

Theme Session Q

Theme Session on Science underpinning stock abundance survey practice, including unaccounted fishing mortality, especially ghost fishing

ICES CM 2007/Q:01

The Continuing Story of the DEEPNET Project

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The DEEPNET report produced in conjunction with a number of scientific institutes in Ireland, the UK and Norway, highlighted the problem of lost gears, especially gillnets, in deepwater areas. In 2005 trials carried out by Bord Iascaigh Mhara, the Marine Institute and Norwegian experts recovered a large amount of lost nets, reinforcing the notion that ghost fishing was an important environmental issue to be tackled. At the EU December Fishery Council in 2005, largely as a result of the issues raised in the DEEPNET report, and subsequently backed up by the findings of this pilot net retrieval survey carried out on the mfv “India Rose”, the EU brought in new measures in 2006 that prohibited gillnetting in depths greater than 200m in ICES Areas VI and VIIb-k. Most Member States broadly welcomed the introduction of these measures, but one issue that was identified subsequently by the EU and also by the North Western Waters Regional Advisory Council was the need for further net retrieval surveys to clear lost, discarded or abandoned nets in the areas covered by the regulation. Therefore in July 2006, BIM/Marine Institute commenced a second net retrieval survey on board the mfv “India Rose” with the assistance of Norwegian experts. The vessel surveyed grounds for lost nets both at Rockall and also in areas around the Porcupine Bank and nets were retrieved in depths between 400-800m in the Southeastern slope of Rockall, in the Northwestern slopes of Porcupine Bank, and in the Southern part of Porcupine Bank. This work has provided additional information on ghost fishing that will augment previous studies and also illustrates the technical difficulties of retrieving nets from deeper waters.

Keywords: DEEPNET; retrieval surveys, lost nets, gillnet, deepwater.

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ICES CM 2007/Q:02

The Modified GOV and Ground gear ‘D’

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Several European laboratories undertake groundfish surveys in the north-eastern Atlantic as part of the southern and western International Bottom Trawl Survey (IBTS). Parts of the western English Channel (ICES Division VIIe), southern Bristol Channel (VIIIf) and St George’s Channel (VIIa) have hard grounds that are not suitable for fishing with the standard GOV with ground gear A. In order to be able to sample these habitats, Cefas have used a modified GOV trawl on these grounds since 2004. The modifications made to the GOV include (i) replacing the central 5m section of the bosom with a 3m section, (ii) removing the middle bridle, (iii) using 20 m sweeps instead of 50m, (iv) replacing the kite with extra flotation, (v) including tearing strips between selected panels and (vi) using a rockhopper ground gear rig. The rockhoppers (ground gear D) comprise 16” discs with one spacer in the bosom, 16” discs with two spacers in the bunts, 14” discs with three spacers in the wings and 12” discs with three spacers on the wing ends. This gear is described, and we present preliminary observations on net geometry (wing spread, door spread and headline height) and the species and size composition of catches around the Cornish Peninsula and St George’s Channel.

Keywords: trawl surveys, Grand Ouverture Verticale, Western English Channel, St George’s Channel.

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ICES CM 2007/Q:03

Influence of current velocity on the near-bottom vertical distribution of fish and their availability to a bottom trawl

David Somerton, Daniel Nichol, and Paul von Szalay

The near-bottom vertical distributions of semi-demersal fishes such as Pacific cod and walleye Pollock have been shown to vary spatially and temporally in the eastern Bering Sea. Knowledge of the factors influencing vertical distribution is important because of its impact on the availability of these species to a bottom trawl. For Pollock, light level has been shown to be an important determinant of whether or not they occur within the effective fishing height of the trawl used by the Bering Sea survey. For Atka mackerel, another Alaskan species, both light level and current strength were found to be important. In this study, we examine the vertical distribution of Pollock, as determined with hydroacoustics, and of cod, as determined with archival tags, to determine if it is influenced by the strength of tidal currents predicted by a tidal model of the eastern Bering Sea

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ICES CM 2007/Q:04

The use of GIS-technology for estimation of the Northeast Arctic cod stock

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The Northeast Arctic cod is one of the most important target species in the Barents Sea. The volumes of cod catches depend on the state of the fishing stock which is assessed by the ICES AFWG by the methods of mathematical modeling based on the theory of fisheries. The authors set ourselves a task to assess the fishing stock, basing on the daily reports of Russian fishery vessels. In total, for the 2000-2006 period the 181,068 reports were analyzed, from which the 89,028 ones were used to estimate the cod biomass. For each square it was determined by the area method the 15-day periods. The cod biomass for the whole Barents Sea was computed as a sum of biomass estimates for the all squares of the sea which areas were determined with the use of software package GIS ArcView, version 3.2 (by the company ESRI). The annual averages of biomass were determined as their arithmetical mean for the April-December period. In total, the 126 estimations of the cod fishing stock biomass in the Barents Sea were made. The results showed that in 2000-2006 the biomass ranged from 1.9 mln t to 2.8 mln t. In 2005-2006 an increase in stock biomass from 2.0 mln t to 2.6 mln t occurred. The values of the fishing stock biomass obtained by our method were essentially higher than those by the ICES data.

Keywords: stock assessment, Northeast Arctic cod, GIS, fishing stock biomass.

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ICES CM 2007/Q:05

The integration of environmental parameters into shrimp stock assessments, Gulf of Mexico, USA

Rick A. Hart and James M. Nance

The National Marine Fisheries Service, Southeast Fisheries Science Center, Galveston Laboratory, conducts stock assessments for three commercially valuable shrimp species harvested from the Gulf of Mexico, USA. These species are brown (*Fartantepenaeus aztecus*), white (*Litopenaeus setiferus*), and pink (*Fartantepenaeus duorarum*) shrimp. In our assessments we use both fisheries dependent and fisheries independent data. Fisheries dependent data include commercial fisheries landings, port agent effort interviews of shrimp vessel captains and crew, and electronic logbook records to estimate fishing effort. Fisheries independent data includes annual SEAMAP research cruises which record shrimp catch, e.g., densities, and spatial locations, as well as environmental data. Our stock pre-assessment models are written in primarily in Cobal, and C++, while our Virtual Population Analysis (VPA) model is written in Fortran. At present we do not incorporate environment parameters in our VPA models. However, we are currently in the process of migrating models into AD Model Builder, with plans to integrate environment parameters into our assessment models. We believe environmental factors are of primary importance in regulating shrimp populations in the Gulf of Mexico. This is most evident when viewing our parent-recruit relationship patterns. Outwardly, there does not appear to be any obvious relationship between the number of parents and resulting recruits. However, when we view these relationships by longer temporal periods, e.g., parents and recruits grouped by decades, we see relationships appear. It is our belief these decadal trends in parent/recruit relationships are due to environmental parameters. With the use of new modeling approaches we hope to be

able to reveal which environmental parameters are regulating this portion of the shrimp populations' behavior.

Keywords: shrimp, stock assessment, virtual population analysis, Gulf of Mexico.

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ICES CM 2007/Q:06

Chilean Crustacean Assessment Surveys: A review

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Three species of crustaceans are subject to fisheries in the lower shelf and upper slope (150 to 500 m) off the Northern-Central Chilean coast: two galatheid squat lobsters (*Cervimunida johni* and *Pleuroncodes monodon*) and a pandalid shrimp (*Heterocarpus reedi*). Their fisheries are managed through a Quota system. For the purposes of assessment, swept area surveys are conducted every year to provide tuning information for the VPA analysis and Quota calculation. The different sampling designs that have been applied during the fourteen years of direct assessments, ranging from systematic transects to randomly stratified designs for the three resources, are critically analyzed. Methodological approaches in relation to tow duration, determination of tow beginning and end, geographic and bathymetric distribution of the three species, analysis of the by-catch caught with the three species are also addressed.

Keywords: squat lobsters, shrimp, fisheries, assessment surveys, Chile.

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ICES CM 2007/Q:07

Sources of variation in *Nephrops* burrow counting schemes

Ewen Bell, Jon Elson, and Julian Addison.

Underwater TV surveys are increasingly being used for the assessment of *Nephrops* stocks due to the uncertainties surrounding catch data and the difficulties in age determination. Video footage of the seabed is reviewed by a number of personnel, and the number of burrow complexes recorded over a 10 minute period. The number of entrances per burrow complex is variable and *Nephrops* are often not the only burrowing animals living within the areas surveyed. Burrow complex identification is therefore a subjective process and the criterion used by each counter is likely to differ. An experiment was designed to look at the effects of counter experience, relative burrow density and whether counters worked alone or concurrently. As expected, the variance of total burrow counts per tow generally decreased with the level of counting experience, however even experienced counters had significantly different mean counts. Some counters experienced “day effects” where all counts were simultaneously higher or lower than average. Analysis of within-tow counts indicated that whilst total count variance can be low, the consistency of burrow identification can be relatively poor. Concurrent counting had a significant effect on individual counts, all counters became significantly more conservative than when counting alone. These results highlight the need for a standardised counting protocol and more extensive training and calibration exercises both within and between countries.

Keywords: *Nephrops*, Underwater TV surveys, variance.

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The effects of improving accuracy and precision of area swept estimates on relative biomass estimation and stock assessment: a retrospective

Michael H. Martin and Stan Kotwicki

The technologies used in the estimation of area swept have changed enormously over the past 30 years, enabling much more accurate estimates of area swept. In addition, the ability to interpret collected data has improved over time as data analyses continually improve and mature. These changes often occur incrementally over time resulting in a “technology creep” that may gradually change the perception of area swept over time. While more accurate estimates are certainly desirable, these improvements can also lead to problems in inter-annual comparison of results as sources of bias are reduced or eliminated. We examined the effect of four analytical changes that could have a direct effect on the estimation of area swept and relative

biomass calculations for three surveys in Alaska. The effects examined were: changes in the methodologies of estimating distance fished and net spread, the effect of better estimates of sound speed at depth on estimation of net spread, and the effect of the added distance travelled by the net during wire retrieval after haulback. The effects of each individual change and the cumulative change on area swept estimation and the resulting biomass estimates were estimated. The potential effect of these changes on the stock assessments of a few key species in Alaska was also examined.

Keywords: Area swept estimation, biomass.

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Quantifying the impact of derelict fishing gear on the marine fauna of the Puget Sound-Georgia Strait basin

Thomas P. Good, Jeffrey A. June, and Ginny Broadhurst

Derelict fishing gear - lost or abandoned commercial and recreational fishing nets, lines, pots, and traps that sit on the bottom or float underwater - can remain in the marine environment for years. Unseen and thus largely unquantified, derelict fishing gear can trap and kill a variety of target and non-target marine organisms. We have documented the capture and mortality of target and non-target marine taxa by derelict fishing nets during recovery and removal operations in Puget Sound and the Northwest Straits, in Washington State (USA) since 2002. Specimens collected during gear recovery are identified and enumerated as nets are hauled onboard, during laboratory necropsies, and/or using osteological characters from skulls and post-cranial material. Of the nearly 500 derelict nets recovered, 98% were gillnets. Of the nearly 7300 individuals found, 67% were dead. The % of individuals found dead was greatest in marine mammals (100%; n=12) and birds (100%; n=120) followed by fishes (93%; n=830); and invertebrates (63%; n=6327). Mortality was documented for several fish, bird and mammal species of regional and national conservation concern. Lethality of nets was related to net size, age, and extent of open suspension; lethality may also be a function of location, season, habitat type, density, and depth in the water. Ongoing derelict gear recoveries to estimate mortality near hotspots (MPAs, haul-out sites, wildlife refuges) as well as experiments to estimate carcass turnover rates will refine analyses to estimate the impacts of derelict gear mortality for target and non-target species of conservation and commercial concern.

Keywords: derelict fishing gear; Puget Sound/Northwest Straits, USA; gillnet; Pacific salmon; marine birds and mammals.

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ICES CM 2007/Q;10

Factors influencing net width and footrope bottom tending performance of a survey trawl

Kenneth L. Weinberg and Stan Kotwicki

Generalized additive modeling was used to analyze numerous variables related to vessel operations, scope, catch, and environmental conditions for their additive effects on net width and footrope (ground gear) contact performance, two important determinants of the catch process. Our model for predicting net width showed spread was most affected by the interactive effect of towing depth and trawl wire length, positively impacted by increases in towing speed, sea height, and areas comprised of fine sand and coarse mud, and negatively impacted by increasing catch, particularly catches of heavy benthic invertebrates, such as snails and sea stars. Our model for predicting footrope performance showed the gear fished closer to the bottom with increasing catches, particularly catches of heavy benthic invertebrates. Knowledge of the factors affecting trawl gear and their relationships to other variables, can assist in endeavors to standardize trawling practices, gear and survey designs, and post-cruise analyses, thus contributing to decreases in survey variance due to variability in survey trawl capture efficiency. For example, improved estimates of area-swept, based upon a variety of trawling conditions can result in increased accuracy of survey biomass estimates for tows in which net mensuration sensors malfunction. Furthermore, improved real time recognition of unsatisfactory gear performance will provide an opportunity for the re-sampling of a station.

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An analysis of rockfish (*Sebastes* spp.) distributions in trawl surveys in Alaska with application to fishery independent survey design and station allocation

Christopher N. Rooper

Rockfish species are notoriously difficult to assess using standard bottom trawl surveys due to the propensity of many species to occur in rocky high relief areas. Rockfish assemblages in two large ecosystems, the Gulf of Alaska and Aleutian Islands, were analyzed using relationships with environmental variables. Four distinct assemblages of rockfish species are described for the continental shelf and slope defined by the distributions of species along depth, position and temperature gradients. The 180 m depth contour was a major division between an assemblage inhabiting mid-depths on the upper slope and shelf and a deeper assemblage on the lower continental slope. A noticeable transition occurred between species centered in southeastern Alaska and those found in the northern Gulf of Alaska and the Aleutian Islands Region. The distribution of species over environmental gradients was correlated to their frequency of co-occurrence in trawl survey catches, indicating those species with similar environmental preferences were more likely to be captured together. This information will be helpful in designing and allocating stations in fishery independent surveys for rockfish. An example is given for a new fishery independent abundance index for rockfish in areas that are currently unsurveyed in the Gulf of Alaska because of rough bottom. The method described here is different than commonly utilized analysis methods that cluster trawl survey catches or stations with similar catch constituents. The method provided similar results to other studies and, because of its ecological basis, it may be more robust for prediction and management purposes.

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ICES CM 2007/Q:12

Direct observations of large mesh capelin trawls; evaluation of mesh escapement and catchability

Haraldur Arnar Einarsson, Einar Hreinsson, and Sigurður Þór Jónsson.

This paper describes the methods used for observing large pelagic trawls with remotely operated towed vehicle (ROTV), evaluation of enmeshing and mesh escapement, estimation of in situ school density and catchability of the gear.

The use of large mesh pelagic trawls has increased in Icelandic waters during the past 15 years. Developing from the redfish trawling, this gear type is now extensively used to catch capelin, herring and blue whiting. The use of these large-mesh trawls has raised questions among fishermen, scientist and management institutions in Iceland, regarding possible unaccounted mortality caused by extensive escapement of fish through the larger mesh panels. Another concern has been raised, that extensive use of these large trawling gears may disturb schooling behaviour of capelin and the migration patterns of the mature part of the stock.

A research program has been running from 2005 to 2007 to address these concerns. Here we firstly describe the instrumentations and techniques used to observe and monitor these giant fishing gears. Secondly, we present observations of mesh escapement and enmeshing of capelin in different net sections and mesh sizes. Thirdly, we present observations of capelin behaviour during the catching process and reactions to light. At last we present an approach used for estimation of in situ volume density of capelin through the catching process and how it can be used to estimate the catching efficiency of the gear.

Keywords: capelin, pelagic trawling, escapement, volume density, catchability.

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ICES CM 2007/Q:13

Application of Bayesian Maximum Entropy method in the procedure of the acoustic survey data processing by the example of the Baltic herring and sprat survey

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The descriptive statistic and classical geostatistical methods represent the commonly used tools of acoustic survey data processing. The current realization of these methods provides fish stocks abundance indices accompanied with the estimates of uncertainty - variance, variation coefficients, and confidential intervals. However, these methods use only the data obtained during the acoustic survey, i.e. the acoustic index NASC measured at transects, species and length composition of fish in trawl catches. At the same time, the additional information is available not used for assessment of the density field. A priori data or estimates in the points where no observations, e.g. obtained with the kriging method, may be used as such information.

Baysian Maximum Entropy method (BME) allows to process of the acoustic survey data taking into account both observations and estimates obtained in the points lacking observations, if these estimates are given by the confidential intervals or a posteriori PDF distribution.

BME application is demonstrated by the examples of the Baltic acoustic survey data processing based on the Russian surveys in 2004–2006. BME was used in reconstruction of NASC distribution. In this case, the distribution obtained by means of the entropy maximization with restrictions for the first and the second moments of the random fish density field was used as a priori distribution. All estimates are accompanied with statistical characteristics or a posteriori functions of distributions used in estimation of herring and sprat abundance indices. The comparative analysis of abundance indices estimates obtained with BME and traditional method or classical geostatistics is presented.

Keywords: Baysian Maximum Entropy method, Baltic acoustic surveys, classical geostatistics.

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ICES CM 2007/Q:14

JUVENA: a critical revision and sensitivity analysis after four years of anchovy juvenile acoustic surveys in the Bay of Biscay

Guillermo Boyra, Paula Álvarez, Unai Cotano, Udane Martínez, and Andres Uriarte

The JUVENA surveys aim to estimate annually the spatial distribution and relative abundance of juvenile anchovies and their growth condition at the end of the summer in a sampled portion of the Bay of Biscay bounded at 5° W and 46° N. The long term objective of the project is to assess the recruitment to the fishery the following year. The program follows the methodology of an acoustic survey. It covers the juvenile distribution area in an adaptive sampling design, taking into account the information recovered from the commercial fleet. Presented are the results from the first annual surveys (2003–2006), and the comparisons of the results of each survey with the adult abundance the next year. The sampling strategy (mainly the adaptive enlargement of the sampling area, the use of different vessels with different fishing gears and the survey resolution imposed by time constraints) as well as the data processing methodologies are critically revised. A sensitivity analysis is performed on the main parameters utilised. Along the first four years of campaigns, several changes have been implemented in the survey strategy and data processing, according to the recommendations by the STECF SGRST on Anchovy in the Bay of Biscay, in order to improve the quality of the recruitment index during this period. The possible incidence of these changes is also discussed. Finally, a foreseen of future implementations and advances, as the adoption of a multispecific-ecosystemic approach, will be presented.

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ICES CM 2007/Q:15

An assessment of net losses in UK gill and tangle net fisheries

Al Kingston, Simon Northridge, and Alice Mackay.

The Sea Mammal Research Unit has been monitoring gill and tangle net fisheries in the UK since 1996. Over 8000 static net fishing operations, mainly in coastal fisheries, have been observed during this time in all seasons and around most of the UK. In addition to monitoring bycatch events, observers are required to report lost nets during hauling. We have analysed records of lost nets reported over the 11 years of sampling, and, with estimates of the total fleet fishing effort, we have used area specific loss rates to estimate total nets lost by the entire UK fleet. Among 8000 observed hauls, only 32 resulted in any reported loss of netting, with losses ranging from half a net panel to an entire tier or fleet of nets. Small differences were found in the loss rates between areas, and we explored the potential effects of weather, trawler density, water depth and observer on net loss rates. Overall losses are estimated to amount to some tens of km of nets per year in both the North Sea and the Celtic Sea areas. We discuss the results in relation to potential environmental impacts and suggest that these losses on their own are probably not a significant environmental threat.

Keywords: ghost fishing; observer programme; net loss.

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ICES CM 2007/Q:16

Local spatial heterogeneity in blue whiting length structure

Mikko Heino and Sondre Aanes

We have used “multisampler”, a multiple opening-closing device that allows obtaining several samples from a single trawl haul, during the trawl-acoustic survey targeting blue whiting (*Micromesistius poutassou*) on their spawning areas west of the British Isles in spring 2005 and 2006. Typically, two consecutive samples were obtained with the vessel towing at same direction and at similar depth all the time, as if when fishing without the multisampler. Typically, cod-end was opened for 10–20 minutes for each sample. During standard survey operation without the multisampler, total towing time would have been similar but only one sample could have been obtained. Multiple samples taken within a distance of just 1-2 nautical miles reveal substantial variation in mean length of blue whiting in the samples originating from the same haul. Within-haul, between-sample variability is less than between haul variation, but the difference was less than one might expect, given that the latter reflects spatial heterogeneity at scales of tens to hundreds of nautical miles. Our findings highlight that spatial heterogeneity can be combated either (1) by taking more trawl samples or (2) by keeping tow duration sufficiently long. The first option is preferable because it allows estimating uncertainty, whereas long tows hide small-scale variability.

Keywords: spatial heterogeneity, sampling design, trawl surveys.

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ICES CM 2007/Q:17

Describing survey effort in terms of new and existing gear parameters

D. Stokes, J. Hjelm, and B. Vincent.

The cornerstone of groundfish surveys producing relative abundance indices is that the efficiency with which a survey trawl samples a population can be standardised. Without this principle, observed variation in catch abundance can be no more attributed to changes in local fish abundance than simply changes in the trawls ability to capture them. In the field many factors such as sea state and speed through the water impact on a trawls sampling efficiency in terms of both the physical dimensions of the sample taken as well as trawl efficiency due to ground contact and hydrodynamics of the net. These affects are generally treated as random and unbiased and are therefore ostensibly ignored. However, many of these affects are routinely measured directly or indirectly and could be used to more accurately describe the effective sampling unit during a tow in relative terms. Using simple multivariate techniques this approach is discussed as having potential to provide a relative index of sampling efficiency/effort to evaluate i) unusual yet valid hauls within a survey, ii) trends in sampling efficiency over a time series, as well as iii) an annual weighting factor for the survey index for use in assessment.

Keywords: groundfish surveys, effort, trawl parameters, standardisation, assessment, CPUE.

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ICES CM 2007/Q:18

Spreading the effort to focus the analysis: otolith collection in the eastern Bering Sea

Troy W. Buckley and S. Kotwicki

The Alaska Fisheries Science Center has conducted annual standardized resource surveys of the eastern Bering Sea continental shelf since 1982. In response to the need for age-data that were better suited for stock assessment and spatial analysis, a new procedure for collecting otoliths from walleye pollock was introduced in 2006. In prior years, a fixed number of otoliths per length per sex were collected from pollock within areas with different growth rates, and the resulting data were combined to create a single age-length key (ALK) for each sex. We performed a simulation to illustrate spatial artifacts caused by applying a combined ALK to areas of different growth rates. Artificial ontogenetic migration from the area of slower growth into the area of faster growth was created by systematic length-age conversion errors in the simulation. The procedure used for the collection of otoliths from pollock prior to 2006 shows a mismatch between the abundance of pollock and the number of otoliths collected, and it created periodic cessation of collecting common sizes while focusing on hunting for rare sizes. The new method for collecting pollock otoliths is random and spread evenly in space, allowing examination of the data for spatial patterns in age and length-at-

age, and allowing construction of multiple ALKs representative of biological distributions rather than pre-determined geographical boundaries.

Keywords: age-length key, growth, sampling procedure, spatial analysis.

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ICES CM 2007/Q:19

Facing the past – recovering of historic echo data

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Since decades, a vast quantity of data is being collected in the field of fishery science. A valuable source of data about the distribution and abundance of living resources within aquatic environments are collected with echosounders. This type of data is a valuable source of information which is used for the assessment of fish stocks, as well as for ecological research. Nowadays, echosounders store their data electronically, which is the basis for fast access and easy analyzes of these data. Until the beginning of 1990s only integrated data were stored, but are often inaccessible since they are archived in paper form solely. This results in acoustic survey time series, which are often truncated before 1990. One example is the Baltic spring acoustic survey, which was carried out by the GDR and the USSR in the late 1970s and 1980s, a period prior to the regime shift from cod domination to sprat domination. Nevertheless, these data are needed to extend the actual international acoustic spring survey to the past and to have a reference of a period prior to the regime shift in the Baltic Sea. The recovery of these survey data includes the digitisation of all paper stored information (meta data, biological data and integrated echo data). Additionally the paper echograms were scanned and electronically archived. Furthermore the vertical distribution of fish species was extracted from echograms using a software package, developed in the German GLOBEC-project. The steps of recovery, as well as exemplary results will be presented.

Keywords: data recovery, hydroacoustic, Baltic Sea.

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ICES CM 2007/Q:20

Survey transition and calibration of bottom trawl surveys along the Northeastern Continental Shelf of the United States

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The Northeast Fisheries Science Center conducts three long term, broad scale, multispecies bottom trawl surveys that have time series of 44 (Autumn), 40 (Spring) and 15 (Winter) years. Data from these surveys are utilized as inputs to 44 single species stock assessments and 13 Fishery Management Plans along the Northeastern continental shelf of the United States. The Center's primary survey vessel (RV Albatross IV) will be replaced by a modern fisheries survey vessel (FSV Henry B. Bigelow) by 2009. In conjunction with the introduction of a new research vessel platform, the Center plans a number of significant changes to trawling gear systems, survey design and operational protocols. The trawling gear system redesign was completed through an inclusive advisory panel process that promoted input by commercial fisheries, academic and management stakeholders. Survey operational protocol revisions will be implemented based on a 2003 peer review of survey operational protocols and recommendations outlined in the 2005 and 2006 reports of the ICES Study Group on Trawl Survey Standardisation. An extensive survey calibration study is planned to evaluate relative catchabilities and estimate calibration coefficients to promote comparability of current survey to future survey datasets. Calibration studies will include both shadow surveys with the RV Albatross IV conducting 2007 and 2008 surveys and the site specific studies in areas of high species abundance and diversity.

Keywords: survey, bottom trawl, calibration.

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Quantifying the effects of derelict crab traps in Chesapeake Bay

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In Chesapeake Bay, the blue crab (*Callinectes sapidus*) fishery uses traps as the primary gear for harvest. Conservative estimates suggest that up to 500,000 crab traps are fished daily during peak season. There are no current estimates of trap losses, but undoubtedly a percentage of traps are lost annually. Lost traps can continue to capture and kill crabs and other marine organisms. We are using a combination of remote sensing technology and field experiments to quantify the effects of derelict crab traps in Chesapeake Bay. Side-scan sonar was used to quantify traps throughout the Maryland portion of Chesapeake Bay. Sonar surveys were performed following a stratified random sampling approach. Sample strata were areas of high, medium, and low crabbing effort. Six-minute side-scan sonar transects were performed at randomly selected locations within each strata. To ground-truth sonar imagery, a set of known traps were imaged and additional observations were made by divers. Two independent reviewers are performing trap counts from the sonar data. From these data the mean number of derelict crab traps per area will be extrapolated to the total survey area for an unbiased estimates of the total number of derelict crab traps. These estimates will be used in combination with information gathered from ongoing field experiments to evaluate if derelict crab traps are a problem in Chesapeake Bay. Once an overall consensus is made then efforts to determine the best measures of prevention or mitigation will commence.

Keywords: Chesapeake Bay, blue crab, side-scan sonar, derelict crab trap, stratified random sampling.

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Estimation of catch efficiency in a new angler fish survey trawl

D. G.Reid, R. J. Kynoch, I. Penny, and K. Peach.

A new series of targeted angler fish (*Lophius* spp.) bottom trawl surveys were launched by FRS in 2005. The surveys used a new survey net based on a commercial trawl and adapted for survey purposes in collaboration with the fishing industry. The aim of the surveys was to use swept area abundance estimates to provide an absolute abundance estimate for these species in waters around Scotland. Before this was possible it was necessary to determine the capture efficiency of the net using the efficiency equations developed by Somerton et al (1999). Two components were examined: herding by the sweeps, and losses under the footrope. Herding was reported in a previous paper. The present papery presents the results of a series of trials using bags below the fishing line to quantify the proportion of fish at length that escaped below the gear. The results show clear length dependency with smaller fish more likely to be lost under the gear. Below 30cm, approximately 75% of the angler fish were found in the ground gear bags, while for the larger fish the proportion was 25%. The paper presents the catching efficiency of the net using both the sweep herding and losses under the ground gear. In brief, the combination of the two components indicated that the net efficiency was approximately 0.7. That is, that the net would be expected to catch approximately 70% of the fish that were originally in the path of the net between the wings.

Keywords: angler fish, trawl efficiency, ground gear.

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Can formaldehyde fixed gadoid eggs be identified using genetic probes?

Freya Goodsir, Clive Fox, Mike Armstrong, Steve Milligan, Mike Shaw, Michael Godard, and Veronique Creach

Field surveys of eggs are being used to monitor the status of the Irish Sea cod, haddock and plaice stocks. Early stage cod eggs cannot be visually distinguished from those of haddock or whiting so genetic probes are being used to identify the eggs. This currently requires sorting a sub-sample of 'cod-like' eggs from each plankton haul at sea and preserving them in ethanol. Here we report on reliability of Taqman probes to identify eggs that have been fixed in 4% formaldehyde for varying amounts of time. Batches of hatchery sourced cod, haddock and whiting eggs were fixed in formaldehyde for 48hrs, 5 days or 3 weeks and then washed and transferred to a non-formaldehyde containing solution. After a further 1, 2 or 3 months the eggs were assessed visually for fixation quality and then analysed in random, double-blind order, using universal primers and species-specific TaqMan probes in a multiplex assay. Results obtained so far demonstrate that eggs fixed for up to three weeks in formaldehyde can be successfully identified using this approach. Removing the need to sort eggs at sea would reduce costly processing time per station, and allow sampling from smaller vessels lacking laboratory facilities, such as fishing vessels.

Keywords: genetics, fish stocks, Irish Sea, Taqman.

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ICES CM 2007/Q:24 Poster**Using genetic probes to identify gadoid eggs in surveys to monitor the Irish Sea cod stock under the EU recovery program**

Freya Goodsir, Clive Fox, Mike Armstrong, David Stone, Pieter-Jan Schön, Natasha Taylor, Martin Taylor, and Michael Godard

Early stage eggs of cod (*Gadus morhua* L) are impossible to visually differentiate from those of haddock (*Melanogrammus aeglefinus* L.) or whiting (*Merlangius merlangus* L). Here we use species-specific genetic probes to distinguish eggs of the three fish species, as part of a project evaluating the use of egg production surveys to monitor the status of the Irish Sea cod stock during the EU stock recovery program. Cod-like eggs were collected during five ichthyoplankton surveys during the spawning season in 2006. At each plankton station, a subset of the eggs caught was fixed in individual vials filled with ethanol at sea and brought back to the laboratory where DNA was extracted and purified. Using universal primers and Taqman species-specific minor groove binding (MGB) probes in a multiplex, high through-put assay, the samples were processed on an Applied Biosystems 7900 real time sequence detection system. Analysis of hatchery egg standards interlaced with the field sampled eggs indicated a 95% accuracy in determining species composition of cod, haddock and whiting. Out of 4700 eggs collected on the surveys, 22% were identified, as cod, 15% as haddock and 42% as whiting, and approximately 20% were other species. Unidentified eggs are being sequenced on an Applied Biosystems 3100 genetic analyser to confirm their species. Application of DNA results will allow estimation of the stock size of gadoids in the Irish Sea using the Annual Egg Production Method.

Keywords: genetics, fish stocks, ichthyoplankton surveys, Irish Sea, Taqman.

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ICES CM 2007/Q:25 Poster**Developing an egg-survey approach to monitoring the biomass of cod and other demersal fish species in the Irish Sea**

Mike Armstrong, Clive Fox, Hans Gerritsen, Freya Goodsir, Lorraine Greenwood, Steve Milligan, Angelika Prael, Pieter-Jan Schön, Natasha Taylor, and Peter Witthames

Egg surveys have many desirable features for supporting fisheries management. As well as providing estimates of spawning stock biomass (SSB), they reveal the spatial extent of spawning grounds and the temporal pattern of spawning, important for identifying stock structure and spawning areas that may need protection. Eggs can be quantitatively sampled over seabed types where trawls can't be deployed and, unlike fish, don't respond to the presence of a ship. However, major issues include the adequacy of survey coverage, the accuracy of egg identification, and the estimation of fecundity. Two major EU-funded contracts investigated the annual egg production method for estimating SSB of cod and other demersal fish in the Irish Sea in 1995 and 2000. A major problem was the identification of early-stage cod eggs which are visually identical to those of haddock and some other species. Recent developments of species-specific gene probes to identify eggs allowed the mapping of cod spawning grounds in the North Sea in 2004, and the method is currently being applied to estimate annual egg production of gadoids in the Irish Sea in 2006 and 2008. Five ichthyoplankton surveys were carried out during February – April 2006, and 80% of 4,700 eggs collected during the surveys were identified as cod, haddock or whiting using Taqman gene probes. In addition, 860 ovaries of cod, haddock and plaice were collected to estimate fecundity and losses due to atresia. This paper evaluates the information obtained during the 2006 surveys, and the usefulness of such surveys in the context of the Irish Sea cod recovery programme.

Keywords: egg production, ichthyoplankton, surveys, fecundity, Irish Sea, cod, haddock, plaice.

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ICES CM 2007/N:26 Poster**Trammel net ghost fishing in Portuguese central coast**

Filipa Baeta, Maria José Costa, and Henrique Cabral

The loss of commercial fishing gears on the ocean bottom can potentially have negative effects on marine communities, particularly if the gear preserves its catching abilities for significant periods of time (a phenomenon called "ghost fishing"). The present study aimed to identify and quantify the impact of trammel nets lost at sea. Twenty trammel nets (each 50 m long and corresponding to the most common type used by the commercial fleet) were deployed at two coastal locations (sandy and rocky bottoms) where traditional fishing activities with trammel nets takes place. One end of each net was cut free to simulate net loss. Changes in net structure (net height, effective fishing area, movement and colonisation) and their catches (species, size and number) were monitored by scuba diving at certain time intervals. In order to evaluate the evolution of catch efficiency of the lost nets over time, six control nets with the same characteristics as the experimental nets were set in the day before the monitoring. To evaluate the nets' catching efficiency, exponential models were fitted to the net efficiency data in number and weight. Similar patterns were observed in all the nets, with a strong decrease in catch rate and effective fishing area. The results suggest that lost trammel nets have a great potential to fish for extended periods, especially in rocky bottoms.

Key Words: ghost fishing, trammel nets, catch efficiency, Portuguese coast.

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Science and monitoring needs for assessing the recovery of Australian orange roughy

Rudy J. Kloser, Paula Shoulda, and Sally Wayte

Orange roughy is a commercially exploited deep water fish that is both long lived and slow growing. In Australian waters it has been commercially fished since the mid 1980s with most management zones in the South East region now assessed as over fished. Based on this assessment the species was listed as threatened in 2006 under the Australian Environmental Protection and Biodiversity and Conservation act (EPBC) and targeted fishing ceased until the species has recovered. Under the 2006 EPBC listing a detailed monitoring strategy is required to determine when and at what level fishing could recommence. Historically orange roughy are managed within several management zones that have separate total allowable catches with varying degrees of monitoring precision ranging from fisheries dependent catch per unit effort (CPUE) data to fisheries independent acoustic surveys. In management zones where CPUE has been used as the stock status, new indicators are now required to evaluate recovery. Stock structure of the species is also uncertain within and between management zones so recovery of one zone may imply a recovery in an adjacent zones. We outline a strategy to monitor the recovery of selected management zones based on a multi-frequency acoustic survey method using an assessment model to predict the necessary timing and precision of the surveys. An overview of the precision and biases of the acoustic method and our ability to infer recovery of other zones using new indicators whilst including a precautionary approach is discussed.

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