

Theme Session P

Integrated assessments in support of regional seas ecosystem advice –

Beyond quality status reporting

ICES CM 2006/P:01

Abundance and trophic interactions in North Sea fish

Georgi M. Daskalov and Steven Mackinson

A detailed mass-balance trophic model of the North Sea was built applying the Ecopath with Ecosim methodology. Our first aim was to parameterise the model based on the best available information. The model structure was set to 84 functional groups including 1 seabird, 3 sea mammal, 46 fish, 15 invertebrate, 3 detritus, and 16 fishing fleet boxes. The different species either constitute single groups or are aggregated clusters of species based on information on abundance, diet, and commercial or functional importance. The commercially important target fish species are divided into juvenile and adult groups (e.g. cod, whiting, herring). Several non-target fish species, which are also commercially and/or functionally important are represented as single species or family groups (e.g. hake, dab, Triglidae). Other species are included in aggregated groups based on similar taxonomic or functional characteristics. The model was supplied with new estimates of biomass, production, and consumption rates. Biomasses of ~80 non-target fish species monitored by the International Bottom Trawl Survey, which are not subject to regular stock assessment, were estimated and compared with previous studies. The diet matrix was compiled using 1991 Year of Stomachs data and literature sources. Data on the landing and discards of 39 different fishing fleets were compiled from the 1991 Scientific Technical Committee for Fisheries data in combination with UK Fishing Activity database and Trio Discards database (Cefas). As first results of the application of the model, biomass estimates corrected for trophic interactions (assuming mass balance) were compared to historical data. Indicators of trophic interactions derived from diet composition, biomass fluxes, trophic efficiency and predator-prey interactions were used to evaluate the relative roles of top-down and bottom-up control and the direct and indirect effects of environment, predation, and fishing. Total fish biomass in the North Sea decreased from ~26 million tonnes by the end of the 19th century to ~10 million tonnes in 1991. The biggest change was in exploited target species, e.g. gadoids (cod, haddock, saithe), mackerel, herring, and flatfish. Gadoids and mackerel/horse mackerel also decreased between the 1980s and 1991, but herring and some prey-fish (e.g. dab) increased in 1991 compared with the 1980s. Development of the North Sea ecosystem model is steered by a strategic work plan for the development, scientific reviewing of parameters, sensitivity testing, and application of the model. Future work will include temporal and spatial simulation of alternative fishing and environmental change scenarios.

Keywords: species abundance, trophic interactions, Ecopath, Ecosim.

Contact author – Georgi M. Daskalov: Cefas, Lowestoft Laboratory, Lowestoft, Suffolk, NR33 0HT, UK [tel/fax: +44 1502 524 584, e-mail: g.m.daskalov@cefass.co.uk].

ICES CM 2006/P:02

What is a “large fish”? – taking a species perspective

Niels Daan

OSPAR has proposed to elaborate on the proportion of large fish in survey catches as an Ecological Quality Objective (EcoQO). In the past, several analyses have been carried out that indicate variable trends in such metrics depending on surveys and criteria applied. “Large fish” is clearly an elastic concept that is difficult to interpret. During the recent meeting of the WG on Fish Ecology, the idea emerged to take a species perspective and to use a criterion that relates the actual size of individuals caught to the reported maximum size of the species (L_{max}). This approach has the advantage that the metric is linked directly to the mature and immature parts of the total fish community. Because fishing mortality should affect the numbers and biomass surviving to maturity, this approach might connect the “large fish” concept to the reference points for spawning stock biomass (SSB) and fishing mortality used in the advice for commercially important species. At least in principle, objective reference levels might be developed for such an indicator of the effects of exploitation on the entire fish community. I used the IBTS database to calculate the ratio of individuals larger and smaller than 50% of their L_{max} and present the observed trends for various groups of species. I also compare the survey results for cod with the ratio of SSB to sub-adult biomass from stock assessment to investigate whether an appropriate reference level might be set.

Keywords: EcoQO, fish community, large fish indicator, North Sea, reference level, trends.

Contact author – Niels Daan: IMARES, P.O. Box 68, 1970 AB IJmuiden, The Netherlands [tel: +31 255 564 646, fax: +31 255 564 644, e-mail: niels.daan@wur.nl].

ICES CM 2006/P:03

An integrated ecosystem assessment of the Central Baltic Sea and the Gulf of Riga

Christian Möllmann, B. Müller-Karulis, R. Diekmann, J. Flinkman, G. Kornilovs, E. Lysiak-Pastuszak, J. Modin, M. Plikshs, Y. Walther, and N. Wasmund

An integrated ecosystem assessment of two sub-systems of the Baltic Sea was conducted in the frame of the ICES "Workshop on Developing a Framework for an Integrated Assessment for the Baltic Sea [WKIAB]". We present initial results of meta-analyses of oceanographic, nutrient, phyto- and zooplankton as well as fisheries data for the Central Baltic Sea (CBS) and the Gulf of Riga (GOR), the former comprising the highly stratified deep basins of the Baltic while the latter represents a shallow low saline coastal bay. Considering the period 1974 to 2004, 88 and 20 variables for the CBS and the GOR, respectively, were used in a Principal Component Analysis. Our integrated analyses demonstrate different regimes within the considered period, which were confirmed by chronological clustering. Major changes in ecosystem structure (regime shifts) were detected at the end of the 1980s, consistent with other areas of the world ocean. Our results further contribute to the understanding of the functioning of the ecosystems under anthropogenic and climatic pressure.

Keywords: central Baltic Sea, chronological clustering, Gulf of Riga, integrated ecosystem assessment, meta-analysis, principal component analysis.

Contact author – Christian Möllmann: Danish Institute for Fisheries Research, Dept. of Marine Fisheries, Charlottenlund Castle, DK-2920 Charlottenlund, Denmark [tel: +45 3396 3458, fax: +45 3396 3333, e-mail: cmo@dfu.min.dk].

ICES CM 2006/P:04

Building multi-discipline, multivariate databases for use in integrated assessments

Doug Beare, Andy Kenny, and Peter Kershaw

Integrated ecosystem assessments require detailed data at various levels of aggregation. There is an almost infinite number of potentially useful variables, e.g. temperature, stratification, plankton, cetaceans, fish and seabirds, fishing fleet dynamics, etc. In addition data are available and should be summarised in long-term, seasonal, and spatial detail. The means that databases very quickly become large and unmanageable. In this paper we describe how we have aggregated data from a range of sources to produce a useful database that can be accessed via the world-wide-web and used for integrated assessments.

Contact author – Doug Beare: Joint Research Centre, Via E. Fermi 1, IT-21020 Ispra (VA), Italy [e-mail: doug.beare@jrc.it].

ICES CM 2006/P:05

Towards improved monitoring and assessment of marine eutrophication

D. K. Mills, M. Devlin, C. Kirk, and S. J. Malcolm

Regular assessments of marine eutrophication are a requirement of a number of international (OSPAR) and European policy drivers. The first application of the OSPAR Common Procedure for the identification of eutrophication status took place recently and a second assessment is being planned. In Europe the outcomes to assessments of marine eutrophication are increasingly being challenged by the European Commission and as such subject to intense legal scrutiny. Against this background it is critical that assessments are based upon a robust evidence base that must draw upon the best available data and underpinned by sound science. Failure to do so may have significant consequences in terms of punitive measures taken by the European court and the potentially expensive remedial action needed to meet policy requirements. To address these pressing needs we are developing an integrated approach designed to build upon an existing monitoring infrastructure and to augment this with new and emerging data sources. Examples of how core monitoring programmes can be augmented with data streams emerging from remote and *in situ* sampling platforms such as satellites and data buoys will be presented. The important role that models can also play directly and indirectly in the assessment process and also in design of monitoring programmes will be illustrated with specific examples. In order to draw together these data sets and to shape them into a form amenable to timely assessment we have developed a Data Integration and Assessment System (DIAS). An example of the application of DIAS will be presented. Our approach is generic and has the potential for expansion to integrate data from other UK national agencies and also non-UK agencies. Concerns over transboundary nutrient transport expressed after the first OSPAR assessment suggest that a multi-national approach will have the potential to resolve emerging conflict and build mutual confidence in the outcome to future assessments.

Contact author – David Mills: Centre for Environment, Fisheries & Aquaculture Science, Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk, NR33 0HT, UK [tel: +44 1502 524 253, fax: +44 1502 513 865, e-mail: david.mills@cefas.co.uk].

ICES CM 2006/P:06

Marine environmental change over decades to millennia – an evaluation of “proxy parameters” and their potential use in understanding the state of the marine ecosystem

P. Larcombe *et al.*

Some of the major factors driving change in marine ecosystems vary on timescales of 100s to 1000s of years,

much longer than historical data. Assessing the significance of historical data and the effectiveness of management actions on the status of the UK marine environment requires methods to extend the instrumental record back in time. Given the focus on parameters in this paper, the terminology requires clarification. Here we distinguish the following:

- Parameters – the numbers themselves which relate definitively to a specific environmental measurable.
- Indicators – numbers or measures derived or calculated from one or more parameters, which might represent a trend through time, a combination of trends, limiting concentrations, etc.
- Tools – the means by which indicators are used by managers to assist the decision-making process. A tool might consist of software, a decision tree, or a series of similar devices, and might range from the simple to the highly complex. A range of types of indicators might be used as part of one or more tools, for example in meeting a suite of marine ecosystem objectives.

Thus, by themselves, or in combination with others, parameters may form indicators, which are then used in various tools to aid decision-making aimed towards achieving various objectives, i.e. Parameters à Indicators (Numerical) à Tools à Objectives.

Regarding the UK shelf seas, a literature search was used to identify proxy parameters that might soon provide useful information to environmental managers and policymakers. The review identified that *Arctica islandica* (and other long-lived bivalves) and cores taken from sediments associated with some shipwrecks could provide key palaeo-environmental information. Fish otoliths have good potential, but work requires greater development.

Some indicators of marine ecosystem state are presently under assessment in OSPAR, and some adjustment may be required in the choice of indicators to consider their ability to be hindcast through the use of appropriate proxy parameters.

Contact author – Piers Larcombe: Centre for Environment, Fisheries & Aquaculture Science, Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk, NR33 0HT, UK [tel: +44 1502 52 4369, fax: +44 1502 513 865, e-mail: piers.larcombe@cefas.co.uk].

ICES CM 2006/P:07

Integrated assessment of chemical pollution pressures and state changes

E. Garnacho, P. Kershaw, and A. Kenny

The provision of ecosystem integrated advice requires the development of new approaches to allow the integration of pressure and state changes information, as well as

to include the causal relationships linking state changes and pressures derived from human activities.

Different approaches will be needed to accommodate a very diverse source and nature of data and information distributed at the different levels of a causal relationship. The integrated assessment of such types of data and information requires the use and combination of different techniques and tools and a careful consideration of different ways to overcome different limitations of datasets and information characteristics.

An example on chemical pollution will be presented, to show possible ways to integrate information and data, the use of techniques and tools including stochastic modelling approaches such as the construction of Bayesian Belief Networks to address the new needs emerging from an integrated assessment exercise.

Contact author – Eva Garnacho: Centre for Environment, Fisheries & Aquaculture Science, Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk, NR33 0HT, UK [tel: +44 1502 524 599, fax: +44 1502 513 865, e-mail: eva.garnacho@cefas.co.uk].

ICES CM 2006/P:08

An integrated ecosystem assessment of the North Sea – a pilot project: the lessons learnt

Authors: REGNS

A Regional Ecosystem Study Group for the North Sea (REGNS) was established in 2003 with the principal aim of producing a comprehensive Integrated Ecosystem Assessment of the North Sea by 2006.

An integrated assessment may mean one of two things, namely: 1) a process of actions which support “adaptive management and the ecosystem approach” (ICES 2003b), but it also relates to 2) the combined numerical assessment of data and information from various sources (including different human pressures and state changes).

This paper sets out the lessons learnt from the REGNS process, in particular recognising the need to identify who the end users are and therefore how the information should be presented to ensure it is understood and is “fit for the purpose”. Much time in the early phase of the REGNS process was devoted to understanding these differences, namely: 1) management needs to make more efficient the use of resources for monitoring at sea, 2) scientific demands to better understand the cause/effect relationships between state changes, and finally 3) to meet the policy needs by tracking performance against agreed and meaningful targets for ecosystem or ecological state (indicators). In response to this REGNS concentrated on meeting the demand for scientific objectivity (ad 2) above) by preparing integrated evidence to support the provision of integrated advice (WGRED). It is important to recognise this distinction as different types of integrated assessment from other expert groups also feed into the advisory process and collectively they constitute

“ecosystem advice”. In addition the management of data for integrated assessment purposes is a critical factor in determining the efficient use of expert group time in addressing assessment requests and the use of data assessment tools; in particular the use of GIS and other spatial/temporal data mining tools are a key component of success.

Contact author – Andrew Kenny: Centre for Environment, Fisheries & Aquaculture Science, Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk, NR33 0HT, UK [tel: +44 1502 524 540, fax: +44 1502 513 865, e-mail: andrew.kenny@cefas.co.uk].

ICES CM 2006/P:09

Integrated assessment to identify the relationship between human pressures and ecosystem state changes in the North Sea – implications for marine management

A. J. Kenny, P. Kershaw, M. Devlin, J. Reid, P. Licandro, A. Gallego, K. Winpenny, C. Houghton, M. Langston, H. R. Skjoldal, and A. Perkins

A meeting of the ICES Regional Ecosystem Group for the North Sea (REGNS) took place in May 2006 which continued the ambitious task of drawing together different types of data relating to pressure and state changes of the North Sea Ecosystem as part of an integrated assessment. An assessment of the data has provided some valuable insights into the significance of the relationships between different pressure and state changes at different scales. For example, an assessment of the plankton community data in relation to the physical and chemical oceanography reveals both gradients of response in relation to the major riverine inputs of nutrients into the North Sea and sources of nutrients from the northern Atlantic. The relative change in plankton community structure over time appears to be greatest in the northern sectors of the North Sea (ICES sub-regions IVa1 and IVa2) and it is suggested that the main driver for this appears to be associated with trends in seawater flux into the North Sea in response to ocean climate forcing. By better understanding the relationship between the causes of change at different scales it is possible to set more realistic targets for the management of human pressures. The significance of this in relation to fish stock assessment data (CPUE data), fisheries (fish landings), seabird species densities (ESAS data), and habitat status is explored and presented in this paper.

Contact author – Andrew Kenny: Centre for Environment, Fisheries & Aquaculture Science, Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk, NR33 0HT, UK [tel: +44 1502 524 540, fax: +44 1502 513 865, e-mail: andrew.kenny@cefas.co.uk].

ICES CM 2006/P:10

Combinatorial algorithms and high performance implementations for elucidating complex ecosystem relationships from North Sea historical data

M. A. Langston, A. D. Perkins, D. J. Beare, R. W. Gauldie, P. J. Kershaw, J. B. Reid, K. Winpenny, and A. J. Kenny

This investigation centers on elucidating complex relationships among quantifiable variables of significance to the North Sea ecosystem. These variables encompass a huge variety of biotic and abiotic factors, and tend to possess divergent periodicities and other diverse properties. Novel mathematical tools and powerful graph algorithms are harnessed to uncover temporal, spatial, and other complex relationships on an immense scale. High performance parallel implementations are synthesized to extract and highlight variable sets common to multiple relationships (cliques), and to determine inflection points, putative regime changes, and other possible patterns of interest. These results are discussed in the context of more traditional clustering methods. Data quality and the significance of missing or corrupted values are also addressed, as is the importance of examining data at multiple levels of granularity. A long-term goal is to establish data dependencies upon which we can draw conclusions about the impact of man and other agents upon the North Sea.

Contact author – Michael A. Langston [e-mail: langston@cs.utk.edu].

ICES CM 2006/P:11 – Poster

What can we learn after the “Prestige” oil spill? Recommendations for fisheries management at the level of regional seas ecosystems

Esther Abad, J. M. Bellido, A. Punzón, V. Trujillo, and P. Abaunza

The “Prestige” oil spill, which occurred in November 2002 in Spanish waters, clarified the need of high quality data on fisheries in relation to management of pollution issues. This is in agreement with the 1992 OSPAR Convention, which is the current instrument guiding international cooperation on the protection of the marine environment of the North-East Atlantic.

The lack of reference data such as georeferenced total commercial catches and total fishing effort, some oceanographic conditions, etc. did not permit an accurate assessment of the real impact of the oil spill on fisheries and, in a broader view, on the entire affected ecosystem.

This paper aims to show how the information should be collected and managed in order to improve the use and access of researchers to high quality data, just in case it will be needed.

It also aims to contribute to the improvement of fishery management within the new European marine strategy, as well as defining the pollution impact on fisheries at smaller scales, such as regional seas ecosystems, instead of ICES Divisions.

Keywords: “Prestige” oil spill, fisheries management, regional seas ecosystems.

Contact author – Esther Abad: Instituto Español de Oceanografía, Centro Oceanográfico de Santander, Promontorio San Martín s/n, 39004 Santander, Spain [tel: +34 942 291 060, fax: +34 942 275 072, e-mail: esther.abad@st.ieo.es].

ICES CM 2006/P:12 – Poster

The North Sea as a case study for a regional implementation of Integrated Assessment with an Ecosystem Approach – How to communicate the data successfully

E. Cruz, P. Walker, A. Kenny, and D. Bearedo

The 6th EAP (Environment Action Programme) requests the development of a Thematic Strategy for the protection and conservation of the European marine environment with the overall aim to promote sustainable use of the seas and to conserve marine ecosystems.

The commitment of all Member States was, among others, to present the provisional results of the implementation of the EMS (European Marine Strategy) by setting out an initial assessment of the ecosystem itself. For the

successful implementation of this new marine policy, the status and trends of the ecosystem should be assessed in an integrated way, taking into account effects of human activities and also keeping in mind the ecosystem approach, on which EMS is based.

In 2003, ICES initiated a new Working Group, REGNS (Regional Ecosystem Group for the North Sea). The objective of this group was mainly to gather information from different ICES working groups and to draw up an integrated assessment for the North Sea from those data. There was a need to look at the best way to present this data and how to communicate it to policy makers, managers, and the general public. This paper will explore ways of doing this. Using Geographical Information Systems (GIS) the data will be presented in such a way that the trends of the ecosystem can be visualized in a clear manner. The importance of this tool relies on the fact that the integration of different data sources is possible, either at temporal or spatial scales. Furthermore, a link will be made between the assessment and the double matrix designed by WGECCO in order to provide the information needed to detect which human activities affect the environment and thereby should be subject to management intervention in order to achieve a good environmental status by 2021.

Keywords: REGNS, integrated assessment, geographical information system, integrated assessment.

Contact author – P. Walker: Rijkswaterstaat-RIKZ, Postbus 207, 9750 AE Haren, The Netherlands [tel: +31 50 533 1367; +31 63 004 1926, fax: +31 50 534 0772, e-mail: p.walker@rikz.rws.minvenw.nl].