

## Theme Session

on

### **Fishery and Environmental Management – Is There a Role for Operational Oceanography? (W)**

#### **ICES CM 2002/W:01**

##### **Jens Eggvin - A Norwegian pioneer in operational oceanography**

Roald Sætre and Johan Blindheim

Jens Eggvin (1899–1989) was employed at the Institute of Marine Research (IMR) in Bergen as head of its physical oceanographic activities in the early 1930s. He followed a Norwegian tradition to relate the physical conditions of the ocean with fisheries. In 1935 he established several fixed hydrographic stations along the Norwegian coast and installed termographs aboard several regular coastal steamers. By this, the whole 2700 km Norwegian coast was covered by regular observations of the temperature in the surface layer. Later this program was extended to include samples for salinity determination at fixed locations along the coast and also to include a number of shipping routes across the North Sea. The system of the fixed hydrographic stations were carried out by local observers, usually fishermen, but trained by IMR. This Norwegian Coastal Observing System is still in operation.

Eggvin was a pioneer also in oceanographic forecasting. An excellent demonstration of the advantage of the new observation system was carried out in his doctoral thesis “The movement of a cold water front” from 1940. He was able to follow an outbreak of cold water from the Skagerrak and its propagation along the southern Norwegian coast. This work is the basis for later forecasts on cold-water outbreaks and transport of harmful algae, both of great importance especially for the fish farmers.

It was early known that the cod in the Lofoten area preferred to spawn in the transition layer between the cold coastal water and the warmer water below of Atlantic origin. The temperature in the transition layer was between 4°C and 6°C and that the thickness as well as the depth of it showed great inter-annual variations. These variations influenced the fisheries in several ways. Eggvin gave in many years regular forecasts for the depth of the transition layer before the start of the fisheries. He also forecasted the migration route of immature cod during winter to the coast of Northern Norway. In cold years the cod followed a more western route than in warm years.

At the ICES meeting in 1959 Eggvin advocated strongly for “synoptic oceanography” for the benefit of fisheries. “We know that certain hydrographic situations influence the fisheries in various ways. If we can predict such special hydrographic situations, we can expect to be able to assist the fisheries with valuable information, knowing in advance that certain oceanographic conditions affect the fish in such and such a manner that we shall know how the fisheries will turn out” Today, this term is called operational oceanography. On Eggvin’s initiative the first ICES pilot project on synoptic oceanography was carried out in January- March 1966.

Keywords: operational oceanography, Norwegian coast, history.

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#### **ICES CM 2002/W:02**

##### **Large Marine Ecosystem monitoring, assessment, and management across the global North-South divide**

Kenneth Sherman and A. Duda

Since the 1992 United Nations conference on Environment and Development, overfishing, loss of coastal habitats, coastal pollution, and loss of biodiversity continue to erode the sustainability of \$10.6 trillion in goods and services generated by coastal ecosystems around the globe. In recognition of the problem, the Global Environment Facility (GEF) has been approached by developing countries for assistance in planning and implementing projects for assessing and managing resources and environments of Large Marine Ecosystems (LMEs) in Africa, Asia, Latin America, and Eastern Europe. Seventeen LME projects involving 126 countries have been approved or are in preparation for funding support by the GEF Council. The participating countries are putting in place an ecosystem-based, five-module methodology based in systematic assessments of LME productivity, fish and fisheries, pollution and ecosystem health,

socioeconomics, and governance. The GEF Operational Strategy recommends that nations sharing an LME begin to address coastal and marine issues by jointly undertaking strategic processes for analysing scientific information on transboundary concerns, their root causes, and setting priorities for action on transboundary concerns. The national interministerial committee established in each country to operationalize reforms and programs is particularly important to achieve practical integration of needed actions in different economic sectors. However, the GEF was designed to play a minor, catalytic role and new North-South partnerships in LME monitoring and assessment is needed to sustain the \$200 million in GEF/LME project momentum that has been created.

Keywords: large marine ecosystems, assessment, monitoring, management, North-South partnerships.

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## **ICES CM 2002/W:03**

### **Monitoring the Norwegian Coastal Zone Environment (MONCOZE)**

Bruce Hackett, Johnny A. Johannessen, and Einar Svendsen

MONCOZE is a Norwegian national project (2001–2005) aimed at constructing and demonstrating a pilot operational monitoring system for the Norwegian coastal zone. Monitoring focuses on physical variables, nutrients and phytoplankton. The key elements of the system are observations, assimilating numerical models and “value-added” user products. The aim is to utilize existing technologies for observation and modelling, concentrating development on combining the various information sources, assimilating coastal/shelf observations and building the operational service.

The observational element aims to combine all available sources of observation that are “operational” (recurring, quality-controlled, NRT available): ships; drifting buoys (ARGO); satellites; coastal radar. Development focuses on synergetic analysis of various types of observation.

The model component includes two alternative systems, based on differing physical and ecological models. A large-scale Atlantic model, assimilating altimetry and SST, supplies far-field forcing for nested regional models. A key area of development in the project is methods for assimilation of SST and ocean colour at shelf and coastal scales.

The operational system will provide real-time updating of standard monitoring products and facilities for dissemination to users. Pilot demonstrations of the system will be carried out in 2004 and 2005 for the coast of southern Norway.

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## **ICES CM 2002/W:04**

### **Interdisciplinary approach to monitoring of fish population and environmental changes in the White Sea**

Georgij G. Novikov and Anatoli N. Pantiulin

Conception of estuarine system is used as a basis for complex ecological and environmental monitoring in the White Sea. The estuarine hierarchy includes the four-dimensional levels from the whole sea as macro - estuary to littoral basins as micro-estuaries and is of great importance in living circle of herring – one of major commercial species of the White Sea. The key processes and factors have been determined and investigated at all estuarine levels. The system of monitoring involves: period of spawning and eggs incubation (ice and temperature conditions on littoral and sublittoral in micro -estuaries); period of passive migration of larvae (temperature, salinity, current distributions in typical and meso-estuaries); period of feeding (biomass and distribution of zooplankton in typical and meso-estuaries); period of wintering (temperature and volume of warm intermediate layer in meso-estuary and macro-estuary). Different aspects, problems and previous results of the new approach are discussed.

Keywords: White Sea, estuarine system, ecological monitoring, herring.

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## **ICES CM 2002/W:05**

### **Developing a Fisheries Ecosystem Plan for the North Sea**

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An ecosystem-based approach to environmental management is still developing as a management tool. If these new management schemes are to be workable and effective it is imperative that they focus on the key processes rather than attempt to address the huge number of potential variables, which could be monitored or measured. The European Fisheries Ecosystem Plan (EFEP) aims to identify and examine the key processes required to introduce ecosystem-based management to the fished areas of the North Sea. The aim is to develop a framework, which allows for sustainable fishing practices whilst protecting the ecosystem. Integrating stakeholder perspectives into environmental management plans is integral to the ecosystem approach. The first phase of the EFEP has been to develop and initiate links with stakeholders and obtain their opinions on their preferred management regimes and their perception of ecosystem health. The second phase characterises the biological and physico-chemical environment of the North Sea to develop a conceptual model of ecosystem function. This model will form an important tool to determine the effectiveness of different management regimes in protecting key ecosystem attributes.

Keywords: fisheries, ecosystem management, stakeholders, key processes.

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## **ICES CM 2002/W:06**

### **Stock assessment and projection of abundance - from environmental parameters to biological processes**

Carl O'Brien

This paper will present the findings of, and conclusions from, the three meetings held in 1999, 2001 and 2002 of the ICES Study Group on the Incorporation on Process Information into Stock-Recruitment Models [SGPRISM]. The task of incorporating environmental parameters and their assessment into the management of commercial fisheries will be considered and discussed. The paper will specifically address the potential use of environmental information in increasing knowledge of the underlying stock-recruitment relationship, as it is currently used in population assessments, and consider how accurate knowledge of the impact of environment variations on recruitment can be used to constrain moderate-term (5–10 year) projections of stock abundance. Although it is not possible to directly control factors such as sea temperature and wind, changes in the environment clearly influence recruitment and the future size of fish stocks. A better understanding of the relationships between environment, parental stock and recruitment should contribute to the design of robust management methods for commercial fisheries. Research aimed at addressing these issues is currently on going and will briefly be discussed.

Keywords: age-based methods, fishery management, medium-term projection, recruitment, stock assessment.

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## ICES CM 2002/W:07

### Coastal environment and fisheries management for sustainable development in West Bengal, India

Ajit Kumar

Traditionally catching fish from the sea has been the profession of a large number of people on the coastal tract in West Bengal. The coastal tract of West Bengal stretches between South 24 Parganas in the east to Midnapur in the west. The coastline extends to about 210 kilometers covering an area of 19445 Square kilometres. The coastal diversified ecosystems have been classified into 2340 hectares of the Hooghly – Matla estuarine system; 33000 hectares of saline and 9600 hectares of non-saline fisheries; 9600 sq. kilometres of the mangroves and the highly saline coastline of the Midnapur district (South). The official estimate of marine fish production in West Bengal on an average (1996–2000) is 60000 tonnes per year. West Bengal coast presents a highly productive environment for rich fishing ground of the Bay of Bengal. Almost all of the fishermen follow the traditional and unscientific way of fishing operation in the area. So, to protect the traditional fishing operation, there is a need of fishing resource management to increase the source of income and employment generation for the coastal people. Finally, the coastal environment and fishery management needs to include assessment of area-wise potentials in different species of fishes and qualitative improvement of the natural stock, to introduce the new method of fish catching, marketing system and preservation etc. There is a need to teach the fishermen about the improvement of fish farming through the inter-fish species culture system.

Keywords: environment, coastal, fishery, sustainable development, management.

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## ICES CM 2002/W:08

### A New System for Automatic Measurement of Biological-chemical Parameters from Ferry Boats

Friedhelm Schroeder, Wilhelm Petersen, Michael Petschatnikov, and Franciscus Colijn

Operational monitoring of coastal areas and shelf seas is mainly carried out by manual sampling and analysis during ship cruises. In addition, automatic operating measuring systems on buoys allow routine measurement of standard oceanographic parameters, e.g., temperature, salinity, currents and in some cases other parameters, e.g., turbidity, oxygen and chlorophyll fluorescence. These systems are much affected by biofouling and the maintenance/operation costs are quite high mainly due to ship costs.

On the other hand, there are many routes for ferryboats and “ships-of-opportunity” which run quite frequently. Standardised measuring systems on such carriers have several advantages: 1) the measuring system is protected against waves etc., 2) biofouling can be more easily prevented (inline sensors) and 3) most important, the running costs are much smaller since the operation costs of the ship have not to be calculated. There are already some examples for scientific equipment on ferryboats, e.g., in Finland, U.K., Norway and The Netherlands. However, most of these systems only measure oceanographic standard parameters automatically and have to take samples for nutrient analysis.

A new system has been developed which overcomes these restrictions. The “German FerryBox” consists of a fully automated flow-through system with different sensors and automatic analysers. For a reliable unmanned operation the system is supervised by an industrial programmable logic control which can shut-off the system in case of very severe errors and operates automatic cleaning cycles, e.g., in harbour. At the time being, the FerryBox has sensors/analysers for the following parameters: water temperature, salinity, turbidity, oxygen, pH, chlorophyll fluorescence, nutrients (ammonium, nitrate/nitrite, phosphate, silicate), main algal classes (specific fluorescence). Data acquisition, -storage and telemetry is coordinated by an industrial PC. Data can be transferred to shore and the system can be remotely operated by GSM (mobile phone). Biofouling is prevented by pressure cleaning of the sensors with acidified tap water or under severe conditions (tropics) by chlorination. Sometimes clogging of the water inlet in the ship interface by debris or fish causes problems. Since all flow rates are supervised by the system in such cases a pressure back-flushing cycle is initiated, which clears the inlet. The system had been installed on the ferry Hamburg (Cuxhaven)-Harwich and is under test since November 2001.

Continuous chemical-biological data from the ferry route across the North Sea will provide scientists and monitoring authorities with information on the eutrophication status and enhance the existing knowledge on nutrient and plankton dynamics. Results from recent measurements will be presented and discussed together with future developments, which could combine ferry data with remote sensing measurements and apply these data to numerical models.

Keywords: monitoring, oceanographic observations, eutrophication, automated systems.

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## **ICES CM 2002/W:09**

### **The ICES/EuroGOOS North Sea Pilot Project (NORSEPP)**

W. R. Turrell

In 1997 the Intermediate Ministerial Meeting for the North Sea recommended that the management of North Sea fisheries should move towards a more holistic ecosystem-based approach, and within ICES many steps have been put in place to help implement this move. Within the Oceanography Committee it was realised that one component which an ecosystem based approach will require will be an operational observing system. Such a system combines real time or near real time environmental monitoring with state of the art forecast models using modern communications systems to produce and disseminate multi-parameter forecasts of useful products designed specifically for targeted users. Such a system will use many of the concepts presently being developed under the international umbrella of the Global Ocean Observing System (GOOS), a project organised within the Intergovernmental Oceanographic Commission (IOC) structure. In order to develop these ideas within ICES, the ICES Steering Group on GOOS (SGGOOS – which has subsequently become a joint ICES/IOC Steering Group) was formed in 1998. As one of its initiatives, the SGGOOS decided to develop a regional GOOS pilot project in order to demonstrate in a practical way the possibilities an operational observing system could offer the fishery and environment management communities represented within ICES. At the same time, EuroGOOS had been developing, through its North West Shelf Task Team, a plan for a North West Shelf Operational Oceanographic System (NOOS). ICES, IOC and EuroGOOS, through a series of joint strategic workshops, have subsequently produced an implementation plan for the North Sea Ecosystem Pilot Project (NORSEPP). This project will use the developments running separately under EuroGOOS in order to develop products and services designed specifically to underpin ICES advisory functions. The overall objective of NORSEPP is to initiate operational fisheries oceanography by integrating existing physical, geochemical, and biological monitoring programmes and models to improve advice to fisheries managers. In order to achieve this, seven specific tasks have been identified; harmonisation of existing relevant monitoring programmes; combination of models and data to generate operational products; application of operational products to fish stock assessment; streamlining the exchange of data; evaluation of the output of operational systems; dissemination of operational products to users; evaluation of monitoring technologies and strategies. The future development of NORSEPP has two approaches. Firstly, a consortium of ICES and EuroGOOS institutes will submit an expression of interest to the Framework 6 June 2002 call. Secondly, within ICES a Category 4 resolution will be submitted to the 2002 Statutory Meeting requesting the establishment of NORSEPP as an ICES adopted project, while at the same time the North Sea Pilot Project Planning Group will be renewed and requested to oversee the implementation of NORSEPP in conjunction with EuroGOOS.

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## **ICES CM 2002/W:10**

### **The current status of operational oceanography and its integration in fishery resource stock assessments in the Newfoundland Region of Atlantic Canada**

E. B. Colbourne, E. G. Dawe, and D. G. Parsons

Environmental observations and ocean climate variability indices are routinely collected and compiled by fisheries laboratories in many ICES member countries throughout the North Atlantic. Variations in the physical oceanographic environment are thought to influence the abundance (recruitment, survival), and behaviour (distribution, catchability) of many marine organisms and hence the management and operations of the fishing industry. Therefore, the integration of environmental information into fishery resource stock assessments for management requirements in a quantitative manner is a pressing issue and one that is receiving increasing attention. A review of preliminary efforts in the Newfoundland Region of Atlantic Canada to incorporate environmental information into fish and invertebrate stock assessments is presented. In general, variations in the oceanographic environment appear to be associated with trends in production in several marine species inferred from commercial fisheries (CPUE) and assessment surveys. Results indicate that environmental factors may be important at early life history stages, particularly for crustacean populations.

Statistical models were employed to explore relationships between invertebrate production and changes in the oceanographic environment in Newfoundland waters. Even though the uncertainty in predictions is generally large, the information can be a valuable addition to a suite of indicators used to assess current status and future prospects for the management of a particular resource.

Keywords: ocean climate, fisheries, invertebrate, stock assessments.

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## **ICES CM 2002/W:11**

### **Ecosystem monitoring in the Northwest Atlantic: Canada's Atlantic Zonal Monitoring Program (AZMP)**

Glen Harrison, Brian Petrie, and Ken Frank

The Canadian Department of Fisheries and Oceans (DFO) has the mandate to provide the environmental datasets that are necessary to track and predict changes in ocean state and productivity, to respond to questions posed by end-users, to alert them to short and long-term environmental/ecosystem changes, and to provide adequate historical databases to address future issues. In that context, DFO designed and implemented an ecosystem-observing program for the Northwest Atlantic in 1998 that builds upon existing monitoring activities in the region. The Atlantic Zonal Monitoring Program (AZMP) represents a minimum requirement to detect and follow climate change and variability in the Northwest Atlantic while increasing Canada's capacity to understand, describe, and forecast the state of the marine ecosystem and to quantifying the changes in ocean physical, chemical and biological properties and the predator-prey relationships of marine resources.

The AZMP derives its information on the state of the marine ecosystem from data collected at a network of sampling locations (fixed point stations, cross-shelf sections, groundfish surveys, satellite remote-sensing) sampled at a frequency of bi-weekly to once annually. Information on the relative abundance and community structure of plankton is also collected on long survey lines from Iceland to Newfoundland and Newfoundland to the Gulf of Maine from commercial ship traffic instrumented with the Continuous Plankton Recorder (CPR).

The AZMP sampling design provides for basic information on variability in physical, chemical (nutrients, oxygen) and biological (plankton) properties of the Canadian Atlantic continental shelf. Groundfish surveys and cross-shelf sections provide detailed regional geographic information but are limited in their seasonal coverage. Critically placed fixed stations complement the geography-based sampling by providing more detailed information on temporal (seasonal) changes in ecosystem properties. Satellite remote sensing of sea-surface phytoplankton biomass (chlorophyll) provides the large scale (zonal) perspective on important environmental and ecosystem variability. The CPR lines provide information on large scale (inter-regional) and long-term (yearly to decadal) variability in plankton abundance and community structure.

Observations from the first three years of AZMP operation and historical data are providing a clear picture of the scales of natural ecosystem variability in the region and are providing encouraging new evidence that links biological variability with changes in physical and chemical environmental properties. Links between indices of groundfish recruitment and environment-/ecosystem variability are also being explored.

Keywords: monitoring, ecosystem, northwest Atlantic, continental shelf, plankton, remote-sensing, CPR, groundfish, recruitment.

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## ICES CM 2002/W:12

### Ecosystem Variation and Fisheries: Operational Test of the Match-Mismatch Hypothesis

Trevor Platt, César Fuentes-Yaco, and Kenneth T. Frank

Using remotely-sensed data on ocean colour, we have established a time-series of the distribution of chlorophyll concentration in the Canadian Atlantic Zone with resolution one week in time and roughly one kilometre in space. From the time series, we can extract the following properties of the spring phytoplankton bloom for each year covered (1997 to present): timing of initiation, timing of maximum, amplitude and duration for each of the 1.5 million pixels in the Zone. These data form the raw material for an operational test of the match/mismatch hypothesis of Cushing. The test was made on the Eastern Scotian Shelf haddock fishery, for which annual survey data are available. We find that some 90% of the variance in abundance of 0-group larvae can be explained in a linear regression with timing of bloom initiation and timing of maximum as independent variables. The results cannot be regarded as definitive, given that the time series is, as yet, quite short. Nevertheless, they are strongly suggestive that variance in larval survival may indeed have a detectable component that is associated with interannual variability in the spring bloom. We extended the analysis further back in time using the CZCS data for the period 1979 to 1981. With the combined data, we find that some 60% of the variance in larval survival can be accounted for by variations between years in the timing of the spring bloom. The data series on survival of larval haddock (1970 to present) contains two instances of very strong year classes: both of these occurred in years with abnormally early spring blooms. The null hypothesis that interannual variation in larval survival is independent of fluctuations in timing of the spring bloom will probably have to be rejected.

Keywords: ocean-colour, remote-sensing, spring-bloom, match/mismatch hypothesis, haddock 0-group larvae, Canadian Atlantic Zone.

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## ICES CM 2002/W:13 Withdrawn

### ICES CM 2002/W:14 (Poster)

#### EDIOS – European Directory of the Initial Ocean-observing System

Johanne Fischer

EDIOS will be a searchable and regularly updated marine Directory of the ocean observing, measuring, and monitoring systems operating in Europe and is an initiative of EuroGOOS (European Global Ocean-observing System). The project will constitute a prerequisite for the full implementation of EuroGOOS by allowing for the first time an analysis of the continuously available data for operational models in Europe, and hence the ability to optimise the deployment of instruments, and the design of sampling strategy.

EDIOS will include information on:

- \* technical specifications of the data collection methods (instruments, sensors, ships, nets, etc.),
- \* geographic co-ordinates,
- \* specifications of the kind of measurements taken as well as of their spatio-temporal characteristics (but not the observational values),
- \* approximate accuracy of measurements,
- \* present applications of the sampled data including derived products,
- \* responsible agency/institute for each instrument or sensor, and
- \* links to data-holding agencies and institutes.

A user-friendly visual interface will ensure multipurpose use of the Directory allowing a large variety of users from different sectors to perform individual searches through the Directory without being experts on data base use.

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### **ICES CM 2002/W:15 (Poster)**

#### **Use of oceanographic information in management of the Russian fisheries in the Barents and Norwegian Seas**

V. Borokov, V. Ozhigin, A. Karsakov, Yu. Lepesevich, and V. Shibanov

The paper describes how oceanographic data are used in Russia for ensuring successful and rational fishery in the Barents and Norwegian Seas. Composition, sources, processing techniques and distribution of marine environment data are discussed. Oceanographic data are used to study relationships between environment and biota and to predict distribution, growth and recruitment to commercial fish stocks. A brief overview of temperature prediction methods from one month to several years in advance is given and criteria of their efficiency are discussed. The paper gives examples of applying oceanographic data for the prognosis of fish distribution, growth and recruitment to commercial stocks. Submission of fisheries predictions to management authorities and administration of fishing fleets is described.

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### **ICES CM 2002/W:16 (Poster)**

#### **Developing a Fisheries Ecosystem Plan for the North Sea: management preferences**

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The ecosystem approach to management attempts to restore and sustain the health, productivity and biological diversity of the ecosystem. The European Fisheries Ecosystem Plan (EFEP) aims to bring stakeholders and scientists together to develop a workable management system for the North Sea. Management plans, which affect the ecosystem, require the support of fishing communities and stakeholders to be successful. Across Europe, stakeholders have been interviewed to determine their management preferences. We present the UK data in this poster.

Keywords: fisheries, ecosystem management, stakeholders.

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