty in fishing effort estimation procedures: the case of northwestern Spain fleets

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Trends in catch per unit of effort are an important means of estimating trends in stock abundance, especially when fishery-independent data are not available. Catch data are usually obtained from logbooks or sales slips databases, but effort information is a combination of different variables and can be estimated following several procedures. Accurate information of fisheries effort is a necessary input for stock assessment and its importance has increased in recent years as many fish stocks are threatened with collapse. In many cases, the selection of the approach is determined by the availability of detailed information on fishing operations and technical characteristics of the vessels and the gear. This study investigates the different approaches used to quantify fishing effort in two selected fisheries of northwestern Spain. Effort data for a gillnet fishery targeting anglerfish and a mix-species bottom-trawl fishery are analysed in this study. We compare the results obtained of applying different calculation approaches and standardization methodologies for effort data. The final objective is to identify the most robust approach for effort estimation in each fleet and to indicate the gaps that must be addressed to improve our ability to quantify fishing effort.

Keywords: fishing effort, quantify, approach, gillnet, bottom trawl, northwestern Spain

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The incidence of skipped spawning in Northeast Arctic gadoids

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Skipped spawning describes the phenomenon of iteroparous spawners aborting one or more spawning opportunities after sexual maturation. If this is a common occurrence it may influence the reproductive potential of a stock and consequently the perceived stock–recruitment relationship. If the models do not take into account the skippers from the annual spawning population then there will be an overestimate of the reproductive potential of a given stock. This could have important implications in heavily exploited populations by being overly optimistic of the resilience of the stock at low stock sizes. Using a combined field and laboratory approach we examined the frequency and the underlying mechanisms causing skipped spawning in northeast Arctic cod (*Gadus morhua*). We found that skipping was a common occurrence and linked to both female age and individual energy reserves. Furthermore, skipping fish separated physiologically from the maturing fraction long before spawning, and could be identified by mid-November. Skippers did not undertake the annual spawning migration to the Lofoten area and remained at the feeding areas in the Barents Sea. At present we are studying another Northeast Arctic gadoid, the haddock (*Melanogrammus aeglefinus*), to establish if we can detect similar patterns of skipped spawning.

Keywords: cod, farming, escapees, mating, genetic introgression.

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A framework for improving accuracy in fisheries data used in stock assessments

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The accuracy of fisheries data is determined by systematic errors (bias), and random errors caused by sampling of catches. Systematic errors may have at least as much impact on the stock

assessment as random sampling errors. Whereas precision in fisheries statistics can be improved by increasing the sample sizes in data collection programmes, this is not the case with bias. It is therefore important to minimize or eliminate sources of bias by developing and following sound field data collection procedures and analytical methods. We present a practical framework for detecting potential sources of bias in fisheries data collection programmes. Several indicators are used to detect bias in each of these parameters, using a simple scorecard for rating. The scorecard is a practical tool to evaluate the quality of data sources used for stock assessments, and can help to reduce bias in future data collections by identifying steps in the data-collection process that must be improved. The proposed scorecard was applied to the data-collection programme for the Norwegian Northeast Arctic saithe fishery in 2007. This case study suggested that the system is practical and useful, but it is recommended that more fisheries be evaluated to develop the scorecard further.

Keywords: accuracy, bias indicators, catch data, surveys, census.

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