2000
ICES Annual Science Conference
27 – 30 September 2000

88th Statutory Meeting, 24 September to 4 October
Brugge, Belgium

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

Brugge, 27-8-2000.

① Parsons (President ICES) Voorzitter Declerck + Richter.

Gilson - Lelong - Hoverd

Gabriels - Dir-CLO - Frank M.

secr: Wagenaar/Mees = vertegenwoordiger Belgium !!!

new delegate to council (from 2006)

② Gabriels - work engineer

België lid council since 1902.

Vanbeneden - Gilson - Belgica - Conference 1926 - ZWI - DV2 early '60

DWTC:

"flatfish" "extended delegates"

③ President: 2002 Copenhagen! 100 yr.

'ecosystem approach'

check Proc symposium on coastal water ecosystems.

PML Manual zooplankton? Zoopl Meth. Manual (Academic Press)

Aktie: * email Paul: consider doing powerpoint presentation
of. local politicians
+ STUDENTS
cf. ook thesis artikels historische gegevens!

↳ + groeten van Michiel M. & Isabel.

+ Stuurmield: idem.

Pauly

°Paris → Suisse → Germany (PhDKiel) → ICLARM → Canada (Univ British Columbia)
± Chesapeake.

Fisheries & conservation : a program for their reconciliation.

① Fisheries resources are in trouble!

ex. canadian cod : fisheries closed but stocks stay low by poachers !!!

declining world catch!

(cf 'coop' in a couple of months
cf. unrealistic chinese figures!

& we are going down the food web!

= Global!

check (Science, March 1998, 279!)

world in North Atlantic!!! IDEM.

= not sustainable!

Fisheries in North Atl !!!!

check Canada, in pers : time series analyses shows something happening in Canada!

Aside : Aquaculture cannot 'replace' fisheries, as it consumes increasing amounts of fish meal & oil.

cannot contribute fish; only transforms fish!

⇒ need for ecosystem based management.

+ clients are changing!

'co-management' : most stuck there!

'new governance'

Ask copy presentation!

dialoog fisheries scientist ⇔ conservation biologists.

check Beverton + Holt.

Aktie 'fisheries-conservation workshop congress' cf. code ED.

Institutional base cf. universities ⇔ institutions.

- IUCN criteria applicable to fish! (cf. depletion extinction)

! Marine Protected Areas!
ICES CM 2000/T:14 'global taxonomy of mar. ecosystem'

Model North Sea Christensen!

ECOPATH → om MPA's te 'voorspellen'
(s+Ecosim limits.

- CHECK OLD LITERATURE
TO SEE WHAT CAN BE
RECOVERED as BASELINE = Archaeology!
Trad. knowledge
Archives
Extinctions

⇓

"in silico"

↓

serves as reference!

→ rebuild!

ICES CM 2000/mini:08

How ICES can help integrate biodiversity considerations into fisheries advice

Mark L Tasker, Paul Knapman, David Donnan, Clare Eno, Barry Haynes, Sandra Close, Bob Hastings

Abstract

Arguably the greatest strength of ICES is the broad breadth of marine scientists who are willing and able to work together in a politically neutral forum to gain a co-operative understanding of the marine environment and its processes. It is however regrettable that this broad range of expertise is not fully utilised in helping to manage human use of the marine environment, particularly in relation to marine biodiversity. While there has been great progress in integration of advice from ICES in recent years, the symptoms of over-harvesting and excessive damage to non-harvested organisms persist.

ICES are, of course, not managers and for any advice to be effectively used it must be delivered into a management system that can respond accordingly. It is plain that the current fishery management regime in Europe is having trouble in integrating the wider needs of the marine environment into the current way of working, despite there being many common objectives between biodiversity conservation and the sustainable management of fish stocks. There are a number of ways in which these common objectives might be better delivered – many of these will involve a wider range of interests in decision-making than is currently the case. Should an improved management structure for fisheries be established in Europe, ICES will need to change to not only provide advice on the state of fish stocks and recommended harvest levels, but also to provide advice on likely wider environmental effects of such decisions. For example, this may mean that environmental assessment of the various methods to catch fish will be required. A much wider constituency will likely be needed within the advisory structure of ICES.

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Introduction

Interest in and the statutory requirements for the conservation of, marine biodiversity, have been rising rapidly in the past two decades. For an international organisation ostensibly concerned with all aspects of marine science, the relative lack of interest in these issues within the structure of ICES, especially in its advice-giving role, is extraordinary. This paper reviews some the current requirements for marine biodiversity conservation within the ICES area, and makes suggestions as to how ICES might revise its work in order to help others better fulfil these requirements. These suggestions need though to be considered in a context of a general failure of current fisheries management in European waters to achieve even the narrower target of sustaining commercially exploited fish-stocks in a condition that would allow optimum exploitation of those stocks.

Biodiversity conservation legislation

The broad aims of biodiversity conservation may be summarised using the objectives of the UN Convention on Biological Diversity (CBD). Amongst others, these are to ensure the conservation of biological diversity and the sustainable use of its components. This Convention is global, and legally binding. Article 2 of CBD defines sustainable use as "the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet needs and aspirations of present and future generations". Parties to the Convention shall "identify processes and categories of activities which have or are likely to have adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects through sampling and other techniques". A consequence of the CBD is that biological criteria must be taken into account and given greater weight in management decisions. In a fisheries context, not only should fish stocks be exploited in a sustainable manner, but there should be as little adverse effects on biological diversity as possible. The original Convention has been further refined at meetings of Parties since it entered into force. Action has been recommended to i) integrate coastal and marine area management; ii) establish marine and coastal protected areas; iii) implement agreed guidelines on sustainable fisheries (essentially including a precautionary approach); iv) manage mariculture and its potential impacts; and v) manage the risks from alien species.

The general aims of CBD are partially supported in both international and national law, but overall the legal and administrative framework of most states is not at present capable of meeting fully the needs of nature conservation. This is particularly the case in the marine environment. The more important of the relevant international conservation instruments innorth-west European seas are described below.

The Convention for the Protection of the Marine Environment of the north-east Atlantic (OSPAR convention) replaced two previous conventions covering the region. The primary purposes of the previous two conventions were to protect the environment from the effects of pollution. A recently agreed Annex extends the provisions of the Convention to cover conservation of species and habitats; however the wording of this Annex specifically excludes protecting species and habitats from the effects of fisheries. This exclusion was inserted to avoid a clash in competence with fisheries management structures in European waters.

The Convention on the Conservation of Migratory Species of Wild Animals, known as the "Bonn Convention", requires States to pay particular regard to migratory animals. The logic of this is to

avoid the nature conservation activities of one state being neutralised by the activities of another state within the range of a migratory species. It functions through a series of specific Agreements drawn up between range states of populations of migratory animals. In north-west European seas, three such Agreements are relevant: the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS), the Agreement on Seals of the Wadden Sea and the African-Eurasian Waterfowl Agreement. An equivalent Agreement on all cetaceans will apply in the Mediterranean.

The Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention) requires Parties to protect all important breeding and resting sites of a long list of animals, and to safeguard many plants. Populations of these fauna and flora should be maintained at levels corresponding to "ecological, scientific and cultural requirements". This convention underlies much national nature conservation legislation and also the Birds and Habitats Directives (see below).

Coastal wetlands may also be protected under the Convention on Wetlands of International Importance, especially as Waterfowl Habitat (the Ramsar Convention). This requires wise use and special protection of wetlands, which include marine areas to a low-tide depth of 6m.

Two nature conservation Directives apply in the European territory of member states of the European Union - Directive 79/409/EEC on the conservation of wild birds and Directive 92/43/EEC on the conservation of natural habitats and wild fauna and flora. Both of these Directives have Annexes that include the requirement to protect specified marine habitats and animals. Until recently, "European territory" has been taken to mean territorial waters; however a High Court judgement in UK in 1999 interpreted this term (for the UK) as meaning within the 200 NM limit established by UK. This view is held also by the European Commission (EUC COM 1999/363)

Biodiversity conservation is also meant to be at the heart of the EU's Common Fisheries Policy. Article 2 of the framework Regulation 3760/92 states that the aim of the CFP is: "to protect and conserve available and accessible marine aquatic resources, and to provide for rational and responsible exploitation on a sustainable basis ... taking account of its implications for the marine ecosystem". It is plain that the first part of this aim is not being met in many areas, while the second part has only so far manifest itself specifically in only two regulations and both of these relate to reducing the impact of specific fisheries on dolphin populations.

ICES and biodiversity conservation

One of the greatest strength of ICES is the broad breadth of marine scientists who are willing and able to work together in a politically neutral forum to gain a co-operative understanding of the marine environment. As can be seen from the above, there are many areas in biodiversity conservation where the politically neutral advice that ICES can provide might be highly relevant. Regrettably in the past two decades, ICES has largely ignored major changes in public and political attitudes to marine biodiversity and as a consequence other bodies and groups have taken scientific leadership in this field. There have been some notable exceptions: the working group on ecosystem effects of fishing activities has carried out much pioneering analysis in the field relating to effects of fishing. However, except where specifically commissioned, this work has not fed through into the advice provided by ICES to fisheries or other administrators.

Capacity building

Where biodiversity-related requests have been made, ICES has been relatively poorly equipped to reply, and is forced often to use the work of other, non-ICES, groups and rely on the very few specialists within the ICES community. None of the databases managed by ICES relate to distribution and abundance of organisms apart from fish. In recognition of this, the initial ICES strategic plan (ICES 2000) identifies one of ICES main future roles will be in characterising and understanding marine biological diversity. The interaction of fisheries with both fish (as opposed to fish stocks) and other organisms in the marine environment has been studied in a few instances, and the working group on ecosystems effects of fishing have summarised some of these. There is plainly insufficient capacity in the ICES system at present to take a lead in providing advice on biodiversity issues. Further capacity needs to be built if ICES wishes to take this lead.

Plainly the blame for this lack of capacity in the ICES system cannot be laid solely on ICES – fisheries managers and others managing human use of the marine environment do not ask as a matter of course for such advice, despite policy requirements. An additional problem is one of funding; many ICES nations will fund participation by scientists only in the working and study groups with most apparent direct economic interest. In the UK, for example, funding for attendance at ICES working groups is controlled directly by the two main marine (fisheries) laboratories. Scientists working outside these laboratories (frequently experts in wider biodiversity disciplines) do not have access to such funds, while scientists working within the laboratories in the more 'peripheral' areas cannot find funds either. Not all nations manage their involvement with ICES in this way and these others are, perhaps not co-incidentally, the more proactive ones in dealing with marine biodiversity issues.

Integration

It is widely agreed that the greatest direct human impact on marine biodiversity is from fishing. If we are to conserve biodiversity, then the impacts of fishing need to be controlled and as far as possible minimised. An area that needs particular development in Europe is the integration of biodiversity considerations into fisheries policy. The European Commission has been attempting to write a biodiversity action plan for fisheries for the past few years. The first draft, when it appeared earlier in 2000, was not well received by nature conservationists as it appeared to be based on the claim that carrying on with current policies and procedures was sustainable both for fish stocks and for wider biodiversity. There is widespread evidence pointing at the exact opposite. The Commission is presently redrafting this document, but this time with the help of non-governmental organisations from the nature conservation sector and, regrettably, not ICES.

ICES is not proving advice routinely on the wider effects of the choices to be made in managing fisheries. ICES has however made some steps that will allow progress in this area. The development and implementation of the Precautionary Approach for some fisheries advice and the regularly-given advice that fishing effort is too high will, if adopted, both help progress towards more sustainable use of fish stocks. Some thinking has taken place on an ecosystem-based approach to fisheries management, but nothing firm is in place yet. It is pleasing to note that the initial ICES strategic plan (ICES 2000) identifies a need for work in this area, but does not appear to place a high priority on the activity. Consequently there is a risk that the lead in this area will be taken by others (Pope and Symes, 2000; Symes and Pope, 2000).

There are suggestions that a wider stakeholder group should be involved in assessing fish stocks and providing advice. Most suggestions for this wider stakeholder group feature the inclusion of fishers (or their representatives) in the process. The group that has negotiated the Irish Sea cod stock recovery plan in the past year may be viewed as a test of the inclusion of fishers early in the management process. We argue strongly that the stakeholder group should be wider than just the fishers involved, but should include at least those with a responsibility for ensuring nature conservation in the marine environment.

Regional Seas management

The current EU policy is that a single ministerial council takes all fisheries management decisions in all EU waters. The expansion proposed above in the formal involvement in fisheries management has the danger of over-burdening this current single-locus system. In addition, European waters include many distinct ecosystems, from the fresher waters of the Baltic, to the deep waters of the Atlantic, and the virtually enclosed Mediterranean. This diversity in ecosystems and the proposed expansion in participation in EU fisheries management process has led to calls for regionalisation (or zonal management, SFF/NFFO, 2000) of EU fisheries policy (Symes and Pope, 2000). Under this, EU waters would be divided into a number of areas and management based of each area based on the needs of each area. The European Commission is already indicating an active interest in these proposals and it seems likely that at least advisory committees will be introduced for regional seas. In practice, some regionalisation has already occurred in the Baltic where the Baltic Sea Fisheries Commission is the main decision-taking body.

ICES will need to respond to this change in management structure and the move towards making management more holistic. Given that some regionalisation (beyond that already in existence for the Baltic) seems likely, ICES should perhaps be more proactive. Questions such as "Where are the most biologically sensible boundaries within the ICES area?" and "How might stocks that straddle these boundaries be addressed?" are likely to be addressed. In order to answer the first question, it would be important for the biology of the ICES area (beyond that of the location of fish stocks) be better described and defined. It would be wise to bring together multi-disciplinary groups to address these questions. The current ICES proposals to continue the separation of fisheries advice (ACFM) from that on the environment (ACME) and to add a third advisory committee on biodiversity seems perverse in this context.

Examination of alternative fisheries management paradigms

The core of the advice provided by ICES at present is related to size of fish stocks and total allowable catches. This advice, when translated into fisheries policy, is not particularly helpful in implementing an ecosystem-based approach. There are also many difficulties (e.g. misreporting, under-reporting and discards) within the resulting fisheries. As a consequence, the system is largely discredited in the eyes of fishers and is largely failing. Several alternatives have been proposed, some more radical than others. These include a great increase in the use of closed areas, introduction of more selective gear, and a switch to effort quotas coupled with a discard ban. All of these proposals may reduce fishing pressure on the marine environment, and the last might reduce the large research and assessment costs associated with the current system. ICES has a good track record in relation to the science of gear selectivity, and has briefly considered closed areas, but has not systematically examined several alternatives for fisheries management from a scientific point of view. There are though plainly difficulties with effort quotas,

particularly perhaps the relationship between effort and fishing mortality. ICES could examine suggestions for alternative management methods, particularly in relation to scientific feasibility.

Summary and Recommendations

Fisheries management in the ICES area may be characterised by failure. This failure encompasses not only the inability to maintain fish stocks at a safe and productive level, but also to allow considerable unnecessary collateral damage to the marine environment and marine biodiversity. It seems therefore inevitable that there will be radical reform of fisheries management in Europe before too long. ICES is an intimate part of the management process in Europe, and can help to address these failures, and participate actively in the reform of fisheries management. In order to help ensure that biodiversity considerations are taken fully into account currently and future, we recommend that

- ICES takes steps to improve capacity within its specialist and advisory structure to improve advice provision on biodiversity conservation issues.
- Member states and the customers of ICES (both present and potential) indicate a desire for ICES to take this role, and to provide the necessary supporting resources.
- ICES takes steps to combine and integrate its advice on fisheries, the environment and biodiversity.
- ICES considers ways in which regionalisation of advice might be best achieved, and adopts structures to best support management within regional seas.
- ICES further examines future possible fisheries management systems, and provides advice on their scientific feasibility, including views on how well biodiversity considerations might be taken into full account.

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2000 ICES ASC Handbook

Contributions
Agendas and Orders of the Day
Abstracts

2000 ICES Annual Science Conference
27–30 September 2000

88th Statutory Meeting
24 September to 4 October 2000

Congress Centre Oud Sint-Jan,
Brugge, Belgium

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The List of Participants will be distributed at the Annual Science Conference

Cover illustrations

Front: Seascape with fishing vessel by Paul Jan Clays (1819 - 1900). Clays was strongly influenced by French realism and worked in his native city, Bruges, as well as Antwerp and Brussels, specializing in marine motifs. Groeninge Museum, Bruges.

Back: Tapestry, ca. 1630, by unknown artist. One of a series depicting miracles attributed to Our Lady of the Potterie, the tapestry shows Pieter Brant praying for her help in increasing his catch in the North Sea. According to legend his prayer was answered and his catch, more than abundant. Our Lady of the Potterie Museum, Bruges.

Welcome by the President of ICES

Last year, at the Annual Science Conference in Stockholm, ICES celebrated the 100th anniversary of the 1899 preparatory meeting which led to the establishment of ICES in 1902. The focus was on the "Evolution of ICES". Also, as part of the process leading up to the Centenary meeting in Copenhagen in 2002, in August 2000, ICES convened a special Symposium in Helsinki, "100 Years of Science under ICES". This Symposium identified the many achievements of ICES during its first century.

While celebrating ICES' many accomplishments we must also examine the challenges and opportunities facing us and look to the future. For several years now ICES has been making substantial changes in the way it works. These include the restructuring of the Statutory Meeting to provide for an improved focus on science through an Annual Science Conference. We have also restructured our Science Committees to provide for the multispecies, interdisciplinary, ecosystem approach needed to tackle the major challenges we will face in the years ahead.

Over the past year we have also been examining improvements to our advisory process. The Bureau Working Group on the Advisory Process has recently developed proposals aimed at improving our capability to provide integrated fisheries and environmental advice in an ecosystem context, where necessary. These proposals will be considered by the Delegates at this year's Council Meeting in Brugge (Bruges).

As we enter ICES' second century, it is also time to develop a new vision for the organization which builds on what we have learned and charts new directions. An initial Strategic Plan was adopted by the Council at the 1999 Stockholm meeting. This plan has been made available to the ICES community, Member Countries, ICES clients, existing and potential partners, and other stakeholders for discussion and comment. On Tuesday, September 26, the day before the opening of the 2000 Annual Science Conference, ICES is holding an Open Forum to provide an opportunity for debate and feedback from a wide variety of stakeholders. The intent is to produce, following further discussions and debate, a Centenary Strategic Plan for adoption at the Copenhagen meeting in 2002.

At this year's Annual Science Conference in Brugge we have an exciting programme which covers a wide range of topics of current and emerging importance, ranging all the way from "defining the role of ICES in supporting biodiversity conservation" to a dialogue between fisheries managers and scientists on the development of reference points and management systems for the fisheries and marine ecosystems. The wide range of theme sessions is impressive.

Thank you in advance for your contribution to the 2000 ICES Annual Science Conference. I wish you an exciting and enjoyable Conference and a very pleasant stay in the beautiful city of Brugge.

Scott Parsons

Welcome by the Delegates of Belgium

Dr Rudy De Clerck and Dr Georges Pichot look forward to greeting participants attending the 2000 ASC

As the Belgian Delegates, we are very pleased and honoured to welcome you to our home country the 2000 ICES Annual Science Conference and 88th Statutory Meeting. Belgium has been an ICES Member since 1903, but this is the first time that it has hosted a Council Meeting so the occasion really is rather special. Better late than never...

The ASC will be held in Brugge (Bruges). The city was founded between the 7th and 9th centuries and enjoyed an economic boom, stimulated by the Counts of Flanders, between the 13th and 15th centuries and became one of the richest in the world at that time. Brugge today remains a medieval city of stunning beauty and charm. It is rich in architectural and artistic treasures and graced by quiet canals and waterways. The Belfry is widely considered to be Belgium's finest, with a fantastic carillon that has been used for almost eight centuries. The Halls of this 260-foot-high tower have been chosen as the location for the plenary ASC reception on Wednesday, 27 September, when the carillon will play special arrangements for ICES participants.

The meeting will be held in the Congress Centre "Oud Sint-Jan", the site of Saint John's Hospital, in the medieval quarter of Brugge, which has been restored. The venue is situated in the real centre of the town and is walking distance from all the hotels listed in the meeting announcement. Everything has been taken into consideration to ensure the highest level of convenience. The Congress Centre also contains a charming pub and restaurant, well suited to lunch breaks.

The Grand Conference Dinner on Saturday, 30 September, will be held in the room "Witte Roos" in the Congress Centre. The same room will be used for coffee breaks and the Poster Session. A special (secret) happening will conclude the Dinner so we hope it will be an evening to remember. Please make your reservation soon.

There are some excursions planned for Sunday, 1 October, and during the week guided tours in Brugge may be booked at the reception desk.

We extend to all of you a very warm welcome to Belgium, to Brugge, and to the 2000 ASC!

Rudy De Clerck and Georges Pichot

Introduction to the 2000 ICES Annual Science Conference
(88th Statutory Meeting)

The 88th Statutory Meeting will run in parallel with the Annual Science Conference.

The ICES Annual Science Conference has two main functions:

- to bring to the attention of the scientific community the results and advancement of the work conducted in many fields of marine research;
- to review the state of knowledge, identify the gaps, and then propose carefully considered actions to fill the gaps.

The 2000 Conference comprises a wide range of activities, as listed in the appended Programme, which we advise you to keep at hand throughout the ASC. The highlights include:

1. The General Assembly, including:

- Opening of the General Assembly by the General Secretary of ICES, David de G. Griffith.
- Opening Address by the President of ICES, Dr Scott Parsons.
- Address to the ICES General Assembly by the Minister of Agriculture and SME, Mr J. Gabriëls, and the Minister for Economy and Scientific Research, Mr C. Picqué.
- Interlude – choral music.
- The Open Lecture by Prof. Daniel Pauly on 'Fisheries and Conservation. A Programme for their Reconciliation'.

2. Invited Lectures:

- by Dr Patrick Gentien (France) on "The 'Species-of-Interest' approach in understanding harmful algal blooms: implications in modelling population growth of *Gymnodinium mikimotoi*"
- by Dr A.E. Gargett (Canada) on "How do extremes of climate variability affect biological production in estuarine systems?"

3. Scientific Sessions (arranged in topics)

MARINE HABITATS

Mini-Symposium on Defining the Role of ICES in Supporting Biodiversity Conservation (Mini). *Dr J. Rice and Dr M. Tasker*

Theme Session S: on Temporal and Spatial Trends in the Distribution of Contaminants and their Biological Effects in the ICES Area. *Dr Remi W.P.M. Laane, Dr P. Matthiessen, and Dr T. Lang*

Theme Session T: on Classification and Mapping of Marine Habitats. *Dr D. de Jong, Dr Jon Side, and Dr Rebecca Allee*

Theme Session U: on Marine Biological Invasions: Retrospectives for the 20th Century – Prospectives for the 21st Century. *Prof. J. Carlton and Dr D. Minchin*

LIVING RESOURCES

Theme Session Q: on Trophic Dynamics of Top Predators: Foraging Strategies and Requirements, and Consumption Models. *Prof. H. Gislason, K.T. Nilssen, and Dr M. Tasker*

Theme Session R: on the Application of Experimental Laboratory Studies to Fisheries Science. *Dr J. S. Christiansen and Prof. J. G. Pope*

Theme Session Y: on Downturn in North Atlantic Salmon Abundance. *Dr J. A. Ritter and A. Isaksson*

FISHERIES RESOURCE MANAGEMENT

Theme Session V: on Medium-Term Forecasts in Decision-Making. *Dr K. Patterson and P. Sandberg*

Theme Session W: on Cooperative Research with the Fishing Industry: Lessons Learned. *Dr G. Chouinard and Dr Paul Rago*

Theme Session X: on the Development of Reference Points and Management Systems for Fisheries and the Marine Ecosystem. *Dr J. Horwood, Dr N.A. Nielsen, Dr G. van Balsfoort, and Dr M. Sissenwine*

FISHERIES TECHNOLOGY AND SURVEYING

Theme Session J: on Efficiency, Selectivity, and Impacts of Passive Fishing Gears. *H. A. Carr and G. Brothers*

Theme Session K: on the Incorporation of External Factors in Marine Resource Surveys. *E.J. Simmonds, Dr P. Petitgas, and Dr S. Walsh*

MARICULTURE

Theme Session O: on Sustainable Aquaculture Development. *Prof. H. Ackefors and Prof. H. Rosenthal*

Theme Session P: on New Trends in Fish Feeding in Aquaculture. *J. Castell and Dr S.J. Kaushik*

OCEANOGRAPHY AND MARINE ECOLOGY

Theme Session L: on North Atlantic Processes. *Dr W.R. Turrell and Prof. T. Rossby*

Theme Session M: on Environment – Plankton – Fish Linkages. *Dr K. Drinkwater, P. Wiebe, Prof. K. Tande, and Dr J. Runge*

Theme Session N: on Spatial and Temporal Patterns in Recruitment Processes. *Prof. E. Houde, Dr P. Pepin, P. Munk, and Prof. D. Schnack*

OPEN SESSION

Theme Session Z: on General Fisheries and Marine Ecology. *W. Vanhee and J.-J. Maguire*

These Sessions are designed to address topical issues of immediate relevance to ICES, and are considered essential to the enhancement of the interdisciplinary role of ICES.

The timetables and venues for these Scientific Sessions are given on page 49.

4. Closing of the Scientific Sessions

This is the official conclusion of the Scientific Sessions, when the General Secretary, the Chair of the Consultative Committee, and the President will make various announcements (results of elections etc.) and present appropriate awards for "Best Paper Presentation Award", "Best Poster Presentation Award", and "Newcomer Award".

5. Science Committee Sessions

To develop and review the scientific work programmes, ICES has seven Science Committees (Oceanography, Marine Habitat, Living Resources, Resource Management, Fisheries Technology, Mariculture, and Baltic Committees) whose Chairs, together with those of the two Advisory Committees (Advisory Committee on Fishery Management and Advisory Committee on the Marine Environment), form the Consultative Committee. The Science Committees serve as a main forum for proposing work programmes and events to be supported by ICES. The appointed members of the Science Committees serve as national contact points for the work conducted.

Action and work needs identified by the Committees are effected by drawing up Draft Resolutions. The Draft Resolutions then pass to the Consultative Committee, where they are edited, amended, and coordinated to make sure that duplication is avoided and that they are justified scientifically. Finally, the package of Draft

Resolutions approved by the Consultative Committee is presented to the decision-making body of the Council – the national Delegates – where they are discussed and, if supported, eventually endorsed as Council Resolutions.

Although there are official members appointed to every Committee, you are all *encouraged to join in the discussions* in the Sessions of the Science Committees on Friday 29 September p.m. Your input will be welcomed.

Meetings listed on the Programme as Business Sessions are for Members only.

6. Elections and Appointments

The following elections/appointments will take place:

- A new Chair of the Oceanography Committee will be elected from 13.30 to 14.00 hrs on Friday 29 September 2000 in the *Morus* Room, by votes cast by officially appointed members or national Delegates.
- A new Chair of the Resource Management Committee will be elected from 15.00 to 15.30 hrs on Friday 29 September 2000 in the *Erasmus* Room, by votes cast by officially appointed members or national Delegates.
- A new Chair of the Marine Habitat Committee will be elected from 16.00 to 16.30 hrs on Friday 29 September 2000 in the *Vives* Room, by votes cast by officially appointed members or national Delegates.
- A new Chair of the Living Resources Committee will be elected from 17.30 to 18.00 hrs on Friday 29 September 2000 in the *Picard* Room, by votes cast by officially appointed members or national Delegates.
- The Council of Delegates will elect a President, a new First-Vice President and three Vice-Presidents. The President, together with the First Vice-President and five other Vice-Presidents constitute the Bureau, the executive body of ICES. The Bureau is responsible for overseeing, together with the General Secretary, the daily operations of ICES.
- The Council will also appoint a new Chair and Vice-Chair of the Consultative Committee.
- Furthermore, it will also be necessary for the Council to appoint at this year's Annual Science Conference a new Chair and two members of the Finance Committee, and a new Chair and three members of the Publications Committee.

You are welcome to complimentary copies of all non-restricted documents, such as scientific papers and Working Group reports. These can be obtained from the Documents Room.

Please feel free to contact the ICES Secretariat and Council Officials (names and pictures on poster) should you need further information and assistance.

The 2000 ICES Annual Science Conference offers a wide and interesting range of topics with something for everyone. Please enjoy it, and make your own contribution to it!

Robin Cook

On behalf of the Consultative Committee

David Griffith

On behalf of the ICES Secretariat

2000 ASC — Scientific Programme

Wednesday 27 September			
09.00–11.00	11.30–13.00	14.00–16.00	16.30–18.00
GENERAL ASSEMBLY and **Open Lecture by Prof. Dr D. Pauly (Canada)** on "Fisheries and Conservation. A Programme for their Reconciliation" **Ambassadeur Room**	Defining the Role of ICES in Supporting Biodiversity Conservation **(MINI)** **Ambassadeur Room**		
	Development of Reference Points and Management Systems for Fisheries and the Marine Ecosystem **(X)** **Morus Room**		Incorporation of External Factors in Marine Resource Surveys **(K)** **Morus Room**
	North Atlantic Processes **(L)** **Erasmus Room**		
	Downturn in North Atlantic Salmon Abundance **(Y)** **Vives Room**	Sustainable Aquaculture Development **(O)** **Vives Room**	New Trends in Fish Feeding in Aquaculture **(P)** **Vives Room**

Thursday 28 September				
08.30–09.15	09.30–10.30	11.00–12.30	14.00–16.00	16.30–18.00
Invited Lecture by Dr Patrick Gentien (France) on "The "Species-of-Interest" approach in understanding harmful algal blooms: implications in modelling population growth of *Gymnodinium mikimotoi*" **Ambassadeur Room**	The Application of Experimental Laboratory Studies to Fisheries Science **(R)** **Ambassadeur Room**		Temporal and Spatial Trends in the Distribution of Contaminants and their Biological Effects in the ICES Area **(S)** **Ambassadeur Room**	
	Cooperative Research with the Fishing Industry: Lessons Learned **(W)** **Morus Room**			General Fisheries and Marine Ecology **(Z)** **Morus Room**
	Incorporation of External Factors in Marine Resource Surveys **(K)** **Erasmus Room**			
	Environment – Plankton – Fish Linkages **(M)** **Vives Room**			
POSTER SESSION (18.00–20.00) **De Witte Roos Room**				

2000 ASC — Scientific Programme

Friday 29 September			
08.30–10.30	11.00–12.30	13.30–15.30	16.00–18.00
Spatial and Temporal Patterns in Recruitment Processes **(N)** **Ambassadeur Room**		Fisheries Technology Committee (B) **Ambassadeur Room**	
Classification and Mapping of Marine Habitats **(T)** **Morus Room**		Oceanography Committee (C) **Morus Room**	
Trophic Dynamics of Top Predators: Foraging Strategies and Requirements, and Consumption Models **(Q)** **Erasmus Room**		Resource Management Committee (D) **Erasmus Room**	
Medium-Term Forecasts in Decision-Making **(V)** **Vives Room**		Marine Habitat Committee (E) **Vives Room**	
		Mariculture Committee (F) **Descartes Room**	
		Living Resources Committee (G) **Picard Room**	
		Baltic Committee (H) **Chambers S. Stevin**	

Saturday 30 September				
08.30–09.15	09.30–10.30	11.00–12.30	13.30–15.30	16.00–16.30
Invited Lecture by Dr A. E. Gargett (Canada) on "How do extremes of climate variability affect biological production in estuarine systems?" **Ambassadeur Room**	Spatial and Temporal Patterns in Recruitment Processes **(N)** **Ambassadeur Room**			CLOSING SESSION **Ambassadeur Room**
	Downturn in North Atlantic Salmon Abundance **(Y)** **Morus Room**	Trophic Dynamics of Top Predators: Foraging Strategies and Requirements, and Consumption Models **(Q)** **Morus Room**	Classification and Mapping of Marine Habitats **(T)** **Morus Room**	
	Efficiency, Selectivity and Impacts of Passive Fishing Gears **(J)** **Erasmus Room**			
	Marine Biological Invasions: Retrospectives for the 20th Century— Prospectives for the 21st Century **(U)** **Vives Room**			

88th Statutory Meeting – Business Sessions (attended by Members only)

Sunday 24 September	
ACFM (08.30–18.00)	**Chambers S. Stevin**
ACME (08.30–18.00)	**Erasmus Room**
Monday 25 September	
Bureau (08.30–18.00)	**de Gerlache Room**
Consultative Committee (08.30–09.30)	**Picard Room**
Fisheries Technology Committee (09.30–13.30)	**Erasmus Room**
Resource Management Committee (09.30–13.30)	**Ambassadeur Room**
Marine Habitat Committee (09.30–18.00)	**Vives Room**
Baltic Committee (09.30–13.30)	**Morus Room**
Oceanography Committee (14.00–18.00)	**Erasmus Room**
Living Resources Committee (14.00–18.00)	**Ambassadeur Room**
Mariculture Committee (14.00–18.00)	**Morus Room**
Tuesday 26 September	
Delegates Meeting (08.30–09.30)	**Chambers S. Stevin**
Open Forum on the ICES Strategic Plan (10.00–16.30)	**Ambassadeur Room**
Consultative Committee (08.30–12.00)	**Picard Room**
Wednesday 27 September	
Delegates (16.00–18.00)	**Chambers S. Stevin**
Thursday 28 September	
Finance Committee (08.30–12.30)	**de Gerlache Room**
Friday 29 September	
Delegates (08.30–12.30)	**Chambers S. Stevin**
Publications Committee (08.30–12.30)	**de Gerlache Room**
Monday 2 October	
Delegates (08.30–12.30)	**Chambers S. Stevin**
Consultative Committee (08.30–17.30)	**Picard Room**
Tuesday 3 October	
Consultative Committee (08.30–)	**Picard Room**
Delegates (08.30–17.30)	**Chambers S. Stevin**
Wednesday 4 October	
Delegates (08.30–17.30)	**Chambers S. Stevin**

Open Lecture
on

Fisheries and Conservation. A Programme for their Reconciliation

by

Dr Daniel Pauly

Dr Daniel Pauly is a French citizen, born in May 1946 in Paris. He grew up in the French-speaking part of Switzerland, but completed high school and university studies in the Federal Republic of Germany, where he acquired a "Diplom" (≈ MSc) in 1974 and a doctorate in fisheries biology in 1979 at the University of Kiel.

He joined the International Center for Living Aquatic Resources Management (ICLARM), in Manila, the Philippines, in July 1979 as a Postdoctoral Fellow, and gradually took on increasing responsibilities as Associate, and Senior Scientist, then Programme and Division Director.

In 1984/1985 he obtained, again at the University of Kiel, the "Habilitation", a postdoctoral degree required for teaching in many European universities.

In October 1994, he joined the Fisheries Centre, University of British Columbia, Vancouver, as a tenured Professor, while remaining ICLARM's Principal Science Adviser until December 1997.

His scientific output comprises authored and edited books, reports and scientific papers - a total of some 400 items - and the concepts, methods, and software he has developed are in use throughout the world.

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Abstract

There are two disciplines presently working on the status of marine organisms: Fisheries Science, founded at the end of the 19th century as a very applied discipline, and Conservation Biology, founded at about the same time as a terrestrial discipline, but which turned its gaze to marine organisms and ecosystems only recently. These two disciplines – like all scientific ventures – have their own standards and aims, as articulated by leading practitioners, and their seminal contributions, in specialized journals. Unfortunately, these parallel tracks lead to many misunderstandings, starting with mutual lack of recognition for each other's achievements, and often ending in unprofessional behaviours.

This lecture will present a case for reconciliation, based on (1) the reduced state of most exploited fish populations, leading to a consensus on the need for wide-ranging fishing effort reduction; (2) the emergence of Marine Protected Areas as a management tool for both rehabilitating fisheries and protecting biodiversity; (3) the emerging consensus that fisheries management, somehow, needs to be concerned with "ecosystem issues "; (4) increasing public interest in the "health" of the oceans, and thence in the disciplines that are (or should be) concerned with this and related issues, notably global climate change; (5) limited funding for science in general, and for the research required to address (1) to (4). A large multidisciplinary research project, recently initiated to address these issues on a basin-wide scale, and evaluating the impacts of fisheries on the ecosystems of the North Atlantic, will be presented. Some of its preliminary results will be used to illustrate how fisheries and conservation issues may be tackled simultaneously, and solutions identified which, if implemented, would benefit both sets of "clients".

Keynote Lecture 1

The "Species-of-Interest" Approach in Understanding Harmful Algal Blooms: Implications in Modelling Population Growth of *Gymnodinium mikimotoi*

by

Dr Patrick Gentien

Gymnodinium mikimotoi is a ubiquitous ichthyotoxic dinoflagellate species causing harm in the North Sea and the Atlantic, as well as waters off Japan, South America, and South Africa. Its blooms have deleterious effects on marine aquaculture stocks (fish and shellfish), on species recruitment (shellfish and probably fish), and possibly on marine flora and ecosystems.

The toxicity of this species is due to a labile exotoxin (20 min. half-life). Synthesis of this exotoxin makes it possible to determine the mechanism of action for this toxin: it inhibits in a non-specific way membrane ATPases. These enzymes are the energy source for ion exchanges at membranes. Biological targets are, therefore, incapacitated in their osmotic pressure regulation. The effect of these exotoxins have been studied in terms of economic losses, but never in terms of the effects on the ecology and the development of a bloom. The spatial scale of action in relation to degradation is of the order of a few centimetres. Since individual cells have been observed to aggregate during the growth phase of the population, it is very likely that the population creates its own specific environment.

In order to define the specificities of this environment in terms of population dynamics, the effect of the toxins on different control (or hexicological, according to the definition of *Miwatt*) factors have been examined.

Oxygen radicals produced by decay of the toxin can only optimize the organic matter uptake. Allelopathic properties of the toxin have been demonstrated and reduce competition for substrate. Toxins and the mucus produced by the dinoflagellate population lower the grazing pressure. On the other hand, though less sensitive than their competitors, *G. mikimotoi* cells are sensitive to their own toxins. Cells have developed an anti-collision system, effective in still environments, which has proven not to act above a certain threshold of turbulence.

Based on the hierarchization of the processes, a simple formulation of population growth has been used to simulate hindcast time series in the Bay of Biscay (France) according to the following formula:

$$\frac{dC}{dt} = \mu(T, h\nu)C - \alpha\gamma C^2$$

with μ: growth rate, $h\nu$: light intensity, and γ: shear.

The zone of inoculation of the population was defined from different scenarios using analysis of trajectories. The results of the modelling exercise are compared with the time series obtained from the monitoring network in terms of confinement on the vertical, timing of events, and geographical extent.

Omission in this model of any growth limitation by nutrients and the advantages of using a "species-of-interest" approach are discussed.

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Keynote Lecture 2

How Do Extremes of Climate Variability Affect Biological Production in Estuarine Systems?

by

Dr Ann E. Gargett

There is increasing evidence that extremes in climate variability correlate with major changes in coastal ecosystems, culminating in large variations in marine fish stocks. Any such correlations presumably arise through effects of atmospheric forcing on ocean processes, which in turn shape the environment in which biological systems function. Climate-induced changes in physical ocean processes could exert "control" over zooplankton production (i) from below, if physical processes set the level of primary production available to support higher trophic levels, (ii) from within, if physical processes determine zooplankton growth rates, or (iii) from above, if physical processes affect the rate at which zooplankton are themselves cropped. These possibilities are explored using a simple N-P-Z biological model coupled to a physical box model of the Strait of Georgia/Haro Strait/Strait of Juan de Fuca system of southern British Columbia. Model results indicate that while observed levels of interannual variation in the physical forcing of this system reproduce observed levels of variability in the annual cycles of characteristic physical parameters such as salinity, stratification, etc., there is very little associated variation in the embedded biological system. However, large changes in annual cycles of biological variables are observed; comparable changes can be produced in the model by relatively minor changes in biological rate parameters (phytoplankton growth rate, zooplankton feeding rate, and/or mortality rate). Thus, model results strongly suggest that climate variability does not affect estuarine ecosystems directly, i.e. by effects on advective flows, nutrient supply rates, etc., but rather indirectly, through modification of characteristics of the physical environment which affect crucial biological rate parameters. In strongly estuarine systems, turbidity changes associated with variability in freshwater forcing is a likely cause of such rate modification.

Dr Ann E. Gargett: Institute of Ocean Sciences, P O Box 6000, Sidney, BC, Canada, V8L 4B2

Notes for Guidance

Registration, conference service, and pigeon holes
The ICES Registration Desk will be located by the main entrance of the Congress Centre Oud Sint-Jan. Tickets for tours and the Grand Conference Dinner may also be purchased in the same locality. Close to the main entrance in the corridor running to the Ambassadeur Room and next to the cloakroom, pigeon holes for ICES Officials and poster boards for announcements and messages will be available.

ICES Officials
The ICES Secretariat will be located in the Voltaire Room. The ICES President and General Secretary will have their office in the Salon S. Stevin. The office of the Chair of the Consultative Committee and ICES Professional Secretaries will be located in the Racine Room. The ICES Editors will have their office in the Mercator Room.

Documents Room
Documents will be available in the Molière Room.

Meeting rooms
Meeting rooms for small *ad hoc* groups must be reserved in advance: contact the ICES Secretariat located in the Voltaire Room.

Paper presentations
In order to allow the Sessions to run smoothly and in fairness to other speakers, please note that all presentations are expected to adhere strictly to the time allocated. The time for your presentation will be found in the Agendas and Orders of the Day starting on page 49.

Posters
Posters will be displayed in the De Witte Roos Room. A special Poster Session will be held here on Thursday, 28 September, between 18.00 and 20.00 hrs, when all contributors of posters are requested to be present to answer any questions.

Refreshments
Complimentary refreshments (coffee and tea) will be served during coffee breaks in the De Witte Roos Room. Smoking is only allowed in the De Witte Roos Room, the Restaurant, and the corridors.

Simultaneous interpretation
Simultaneous interpretation (English and French) will be provided during the General Assembly and during five of the six Sessions of the Delegates Meetings. Headsets will be available.

Social activities
A General Reception for all participants and their guests will be held by the Minister of Agriculture and Small and Medium-Sized Enterprises, J. Gabriëls, and the Minister for Economy and Scientific Research, C. Picqué, on Wednesday, 27 September, from 20.00 to 22.00 hrs at the Belfry in Brugge (Bruges).

The Grand Conference Dinner will be held on Saturday, 30 September, at 20.00 hrs in the De Witte Roos Room. Tickets may be purchased from the conference service located by the main entrance to the Congress Centre.

Excursions
Sunday, 1 October, is an optional excursion day.
On Saturday, 30 September, the RV "Belgica" will be open for visits. Information on how to reach the vessel in the harbour will be provided.

Contributions to the 2000 Annual Science Conference

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Requests for additional copies of documents when supplies run out

Authors have been requested to sent 125 copies of their papers to Belgium and 5 to the ICES Secretariat). Copies of the various papers are made available in the Documents Room. Participants may help themselves to copies of scientific papers on a first-come-first-served basis. Should supplies of particular papers run out, those wishing to obtain copies should not contact the Secretariat but approach the senior author of the paper concerned (name and address given with Abstracts). It is hoped that authors will send copies to those requesting them once the Annual Science Conference is over.

GENERAL ASSEMBLY REPORTS AND PAPERS OF GENERAL INTEREST

Gen:1	Observers' Reports from Cooperating Organisations
Gen:2	ICES Activities in 1999/2000
Gen:3	Elections and Appointments of Council Officials at 2000 Annual Science Conference (88th Statutory Meeting) (E+F)
Gen:4	Report on ICES Symposia
Gen:5	1999/2000 Overview of ICES Committees and Subsidiary Groups and their Shadowing by Secretariat Staff, and Schedule of ICES Meetings and List of CM Codes

REFERENCE PAPER: Del:10

DEL - DELEGATES DOCUMENTS

Del:1	Final Accounts for Financial year 1998/99
Del:2	Progress Report on Administration
Del:3	Application by Chile for Observer Status
Del:4	Estimated Accounts for Financial Year 1999/2000
Del:5	Budget for Financial Year 2001
Del:6	Forecast Budget for Financial Year 2002
Del:7	Report of the Coordinating Group on ICES Advice
Del:8	Proposal to Change the Financial and Operational Year
Del:9	Proposed Changes of Rules of Procedure 26, 28 and 29, and Related decisions Required by the Council Regarding Advisory Committee
Del:10	Report of the Bureau Working Group on the Advisory Process
Del:11	Progress on Planning and Funding for the ICES Centenary
Del:12	Report on the History Book Project
Del:13	Developing Memoranda of Understanding
Del:15	Report of 6 February Meeting of Joint ICES/Commissions Working Group on Cooperative Procedures
Del:16	Arrangements for 2001 (89th Statutory Meeting; Norway), 2002 (90th Statutory Meeting; Denmark), and Subsequent Annual Science Conferences
Del:17	Progress Report on the GEF Baltic Sea Regional Project
Del:18	Preliminary Report of the 12th (Environmental) Dialogue Meeting
Del:19	Status of ICES/GLOBEC Office
Del:20	Report on the Follow-Up of the 11th Dialogue Meeting
A:5	Report of the 2000 Mid-Term Meeting of CONC
Gen:3	Elections and Appointments at the 88th Statutory Meeting

REFERENCE PAPERS: A:5, GEN:3

FI - FINANCE COMMITTEE

Fi:1*	Agenda for Finance Committee

* For Finance Committee and Delegates only

PUB - PUBLICATIONS COMMITTEE

Pub:1	Agenda for Publications Committee
Pub:2	Review of ICES Publication Activities in 1999/2000
Pub:3	*ICES Journal of Marine Science:* Editors' Report for 1999/2000
Pub:4	*ICES Journal of Marine Science:* Academic Press Publisher's Report for 1999/2000
Pub:5	*ICES Cooperative Research Report* series: Editor's Report for 1999/2000
Pub:6	*ICES Identification Leaflets for Plankton:* Editor's Report for 1999/2000
Pub:7	*ICES Identification Leaflets for Diseases and Parasites of Fish and Shellfish:* Editor's Report for 1999/2000
Pub:8	*ICES Techniques in Marine Environmental Sciences:* Editor's Report for 1999/2000

CONSULTATIVE COMMITTEE

A:1	Agenda for Consultative Committee
A:2/ ACFM:00A	Minutes from ACFM Meeting 26 October to 4 November 1999
A:3/ ACFM:00B	Minutes from ACFM Meeting 25 May to 1 June 2000
A:4/ ACME:01A	Minutes from ACME Meeting 26 January to 2 February 2000
A:5	Report of Mid-Term Meeting of the Consultative Committee and the ASC Programme Planning Group
A:6/ ACME:01B	Minutes from ACME Meeting 5–10 June 2000
A:7	Compendium of Draft Resolutions

REFERENCE PAPER: H:03

FISHERIES TECHNOLOGY COMMITTEE

B:01	Study Group on Methods for Measuring the Selectivity of Static Gear (SGMMG)
B:02	Study Group on Mesh Measurements Methodology (SGMESH)
B:03	Working Group on Fishing Technology and Fish Behaviour (WGFTFB)
B:04 Ref. H	Working Group on Fisheries Acoustics Science and Technology (WGFAST)
B:05	Joint Session of the Working Group on Fishing Technology and Fish Behaviour (WGFTFB) and Working Group on Fisheries Acoustics Science and Technology (WGFAST)

REFERENCE PAPERS: C:02, G:11

OCEANOGRAPHY COMMITTEE

C:01 Ref. D	Study Group on Incorporation of Process Information into Stock-Recruitment Models (SGPRISM)
C:02 Ref ACME, B, D, E,F, G, H	ICES/IOC Steering Group on GOOS (SGGOOS)
C:03 Ref. G	Working Group on Recruitment Processes (WGRP)
C:04 Ref. ACME, E	Working Group on Seabird Ecology (WGSE)
C:05 Ref. ACME	Working Group on Shelf Seas Oceanography (WGSSO)
C:06 Ref. ACME, E	ICES/IOC Working Group on Harmful Algal Bloom Dynamics (WGHABD)
C:07 Ref. ACME, E	Working Group on Oceanic Hydrography (WGOH)
C:08	Working Group on Marine Data Management (WGMDM)
C:09 Ref. ACME	Working Group on Zooplankton Ecology (WGZE)
C:10 Ref. ACME	Working Group on Phytoplankton Ecology (WGPE)
C:11 Ref. G	ICES/GLOBEC Working Group on Cod and Climate Change (WGCCC)
C:12 Ref. ACFM	Workshop on the Dynamics of Growth in Cod (WKDGC)
C:13	Study Group on an ICES/IOC Checklist of Phytoplanton (SGPHYT)
C:14	Steering Group for the ICES/GLOBEC North Atlantic Regional Office (SGNARO)

REFERENCE PAPERS: E:01, ACME:03, ACME:04, ACME:05, and ACME:09

RESOURCE MANAGEMENT COMMITTEE

D:01 Ref. ACFM	Study Group on Market Sampling Methodology (SGMSM)
D:02	Working Group on Fishery Systems (WGFS)
D:03 Ref. ACFM	Planning Group on Surveys on Pelagic Fish in the Norwegian Sea (PGSPFN)
D:04 (to ASC 2001)	Workshop on Synthesis of Surveys on Pelagic Fish in Norwegian Sea and Adjacent Areas (WKSSPF)
D:05 Ref. ACFM (to ASC 2001)	Workshop on International Analysis of Market Sampling and the Evaluation of Raising Procedures and Data-Storage (software) (WKIMS)
D:06 Ref. ACFM, G (to ASC 2001)	Study Group to Evaluate the Effects of Multispecies Interactions (SGEEMI)
D:07 Ref. ACFM, G	International Bottom Trawl Survey Working Group (IBTSWG)

REFERENCE PAPERS: C:01, C:02, G:01, G:02, G:03, H:02, ACFM:11, ACME:02

MARINE HABITAT COMMITTEE

E:01 Ref. ACME, C	Marine Chemistry Working Group (MCWG)
E:02 Ref. ACME	Working Group on the Marine Mammal Habitats (WGMMHA)
E:03 Ref. ACME	Working Group on Marine Sediments in Relation to Pollution (WGMS)
E:04 Ref. ACME	Working Group on Biological Effects of Contaminants (WGBEC)
E:05 Ref. ACME	Working Group on Statistical Aspects of Environmental Monitoring (WGSAEM)
E:06 Ref. ACME	Study Group on Marine Habitat Mapping (SGMHM)
E:07 Ref. ACME	Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT)
E:08 Ref. ACME	Benthos Ecology Working Group (BEWG)
E:09 Ref. ACME	Study Group on Ecosystem Assessment and Monitoring (SGEAM)

REFERENCE PAPERS: C:02, C:04, C:06, C:07, F:01, F:02, G:05, G:12, G:13, ACME:02, ACME:03, ACME:04, ACME:05, ACME:07, ACME:08, ACME:09

MARICULTURE COMMITTEE

F:01 Ref. ACME, E	Working Group on Pathology and Diseases of Marine Organisms (WGPDMO)
F:02 Ref. ACME, E	Working Group on Environmental Interactions of Mariculture (WGEIM)
F:03 Ref. ACME	Working Group on the Application of Genetics in Fisheries and Mariculture (WGAGFM)
F:04	Working Group on Marine Fish Culture (WGMAFC)

REFERENCE PAPERS: C:02, ACME:07, ACME:08

LIVING RESOURCES COMMITTEE

G:01 Ref. D	Working Group on Mackerel and Horse Mackerel Egg Surveys (WGMEGS)
G:02 Ref. D	Planning Group for Herring Surveys (PGHERS)
G:03 Ref. D	Planning Group for Pelagic Acoustic Surveys in ICES Sub-Areas VIII and IX (PGPAS) - no report
G:04 Ref. ACFM, ACME	Working Group on Cephalopod Fisheries and Life History (WGCEPH)
G:05 Ref. ACFM, ACME, E	Working Group on Marine Mammal Population Dynamics and Trophic Interactions (WGMMPD)
G:06 Ref. ACFM	Study Group on Life History of *Nephrops* (SGNEPH)
G:07	Workshop on the Estimation of Spawning Stock Biomass of Sardine (WKSBS)
G:08	Workshop on Identification and Staging of Mackerel and Horse Mackerel Eggs (WKMHME)
G:09 Ref. ACFM	Study Group on Elasmobranch Fishes (SGEF)
G:10	Stock Identification Methods Working Group (SIMWG)
G:11 Ref. ACFM, B	Working Group on Crangon Fisheries and Life History (WGCRAN)
G:12 Ref. ACFM, E	Working Group on Beam Trawl Surveys (WGBEAM)
G:13 Ref. E	Study Group on the Biology and Life History of Crabs (SGCRAB)

REFERENCE PAPERS: C:02, C:03, C:11, D:06, D:07, ACFM:02, ACFM:05, ACME:02

BALTIC COMMITTEE

H:01	Study Group on Baltic Cod Age Reading (SGBCAR)
H:02 Ref. D	Baltic International Fish Survey Working Group (WGBIFS)
H:03 Ref. A	Study Group on the Scientific Basis for Ecosystem Advice in the Baltic (SGBEAB)
H:04	Baltic Herring Age-Reading Study Group (BHARSG)
H:05	Study Group on Multispecies Predictions in the Baltic (SGMPB)
H:06	Study Group on Salmon Scale Reading Problems (SGSSR)

REFERENCE PAPERS: B:04, C:02, ACFM:09, ACME:03, ACME:04, ACME:06, ACME:09

ACFM

ACFM:00A	Minutes from ACFM Meeting 26 October to 4 November 1999
ACFM:00B	Minutes from ACFM Meeting 25 May to 1 June 2000
ACFM:01	Working Group on the Assessment of Northern Shelf Demersal Stocks (WGNSDS)
ACFM:02 Ref. G	*Pandalus* Assessment Working Group (WGPAND)
ACFM:03	Arctic Fisheries Working Group (AFWG)
ACFM:04	Working Group on the Assessment of Southern Shelf Demersal Stocks (WGSSDS)
ACFM:05 Ref. G	Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine, and Anchovy (WGMHSA)
ACFM:06	EIFAC/ICES Working Group on Eels (WGEEL)
ACFM:07	Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK)
ACFM:08	Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources (SGDEEP)
ACFM:09 Ref. H	Study Group on Baltic Herring Maturity (SGBHSM) - no report
ACFM:10 + Addendum	Herring Assessment Working Group for the Area South of 62° N (HAWG)
ACFM:11 Ref. D	Study Group on Discard and By-catch information (SGDBI)
ACFM:12	Baltic Salmon and Trout Assessment Working Group (WGBAST)
ACFM:13	Working Group on North Atlantic Salmon (WGNAS)
ACFM:14	Baltic Fisheries Assessment Working Group (WGBFAS)
ACFM:15 + Addendum	North-Western Working Group (NWWG)
ACFM:16	Northern Pelagic and Blue Whiting Fisheries Working Group (WGNPBW)
ACFM:17	CWP Intersessional Meeting
ACFM:18	Arctic Working Group on North-East Arctic Cod and Haddock

REFERENCE PAPERS: **A:2, A:3, C:12, D:01, D:03, D:05, D:06, D:07, G:04, G:05, G:06, G:09, G:11, G:12, ACME:02**

ACME

ACME:01A	Minutes from ACME Meeting 26 January to 2 February 2000
ACME:01B	Minutes from ACME Meeting 5-10 June 2000
ACME:02 Ref. ACFM, D, E, G	Working Group on Ecosystem Effects of Fishing Activities (WGECO)
ACME:03 Ref. C, E, H	ICES/HELCOM Steering Group on Quality Assurance of Biological Measurements in the Baltic Sea (SGQAB)
ACME:04 Ref. C, E, H	ICES/HELCOM Steering Group on Quality Assurance of Chemical Measurements in the Baltic Sea (SGQAC)
ACME:05 Ref. C, E	ICES/OSPAR Steering Group on Quality Assurance of Biological Measurements Related to Eutrophication Effects (SGQAE)
ACME:06 Ref. H	Study Group on Estimation of the Annual Amount of Discards and Fish Offal in the Baltic Sea (SGDIB)
ACME:07 Ref. E, F	Working Group on Introductions and Transfers of Marine Organisms (WGITMO)
ACME:08 Ref. E, F	ICES/IOC/IMO Study Group on Ballast and Other Ship Vectors (SGBOSV)
ACME:09 Ref. C, E, H	ICES/HELCOM Second Workshop on Quality Assurance of Chemical Analytical Procedures for the COMBINE and PLC-4 Programmes (WKQAC)

REFERENCE PAPERS: A:04, A:06, C:02, C:04, C:05, C:06, C:07, C:09, C:10, E:01, E:02, E:03, E:04, E:05, E:06, E:07, E:08, E:09, F:01, F:02, F:03

MINI-SYMPOSIUM ON DEFINING THE ROLE OF ICES IN SUPPORTING BIODIVERSITY (MINI)

Mini:01	Chris Frid and Leonie Robinson	Ecological reference points for North Sea benthos: can we manage benthic biodiversity?
Mini:02	Chris Frid, Stuart Rogers, Mike Nicholson, Jim Ellis, and Steve Freeman	Using biological characteristics to develop new indices of ecosystem health
Mini:03	Sarah Jones, Stephan Lutter, and Simon Cripps	Scientific advice for marine ecosystem management – an NGO perspective
Mini:04	Thomas Osborn and Richard T. Barber	Why are large, delicate, gelatinous organisms so successful in the ocean's interior?
Mini:05	Jake Rice	ICES and species at risk
Mini:06	Marie-Joëlle Rochet, Verena M. Trenkel, Jean-Charles Poulard, and Isabelle Péronnet	Using discards estimates for assessing the impact of fishing on biodiversity
Mini:07	Rob Stephenson and Ellen Kenchington	Conserving fish stock structure is a critical aspect of preserving biodiversity
Mini:08	Mark L. Tasker and Paul Knapman, David Donnan, Clare Eno, Barry Haynes and Bob Hastings	How ICES can help integrate biodiversity consideration into fisheries advice
Mini:09	Filip A.M. Volckaert, Edgar Daemen, Tom Cross, and Frans Ollevier	The genetic structure of European eel revisited and implications for its conservation
Mini:10	Anna Was and R. Wenne	Biodiversity at the population genetic level: microsatellite DNA poplymorphism in the sea trout population from southern Baltic
Mini:11	H.M. Winkler, K. Skora, R. Repecka, M. Pliks, E. Urtans, A. Gushin, and H. Jespersen	Checklist and state of Baltic Sea fish species
Mini:12 Poster	A.V. Dolgov	New data on composition and distribution of the Barents Sea ichthyofauna
Mini:13 Poster	Michele Gristina, G. Garofalo, G. Bono, and D. Levi	Effects of commercial trawl fishing in the Straits of Sicily on the diversity of demersal resources
Mini:14 Poster	Yves Samyn and Edward Vanden Berghe	Faunistics as the impetus for conservation of sea cucumbers (*Echinodermata: Holothuroidea*) in the littoral waters of Kenya
Mini:15 Poster	Edward Vanden Berghe and Yves Samyn	The use of databases for conservation of sea cucumbers (*Echinodermata: Holothuroidea*) in the littoral waters of Kenya

THEME SESSION ON EFFICIENCY, SELECTIVITY, AND IMPACTS OF PASSIVE FISHING GEARS (J)

J:01	Pascal Bach, L. Dagorn, and C. Misselis	The role of bait type on pelagic longline efficiency
J:02	Arne Bjørge, Nils Øien, Siri Hartvedt, and Trine Bekkby	Dispersal and by-catch mortality in grey, *Halichoerus grypus*, and harbour, *Phoca vitulina*, seals tagged at the Norwegian coast
J:03	H. Arnold Carr,	Methods for measuring the selectivity of static gear; A progress review of the manual
J:04	Daniel Erickson, Susan Goldhor and Radu Giurca	Efficiency and species selectivity of fabriacated baits used in Alaska demersal longline fisheries
J:05	Hallvard Godøy, Dag. M. Furevik and Svein Løkkeborg	Reduced bycatch of red king crab (*Paralithodes camtschatica*) in the cod gillnet fisheries in northern Norway. Fishing trials with norsel mounted gillnets
J:06	René Holst, David Wileman, and Niels Madsen	The effect of twine thickness in cod gill nets
J:07	René Holst and Rasmus J. Nielsen	A longitudinal study of the selectivity parameters estimated from experimental gillnet catch data for herring, *Clupea harengus*
J:08	Odd-Børre Humborstad and D.M. Furevik	Ghostfishing gillnets in Norwegian waters
J:09	I. Huse and A.V. Soldal	Mortality in pelagic longline fisheries for haddock
J:10	Svein Løkkeborg,	Review and evaluation of three mitigation measures – bird-scaring line, underwater setting and line shooter – to reduce seabird bycatch in the Norwegian longline fishery
J:11	F.M. Lucena, C.M. O'Brien, and E.G. Reis	The effect of fish morphology and behaviour on the efficiency of gill nets, their selectivity and by-catch: two examples from southern Brazil
J:12	Tönjes Mentjes and Kay Panten	Relative size and girth selectivity of cod gillnets in the Western Baltic
J:13	Henry O. Milliken, H.Arnold Carr, Holly McBride, and Marianne Farrington	Selectivity studies in the Northwest Atlantic longline fishery
J:14	E. Urtans, J. Priednieks	The present status of seabirds bycatch in Latvian coastal fishery of the Baltic Sea
J:15 Poster	Gerald Brothers	Testing square mesh panels in trap nets to reduce the catch of juvenile Atlantic Cod
J:16 Poster	Leili Järv, T. Drevs, and A. Järvik	Size-species selectivity of gillnets in the Estonian coastal zone: regulation efficiency

J:17 Poster	G.A. Petrakis, A. Chilari, and A. Terrats	Gillnet metier of blackspot seabream in the Ionian Sea
J:18 Poster	Ahto Järvik and Tiit Raid	On biological, technical and socio-economical aspects of Baltic herring pound net fishery in Estonia
J:19	Withdrawn	

THEME SESSION ON THE INCORPORATION OF EXTERNAL FACTORS IN MARINE RESOURCE SURVEYS (K)

K:01	Sara Adlerstein, and Siegfried Ehrich	Effect of deviation from vessel target speed over ground, trawl speed through water and time of day on catch rates of several fish species in North Sea surveys
K:02	D.J. Beare, D. Reid, and P. Petitgas	Spatio-temporal patterns in herring (*Clupea harengus* L.) school abundance and size in the NW North Sea: Modelling space time dependencies to allow examination of the impact of local school abundance on school size
K:03 Poster	D.J. Beare, D.G. Reid, P. Petitgas, P. Carrera S. Georgakarakos, J. Haralambous, M. Iglesias, B. Liorzou, J. Masse, and R. Muino	Spatio-temporal patterns in pelagic fish school abundance and size: a study of pelagic fish aggregation using acoustic surveys from Senegal to Shetland
K:04	D.J. Beare and D.G. Reid	Investigating the complexity of spatio-temporal patterns evidenced in the triennial mackerel and horse-mackerel egg survey data
K:05 Poster	Nicolas Bez and Jacques Rivoirard	Collocation indices to compare spatial distributions of populations
K:06	Withdrawn	
K:07 Poster	Patrice Brehmer, F. Gerlotto, and B. Samb	Measuring fish school avoidance during acoustic surveys
K:08	Withdrawn	
K:09	Liz Clarke and John Simmonds	Spatio-temporal models of North Sea herring
K:10 Poster	Janet Coetzee, Ole Arvid Misund, and David Boyer	Survey vessel avoidance reaction of Sardinella off Angola
K:11 Poster	T.R. Hammond and C.M. O'Brien	Persistence of acoustically observed fish biomass in a 220 km^2 survey region
K:12	Astrid Jarre, Liz Clarke and Bo Lundgren	Adult gadoids in the North Sea: A view from IBTS and generalised additive models
K:13	Astrid Jarre, Liz Clarke, and Bo Lundgren	Abundance of juvenile gadoids in the North Sea: Habitat descriptors derived from IBTS data using generalised additive models, and implications for stock assessment

K:14	Cecilie Kvamme, Leif Nøttestad, Anders Fernö, Ole A. Misund, Are Dommasnes, and Bjørn E. Axelsen	A sonar study of the migration pattern of Norwegian spring-spawning herring (*Clupea harengus* L.) in July
K:15	Oleg M. Lapshin, Y.V. Gerasimov, Y.G. Izumov, and I.G. Istomin	The influence of polymorphic characteristics on the Alaska Pollack (*Theragra chalcogramma*) fishing efficiency
K:16 Poster	R.B. Mitson	Fish avoidance: the vessel noise factor
K:17	Ramón Muiño and Pablo Carrera	Sardine (*Sardina pilchardus* Walbaum) characterisation off the Spanish Atlantic coast
K:18	C.M. O'Brien and J.C. Fox	Incorporating temporal information in ichtyoplankton surveys using a model-based approach: cod: (*Gadus morhua* L.) in the Irish Sea
K:19 Poster	C.M. O'Brien, S. Adlerstein, and S. Ehrich	Accounting for spatial-scale in research surveys: analyses of 2-year old cod from English, German and international groundfish surveys in the North Sea
K:20	R. Oeberst, P. Ernst, and C.C. Friess	Inter-calibrations between German demersal gears HG 20/25 and TV3 520 as well as between the gears TV3 520 and TV3 930
K:21	R. Oeberst	Proposal for the stratification of the Baltic Sea for the Baltic International Trawl Survey
K:22	Withdrawn	
K:23	Michael Pennington, Liza-Maré Burmeister, and Vidar Hjellvik	Assessing trawl-survey estimates of frequency distributions
K:24	Michael Pennington,	Survey-based stock assessments: Are they more reliable than catch-based assessments?
K:25	Pierre Petitgas	On the clustering of fish schools at two scales and their relation with meso-scale physical structures
K:26	G.A. Petrakis, D.N. MacLennan, and A.W. Newton	North Sea trawl surveys: Diel and depth effects on the catch rates
K:27	Gerjan Piet	Evaluation of the incorporation of external information using GAM on the catch-at-age index estimation for North Sea plaice and sole
K:28	D.G. Reid, J-C Mahe, P. Connolly, C.G. David, and A. Newton	Quantifying variability in gear performance on IBTS surveys: Swept area and volume with depth
K:29 Poster	D.G. Reid,	The relationship of herring school size and abundance with seabed characteristics in the NW North Sea
K:30	Jacques Rivoirard	Testing the effects of vessel, gear and daylight on catch data from the International Bottom Trawl Survey in the North Sea

K:31	Jacques Rivoirard and Kai Wieland	Correcting daylight effect in the estimation of fish abundance using kriging with external drift, with an application to juvenile haddock in North Sea
K:32 Poster	John Simmonds, Jacques Rivoirard, and Paul Fernandes	Vessel, gear and day/night effects in the estimation of herring abundance and distribution from the IBTS surveys in North Sea
K:33	David Somerton and Ken Weinberg	The effect of water speed on bottom contact and escapement under the footrope of a survey trawl
K:34	Boonchai K. Stensholt, Kathrine Michalsen, and Olav Rune Godø	Behavioural rhythm of cod during migration in the Barents Sea
K:35	Rune Vabø	The effects of removing behaviourally based biases from acoustic estimates of wintering NSS-herring
K:36	Marion Verdoit, and Dominique Pelletier	Characterizing the spatial and seasonal dynamics of the whiting population in the Celtic Sea from the analysis of commercial catch and effort data and scientific survey data
K:37 Poster	Charles W. West and John R. Wallace	Measurements of distance fished during the trawl retrieval period
K:38Poster	Pablo Carrera and Ramón Muiño	Evidence of a change in the aggregation pattern of coastal pelagic fish species in the Bay of Biscay after a period of high intensity rain
K:39 Poster	E.J. Simmonds, E. Toresen, E. Torstensen, C. Zimmermann, E. Götze, D.G. Reid, and A.S. Couperus	1999 ICES Coordinated Acoustic Survey of ICES Divisions IIIa, IVa, IVb and VIa (north)

THEME SESSION ON NORTH ATLANTIC PROCESSES (L)

L:01	Yu. Bochkov, E. Sentyabov, and A. Karsakov	The relation between long-term variations of water temperature in the North Atlantic and Nordic Seas
L:02	Eugene Colbourne	Interannual variation in the transport of the Labrador Current on the Newfoundland Shelf
L:03	Bogi Hansen, Steingrímur Jónsson, William R. Turrell, and Svein Østerhus	Seasonal variations in the Atlantic water inflow to the Nordic Seas
L:04	Pierre Jaccard, G. Reverdin, H. Svendsen, S. Østerhus, and T. Rossby	First results of upper ocean variability in the North Atlantic between the North Sea and Greenland from repeat ADCP and thermo-salinograph measurements onboard the container vessel 'Nuka Arctica'
L:05	Withdrawn	
L:06	E.M. Karasiova and A.S. Zezera	On influence of long-term variability of temperature regime in the Gdansk Deep of the Baltic Sea on the sprat reproduction and the offspring survival

L:07	Gerd Krahmann, Martin Visbeck, and Gilles Reverdin	Formation and propagation of temperature anomalies in the North Atlantic Current
L:08	S. K. Kydersky and A. S. Zezera	Multidecadal changes in the Baltic marine ecosystem under hydroclimatological forcing
L:09	Karin Margreta H. Larsen, Bogi Hansen, Regin Kristiansen, and Svein Østerhus	Internal tides in the waters surrounding the Faroe Plateau
L:10	Sven-Aage Malmberg, Hedinn Valdimarsson, and Steingrimus Jonsson	Fresh/polar water input in the East Icelandic Current
L:11	Sven-Aage Malmberg	Hydrographic conditions in the inflow of Atlantic water into North Icelandic waters in relation to NAO
L:12	John Mortensen	Repeated seasonal hydrographic observations in the northern Irminger Sea in 1997 to 1999
L:13	Withdrawn	
L:14	V.K. Ozhigin, A.G. Trofimov, and V.A. Ivshin	The Eastern Basin Water and currents in the Barents Sea
L:15	Gilles Reverdin, H. Valdimarsson, and P. Jaccard	Surface waters of the North Atlantic subpolar gyre in recent years
L:16	Tom Rossby, A. Bower, P. Richardson, M. Prater, H. Zhang, H. Hunt, and S. Fontana	Direct observations of warm water pathways in the northern North Atlantic
L:17	Igor M. Yashayaev	12-year hydrographic survey of the Newfoundland Basin: seasonal and interannual variability in water masses
L:18	Igor M. Yashayaev Allyn Clarke, and John Lazier	The recent decline of the Labrador Sea Water
L:19	Walter Zenk	Direct observations of the Iceland Basin cyclone at mid depths
L:20 Poster	Randi Invaldsen, Lars Asplin, and Harald Loeng	Transport of Atlantic water through the Barents Sea
L:21 Poster	H.-Ch. John, V. Mohrholz, and J.R.E. Lutjeharms	Cross-front structures in hydrography and fish larvae at the Angola-Benguela Frontal Zone
L:22 Poster	V. Mohrholz, M. Schmidt, J.R.E. Lutjeharms, and H.-Ch. John	Space-time behaviour of the Angola-Benguela Frontal Zone during the Benguela Niño of April 1999

THEME SESSION ON ENVIRONMENT – PLANKTON – FISH LINKAGES (M)

M:01	Cyril C. Ajuzie and Guy T. Houvenaghel	*Prorocentrum lima* (Microalgae: Dinoflagellata): killer food for zooplankton
M:02	Withdrawn	
M:03	L.J. Buckley, E.C. Caldarone, R.G. Lough, and T.L. Ong	Patterns in growth, ingestion and survival probability of Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*) larvae on Georges Bank
M:04	Ann Bucklin, O.S. Astthorson, Astthor Gislason, and Peter H. Wiebe	Calanus finmarchicus in Icelandic waters: population genetics and ecology at the Norwegian Sea/N. Atlantic Ocean boundary
M:05	Robin Clark and Chris L.J. Frid	Long term changes in the North Sea – A two model system?
M:06	Padmini Dalpadado, Bjarte Bogstad, Nina Borkner, H. Gjøsæter, Sigbjørn Mehl, and H.R. Skjoldal	Are the macrozooplankton populations in the Barents Sea controlled by predation?
M:07	K.F. Drinkwater, K.T. Frank, and B. Petrie	The effects of *Calanus* on the recruitment, survival and condition of cod and haddock on the Scotian Shelf
M:08	Are Edvarden, Dag Slagstad, Kurt S. Tande, and Pierre Jaccard	Measurements and modelling of ocean climate and zooplankton in the Barents Sea
M:09	Astthor Gislason and Olafur S. Astthorsson	On the food of herring in the western part of the Norwegian Sea
M:10	Erica Head	Internannual variations in hydrography and spring bloom dynamics, and their effect on *Calanus finmarchicus* distribution and reproduction on the Scotian Shelf in the late '90s and 2000
M:11	Withdrawn	
M:12	Ahmet E. Kideys	The role of plankton fluctuations in the production of pelagic fishes in a sensitive ecosystem
M:13	Kosei Komatsu, Y. Matsukawa, K. Nakata, T. Ichikawa, and K. Sasaki	Seasonal variation of plankton dynamics in the Kuroshio extension region based on a 3-D ecosystem model
M:14	A. M'harzi, S. De Galan, M. Tackx, M.H. Daro, and L. Goeyens	Plankton size distribution and predator-Prey relationship in the Belgian coastal zone
M:15	David Mountain, Joseph Kane, and John Green	Environmental forcing of variability in zooplankton abundance and cod recruitment on Georges Bank
M:16	Lutz Postel	Interannual variations of the amount of herring in relation to plankton biomass and activity, temperature and cloud coverage in the Baltic Sea

M:17	Jeffrey A. Runge, J. Quinland, E. Durbin, L. Incze, G. Lough, J. Manning, D. Mountain, B. Niehoff, S. Plourde, and F. Werner	The effect of spatial and temporal variations zooplankton concentrations on larval cod growth and survival on Georges Bank: a sensitivity analysis based on modeling and observations
M:18	Doug Sameoto	Decadal plankton changes on the eatern Nova Scotian Shelf and western North Atlantic
M:19	Kenneth Sherman, Jospeh Kane, Steven Murawski, William Overholtz, and Andrew Solow	Zooplankton as an ecological indicator in a fish stock recovery assessment
M:20	Dag Slagstad, Kurt Tande, Webjørn Melle, Bjørnar Ellertsen and François Carlotti	Regional dynamics of *Calanus* in the Norwegian Sea in response to ocean climate in 1997
M:21	John H. Steele	How to get more fish: ecosystem and environmental options
M:22	Withdrawn	
M:23	Kazuaki Tadokoro, Toshiro Saino, and Takashige Sugimoto	Geographical variation of Chl-a seasonality, and its interannual variation in the subarctic North Pacific Ocean
M:24	F.E. Werner, et al.	Modeling growth and advection of larval cod and haddock on Georges Bank in evolving flow and prey fields: a synthesis of observations and model results for Spring 1995
M:25 Poster	Gustavo L. Alvarez Colombo, A. Madirolas	Sound scattering from macrozooplankton aggregations off Patagonia at 38 kHz
M:26 Poster	Kerim Aydin, Patricia Livingston, and Robert C. Francis	Carrying capacity of apex predators and the frequency and cadence of physical forcing in marine foods webs
M:27 Poster	James J. Bisagni	The seasonal cycle of nitrate supply and potential new production in the Gulf of Maine and Georges Bank Regions
M:28 Poster	S. Chiba, T. Ishimaru, G.W. Hosie, and M. Fukuchi	Large scale interaction between sea ice dynamics and zooplankton community off east Antarctica
M:29 Poster	S.S. Drobysheva and V.N. Nesterova	Reasons of plankton biomass dynamics in the southern Barents Sea
M:30 Poster	D.S. Neto, B.B. Sangolay, C.A. Ruby, M.L. Silva, and H.S. Marques	Phytoplankton biomass across and along the Angola-Benguela frontal zone in April 1999

M:31 Poster	E. L. Orlova, A. V. Dolgov, V. N. Nesterova, M. Yu. Antsiferov, and L. L. Konstantinova	Pecularities of feeding behaviour in Arcto-Norwegian cod in the southern Barents Sea when major food objects are in deficiency
M:32 Poster	E. L. Orlova, E. I. Seliverstova, and V. N. Nesterova	Some features of distribution and feeding of the Atlantic herring (*Clupea harengus* L.) in the Barents Sea
M:33 Poster	E.V. Sentyabov and N.V. Plekhanova	Rapid variations of the Norwegian Sea water heat content during 1995–1999 and their influence on condition of the feeding plankton
M:34	Withdrawn	

THEME SESSION ON SPATIAL AND TEMPORAL PATTERNS IN RECRUITMENT PROCESSES (N)

N:01	G.A. Begg and G. Marteinsdottir	Incorporating spawning origins of pelagic juvenile cod and environmental variation in the stock-recruitment relationship
N:02	M. Bleil and R. Oeberst	Reproduction areas of the cod stock in the western Baltic Sea
N:03	Jesper Boje and E. Hjörleifsson	Nursery grounds for the West Nordic Greenland halibut stock - where are they?
N:04	Robert K. Cowen, C.B. Paris, Kamazima M.M. Lwiza, and D.B. Olson	Long distance dispersal versus local retention as a means of replenishing Carribean marine fish populations
N:05	Paul D. Eastwood and Geoff J. Meaden	Spatial modelling of spawning habitat suitability for the sole (*Solea solea* L.) in the eastern English Channel and southern North Sea
N:06	Martin D. Ehrlich, P. Marthos, and R.P. Sánchez	Causes of spawning pattern variability of anchovy and hake on the Patagonian shelf
N:07	V.N. Feldman and T.G. Vasilieva	Inter- and intra-annual variability in meso- and large-scale horizontal distribution, abundance and population structure of Baltic sprat
N:08	Øyvind Fiksen and Aril Slotte	Recruitment variability in Norwegian spring-spawning herring (*Clupea harengus* L.): the effect of temperature in larval drift trajectories
N:09	Tomas Gröhsler, Uwe Böttcher,and Eberhard Götze	Horizontal and vertical distribution of sprat in the Southern Baltic Sea during spawning time. First results on the 1999 German June acoustic survey
N:10	Allain Gwenhael, P. Petitgas, P. Lazure, and P. Grellier	Coupling the otolith growth history of anchovy larvae with the physical history of water masses tracked in a hydrodynamic model
N:11	Mike Heath and Alejandro Gallego	Modelling the spatial and temporal structure of survivorship to settlement in North Sea and west of Scotland haddock

N:12	S. Hinckley, A.J. Hermann, and B.A. Megrey	An evaluation of the utility of spatially-explicit biophysical models in recruitment studies: the FOCI example
N:13	Sukgeun Jung and Edward D. Houde	Scale and pattern in recruitment processes of bay anchovy in Chesapeake Bay
N:14	Ryo Kimura, D.H. Secor, E.D. Houde, and P.M. Piccoli	Migration/dispersal patterns of YOY bay anchovy *Anchoa mitchilli* in the Chesapeake Bay: Sr:Ca analysis on a ubiquitous species
N:15	Birgitt Klenz	Abundance and distribution of larvae of commercially important fish species in the western Baltic Sea during the period 1993–1998
N:16	F.W. Köster, H.-H. Hinrichsen, D. Schnack, M.A. St. John, B.R. MacKenzie, J. Tomkiewicz, C. Möllmann, M. Plikshs, and A. Makachouk	Recruitment of Baltic cod and sprat stocks: Identification of critical life stages and incorporation of environmental variability and spatial heterogeneity into stock-recruitment relationships
N:17	Jesús García Lafuente, Alberto García, Salvatore Mazzola, Luis Quintanilla, Javier Delgado, Angela Cuttita, and Bernardino Patti	Influence of the surface circulation on the spawning strategy of the Sicilian Channel anchovy
N:18	R.G. Lough, C.G. Hannah, P. Verrien, D. Brickman, J.W. Loder, and J.A. Quinlan	Oceanic factors in cod and haddock egg and larval distributions on Georges Bank (1977-87) and processes which may govern interannual variability in recruitment
N:19	S. Mahévas, P. Petitgas, and P. Lazure	Stochastic (Markov) modelling along trajectories in a hydrodynamic model of series of events of potential interest for requitment
N:20	Andrei Makarchouk and Galina Grauman	The temporal and spatial changes in the observed size of cod eggs in the Eastern Baltic
N:21	Piotr Margoński	The abundance, growth rate and mortality of the early life stages of herring (*Clupea harengus*) and smelt (*Osmerus eperlanus*) in the Vistula Lagoon (southern Baltic Sea) during 1998–1999
N:22	Peter Munk	Spatial patterns in growth rate variability of Arctic cod in Disko Bay, West Greenland
N:23	E.W. North and E.D. Houde	Times, space, physics and food: the temporal and spatial distribution of anadromous fish larvae in an Estuarine Turbidity Maximum (ETM)
N:24	Pierre Pepin, John F. Dower, and Fraser Davidson	A dynamic spatiallyexplicit analysis of growth and mortality in larval radiated shanny (*Ulavria subbifurcata*)

N:25	J.A. Quinlan, R.G. Lough, W. Michaels, M. Fogarty, L.J. Buckley, J.P. Manning, E. Durbin, J.A. Runge, and F.E. Werner	Examining the potential effects of vertebrate predation on Georges Bank larval cod: A modeling study for the 1995 field season
N:26	Marie-Joelle Rochet	Spatial and temporal patterns in age and size at maturity and spawning stock biomass of North Sea gadoids
N:27	M.A. St. John, H. Mosegaard, H.-H. Hinrichsen, P. Grønkjær, F. Köster, K. Hüssy, and R. Neilsen	Baltic Cod: Resolving processes determining spatial and temporal windows of survival
N:28	Christoph Stransky	Migration of juvenile deep-sea redfish (*Sebastes mentella* Travin) from the East Greenland shelf into the central Irminger Sea
N:29	Konrad Thorisson and Thor H. Asgeirsson	Cod larval atches in Icelandic waters in 1998
N:30	Hiroshi Kubota, Yoshioki Oozeki, and Ryo Kimura	Distributions of larvae and juveniles of small pelagic fishes in the northwest Pacific off east Japan
N:31	T. Thangstad, Jan Helge Fosså, Anders Fernö, and Arne Johannessen	Factors affecting the distribution of wrasses (*Pisces: Labridae*) in a fjord system: analysis by generalised linear models
N:32	Michala Aschan, Bjørn Ådlansvik, and Sigurd Tjelmeland	Spatial and temporal patterns in recruitment of shrimp Pandalus borealis in the Barents Sea

THEME SESSION ON SUSTAINABLE AQUACULTURE DEVELOPMENT (O)

O:01	Ian M. Davies	Waste production in salmon farming
O:02	Daan Delbare and Rudy de Clerck	Release of reared turbot in Belgian coastal waters as a tool for stock enhancement
O:03	Inge Døskeland and Pia Kupka Hansen	Geographic infromations systems (GIS) are tools for better integrated coastal zone planning and management (ICZP/M)
O:04	Arne Ervik	Monitoring programmes - a vital part of mariculture regulation
O:05	Svein-Erik Fevolden and Knut H. Røed	Prospects for selective breeding for stress tolerance in aquacultured fish
O:06	N. Koueta, A. Le Calvé, B. Noel, and E. Boucaud-Camou	Changes of digestive enzymes during growth of cultured juvenile cuttlefish Sepia officinalis L (Mollusca Cephalopoda). Effect of a enriched diet and ration

O:07 Poster	Lasse H. Pettersson, Dominique Durand, Thomas T. Noji, Henrik Søiland, Einar Svendsen, Steve Groom, Samantha Lavender, Peter Regner, and Ola M. Johannessen	Satellite observations and forecasting can mitigate effects of toxic algae blooms
O:08 Poster	Emilia Vázquez, C. Fernández, C. Martínez, G. Blanco, and JA Sanchez	Some growth data of cold shock triploids in turbot (*Scophthalmus maximus* L.)

THEME SESSION ON NEW TRENDS IN FISH FEEDING IN AQUACULTURE (P)

P:01	P. Coutteau, S. Ceulemans, R. Robles, A. Oliva-Teles, S. Chatzifotis, A. Van Halteren, and P. Verstraete	Fish meal/fish oil replacement in practical diets for European seabass Dicentrarchus labrax and Gilthead seabream *Sparus aurata*
P:02	Gro-Ingunn Hemre and Kjartan Sandnes	By-catch and offal feed from the herring industry - performance of Atlantic salmon as concerns growth, feed utilisation and fillét quality
P:03	Anne-Katrine Lundeby, Bjarne Bøe, and Kåre Julshamn	Documenting seafood safety: contaminant concentrations in Norwegian fish feeds and mariculture products
P:04	Clive Talbot and Antonio García-Gómez	The role of technology transfer in the development of new fish species for aquaculture
P:05 Poster	Peter Coutteau, L. Tort, J. Rotllant, and S. Ceulemans	Screening of immunostimulants for the gilthead seabrean *Sparus aurata*

THEME SESSION ON TROPHIC DYNAMICS OF TOP PREDATORS: FORAGING STRATEGIES AND REQUIREMENTS, AND CONSUMPTION MODELS (Q)

Q:01	Arne Bjørge, Trine Bekkby, Vegar Bakkestuen, and Erik Framstad	Harbour seal *Phoca vitulina* habitat use and interaction with fisheries as explored by a combined GIS and population energetics model
Q:02	A.V. Dolgov	Feeding and food consumption by the Barents Sea predatory fishes in the 1980-90s
Q:03	Robert W. Furness	Impacts of fisheries on seabird community stability
Q:04	Stefan Garthe and William A. Montevecchi	Foraging strategies of seabirds: the northern Gannet (*Sula bassana*) as a model

Q:05	Viktor Lapko, Kerim Aydin, Vladimir Radchenko, and Patricia Livingston	A comparison of the Eastern and Western Bering Seas as seen through predation-based food web modeling
Q:06	Withdrawn	
Q:07	Ulf Lindstrøm, Alf Harbitz, Tore Haug, and Torstein Pedersen	Foraging behaviour of minke whales (*Balaenoptera acutorostrata*) in the southern Barents Sea
Q:08	W.A. Montevecchi and G.K. Davoren	Prey selectivity, capelin and inter-annual variation in the diets of common murre chicks in the Northwest Atlantic
Q:09	D. Righton, K. Turner, and J.D. Metcalfe	Behavioural switching in North Sea cod: implications for foraging strategy?
Q:10	D.J. Uzars, T. Baranova, and E. Yula	Variation in environmental conditions, feeding and growth of cod in the Eastern Baltic
Q:11	F. Velasco and I. Olaso	Hake food consumption in the southern Bay of Biscay estimated from a gastric evacuation model
Q:12	F. Velasco, J. Riis-Vestergaard, L. Hill, and I. Olaso	Food consumption of European hake (*Merluccius merluccius*) estimated by the application of two bioenergetic models: Is the growth of hake underestimated?
Q:13 Poster	L. Hill and M.F. Borges	A comparison of the seasonal abundance of hake (*Merluccius merluccius*) and its main prey species off the Portuguese coast
Q:14 Poster	Tsutomu Tamura and Y. Fujise	Geographical and seasonal changes of prey species and prey consumption in the western North Pacific minke whales
Q:15 Poster	V.N. Feldman, F.A. Patokine, and N.A. Kalinina	Diet composition, feeding rhythms and daily rations of the Baltic herring in the Gdansk Basin
Q:16 Poster	Kumbi Kilongo	Geographical distribution versus feeding habits of large-eye dentex (*Dentex macrophathalmus*) off Namibia and Angola
Q:17	Withdrawn	

THEME SESSION ON THE APPLICATION OF EXPERIMENTAL LABORATORY STUDIES TO FISHERIES SCIENCE (R)

R:01	Jean-Denis Dutil, Y. Lambert, and D. Chabot	Estimating natural mortality of wild cod from controlled feeding and starvation experiments conducted in the laboratory
R:02	Øyvind Fiksen, Erling Otterlei, and Arild Folkvord	Experiments and models as reciprocal tools to understand environmental links in recruitment dynamics
R:03	Withdrawn	
R:04	Hans Høie, Arild Folkvord, and Arne Johannessen	A multivariate analysis of condition of herring larvae from different environmental regimes

R:05	Anders Nissling. Lars Westin, and Olle Hjerne	Spawning success in relation to salinity of three flatfish species, Dab (*Pleuronectes limanda*), plaice (*Pleuronectes platessa*) and flounder (*Pleurone flesus*), in the brackish water Baltic Sea.
R:06	Withdrawn	
R:07	Tone Rasmussen, Michala Aschan, and Jørgen Schou Christiansen	The implementation of laboratory studies to shrimp recruitment modelling - a brief review of experimental procedures
R:08	Terje Svåsand, A.M. Ajiad, G.R. Carvalho, C. Clemmesen, G. Dahle, L. Hauser, W.F. Hutchinson, T. Jakobsen, O.S. Kjesbu, E. Moksness, H. Otteraa, H. Paulsen, D. Schnack, P. Solemdal, and A. Thorsen	Demonstration of maternal effects of Atlantic cod: Combining the use of unique mesocosm and novel molecular techniques - A new EU-project
R:09	P.R. Witthames, T.E. Andersen, and O.S. Kjesbu	The application of tank experiments to the study of reproductive potential in teleosts using *Gadus morhua* as a test model
R:10 Poster	Ana Moreira, Pedro Bordalo Machado, and Ivone Figueiredo	The use of known ageing techniques to enhance growth bands on the second dorsal spine of the gulper shark (*Centrophorus granulosus* Schneider, 1801) and the portuguese dogfish (*Centroscymnus coelolepis* Bocage & Capello, 1864)
R:11 Poster	Lars Vallin and Anders Nissling	Maternal effects on egg size and egg buoyancy of Baltic cod, *Gadus morhua*. Implications for stock structure effects on recruitment
R:12	Nils Chr. Stenseth, Jakob Gjøsæter, Kyrre Lekve, and Arnoldo Frigessi	Modeling the population dynamics of cod along the Norwegian Skagerrak coast: what we need to understand better before we have reliable population model

THEME SESSION ON TEMPORAL AND SPATIAL TRENDS IN THE DISTRIBUTION OF CONTAMINANTS AND THEIR BIOLOGICAL EFFECTS IN THE ICES AREA (S)

S:01	H. von Westernhagen, V. Dethlefsen and M. Haarich	Temporal trends in malformations of pelagic fish embryos from the southern North Sea in relation to anthropogenic xenobiotics
S:02	Stuart Fleming, R.W. Furness, and Ian M. Davies	Contemporary patterns and historical rates of increase of mercury contamination in different marine food chains
S:03	Ketil Hylland, Birger Bjerkeng, and Norman Green	Is there a relationship between accumulated contaminants and biomarker responses in Atlantic cod, *Gadus morhua*?
S:04	Ketil Hylland	Strategies to investigate links between community response and individual response to environmental contaminants

S:05	Ketil Hylland	Biological effect of contaminants in pelagic marine ecosystems - a practical workshop
S:06	Mark F. Kirby, Mark Hurst, Carole A. Kelly, Sonia J. Kirby, Paula Neall, Tina A. Tylor, Steven Morris, and Peter Matthiessen	EROD and ChE measurements in flounder (*Platichthys flesus*) as monitoring tools in English estuaries
S:07	Hans J.C. Klamer, Willem M.G.M. van Loon, L.A. Villerius, A.E. van de Zande, and J.F. Bakker	QID: an innovative instrument for identification and verification of environmental toxicity
S:08	Peter Matthiessen, Yvonne Allen, John Bignell, John Craft, Steve Feist, Gary Jones, Ioanna Katsiadaki, Mark Kirby, Fiona Robertson, Sandy Scott, Christie Stewart, and John Thain	Studies of endocrine disruption in marine fish – progress with the EDMAR programme
S:09	Rolf Schneider, Doris Schiedek, and Gitte I. Petersen	Baltic cod reproductive impairment: ovarian organochlorine levels, hepatic EROD activity, developmetn success of eggs and larvae, challenge tests
S:10	J. Thain, Y. Allen, S. Kirby, and J. Reed	The use of Sediment Bioassays In Monitoring And Surveillance Programs In The UK. A preliminary assessment.
S:11	Kevin V. Thomas, Mark R. Hurst, Jacqueline Lavender, Peter Matthiessen, John E. Thain, and Mike J. Waldock	Characterising hazardous substances in the UK marine environment
S:12	W. Wosniok, T. Lang, V. Dethlefsen, S.W. Feist, A.H. McVicar, S. Mellergaard, and A.D. Vethaak	Analysis of ICES long-term data on diseases of North Sea dab (*Limanda limanda*) in relation to contaminants and other environmental factors
S:13 Poster	A.D. McIntosh, L. Webster and D. Richardson	Temporal trend observations in fish and sediments in the Clyde estuary
S:14 Poster	A.D. McIntosh, L. Webster and B. Gowland	Biomarkers and PAH concentrations of the common mussel, *Mytilus edulis*, in an industrially polluted sea loch
S:15 Poster	A.D. McIntosh, L. Webster, and D. Richardson	PAH concentrations and bile metabolite measurements in plaice and flounder from the Firth of Forth

THEME SESSION ON CLASSIFICATION AND MAPPING OF MARINE HABITATS (T)

T:01	Rebecca J. Allee	A proposed ecosystem and habitat classification system for United states marine and estuarine waters
T:02	C.J. Brown, K.M. Cooper, W.J. Meadows, D.S. Limpenny, and H.L. Rees	An assessment of two acoustic survey techniques as a means of mapping seabed assemblages in the Eastern English Channel
T:03	David W. Connor	The BioMar marine habitat classification - its application in mapping, sensitivity and management
T:04	Cynthia E. Davies and Dorian Moss	The EUNIS habitat classification
T:05	D.J. de Jong	Ecotopes in the Dutch marine tidal waters
T:06	S. Degraer, V. van Lancker, G. Moerkerke, M. Vincx, P. Jacobs, and J.P. Henriet	Intensive evaluation of the evolution of a protected benthic habitat: HABITAT
T:07	D.C. Gordon, E.L.R. Kenchington, K.D. Gilkinson, D.L. McKeown, G. Steeves, M. Chin-Yee, W.P. Vass, K. Bentham, and P.R. Boudreau	Canadian imaging and sampling technology for studying marine benthic habitat and biological communities
T:08	H. Gary Greene, M.M Yoklavich, V.M. O'Connell, R.M. Starr, W.W. Wakefield, C.K. Brylinsky, J.J. Bizzarro and G.M. Cailliet	Mapping and classification of deep seafloor habitats
T:09	Eric Jagtman	Marine habitat classification and mapping within ICES: where to go from here?
T:10	A.J. Kenny *et al.*	An overview of seabed mapping technologies in the context marine habitat classification
T:11	Alexander Korolev and Marina Fetter	The mapping of benthic biocenoses in the coastal zone of Latvia
T:12	Ron McHugh	The potential of synthetic aperture sonar in seafloor imaging
T:13	Thomas Noji, Terje Thorsnes, and Jan Helge Fosså	Marine habitat mapping for the Norwegian Sea

T:14	Daniel Pauly, Villy Christensen, Rainer Froese, Alan Longhurst, Trevor Platt, Shubha Sathyendranath, Kenneth Sherman, and Reg Watson	Mapping fisheries onto marine ecosystems: a proposal for a consensus approach for regional, oceanic and global integrations
T:15	Maria Joào Rendas and Jon Side	Using autonomous underwater vehicles for seabed habitat mapping
T:16	Brian J. Todd, Vladimir E. Kostylev, Gordon B.J. Fader, Robert C. Courtney, and Riachard A. Pickrill	New approaches to benthic habitat mapping integrating multibeam bathymetry and backscatter, surficial geology and sea floor photographs: a case study from the Scotian Shelf, Atlantic Canada

THEME SESSION ON MARINE BIOLOGICAL INVASIONS: RETROSPECTIVES FOR THE 20TH CENTURY – PROSPECTIVES FOR THE 21ST CENTURY (U)

U:01	Allegra A. Cangelosi and Ivor T. Knight	Comparing the bioeffectiveness of ballast water treatments
U:02	Withdrawn	
U:03	Clare Eno and John P. Hamer	The nature conservation implications of marine biological introductions
U:04	Karel Essink and Rob Dekker	Invasion ecology of *Marenzelleria c.f. wireni* (Polychaeta; Spionidae) in the Dutch Wadden Sea
U:05	Elena Ezhova and L.V. Rudinskaya	Ecological impact of Marenzelleria viridis (Polychaeta, Spionidae) in the Vistula lagoon, Baltic Sea
U:06	Oliver Floerli and Graeme J. Inglis	Marine bioinvasions: quantifying the potential of a transfer vector by analysing its relationship with the donor region
U:07	A. Gudimov nad Elena Gudimova	Towards biological consequences of the inroduction of red king crab Paralithodes camtchatica in the Barents Sea
U:08	Chad L. Hewitt	Marine biological invasions in Australian coastal waters: Current status and future trends
U:09	Withdrawn	
U:10	Ahmet E. Kideys, Zina Romanova, Galina A. Finenko, and Levent Bat	Alien wars in the Black Sea
U:11	V.V. Krylov	An optimum annual catch of snow crab *Chionoecetes opilio*
U:12	Daniel Masson	Ballast water research in France: current status
U:13	Dan Minchin	A conceptual approach for management of exotic species; modes of life, time-tunnels and exotic species cells

U:14	E.N. Naumenko and Yu. Yu Polunina	New Cladocera species – *Cercopagis pengoi* (Ostroumov, 1891) (Crustacea) in the Vistula Lagoon on the Baltic Sea
U:15	Henn Ojaveer, S. Gollasch, S. Olenin, V. Panov, and E. Leppäoski	Distribution and ecosystem impacts of exotic speces in the Baltic Sea
U:16	Henn Ojaveer, M. Simm, and A. Lankov	Consequences of invasion of a predatory cladoceran
U:17	Giulio Relini, M. Relini, and G. Torchia	Fish population changes following to invasion of the allochthonous alga *Caulerpa taxifolia* in the Ligurian Sea (NW-Mediterranean)
U:18	Sigal Sheffer, Eli Geffen and Avigdor Abelson	The invasion of Red-Sea species to the Mediterranean Sea: defining invasion mechanisms by assessment of transport modes and routes
U:19	Susan D. Utting	Introductions of molluscan shellfish – past experience and future considerations
U:20	Gro I van der Meeren, Kees O. Ekeli, Knut E. Jørstad, and Stein Tveite	Americans on the wrong side - the lobster *Homarus americanus* captured in Norwegian waters
U:21 Poster	S. Kuzmin	Distribution of snow crab *Chionoecetes opilito* (Fabricius) in the Barents Sea
U:22 Poster	Inger Wallentinus,	Introduced macrophytes - do they have as large an impact on the ecosystem and fisheries as animals?

THEME SESSION ON MEDIUM-TERM FORECASTS IN DECISION-MAKING (V)

V:01	Bjarte Bogstad, Ingolf Røttingen, Per Sandberg, and Sigurd Tjelmeland	The use of Medium-Term Forecasts in advice and management decisions for the stock of Norwegian spring spawning herring (*Clupea harengus* L.)
V:02	Tenno Drevs	On the flounder yield and spawning stock medium-term forecasts in Estonian waters
V:03	Stratis Gavaris, K.R. Patterson, C.D. Darby, P. Lewy, B. Mesnil, A.E. Punt, R.M. Cook, L.T. Kell, C.M. O'Brien, V.R. Restrepo, D.W. Skagen, and G. Stéfansson	Comparison of uncertainty estimates in the short term using real data
V:04	Johannes Hamre	Effects of climate and stocks interactions on the yield of north-east arctic cod. Results from multispecies model run
V:05	C.L. Needle, C.M. O'Brien and C.D. Darby, and M.T. Smith	The use of recruitment time-series structure and environmental information in medium-term stock projections

V:06	K.R. Patterson, C.D. Darby, D.W. Skagen, and M. Smith	Validating three methods for making probability statements in fisheries forecasts
V:07	H.-J. Rätz, J. Lloret, J. Casey, A. Aglen, S.A. Schopka, L.O'Brien, and P. Steingrund	Variation in fish condition between Atlantic cod (*Gadus morhua*) stocks and implications for their management
V:08	Victor Restrepo, K.R. Patterson, C.D. Darby, S. Gavaris, L.T. Kell, P. Lewy, B. Mesnil, A.E. Punt, R.M. Cook, C.M. O'Brien, D.W. Skagen, and G. Stéfansson	Do different methods provide accurate probability statement in the short term?
V:09	V.L. Tretyak	Modelling of age-dependent instantanous coefficients of natural mortality for Northeast Arctic cod
V:10	D.A. Vasilyev	Triple-separable VPA (TSVPA) or a stone to bridge the gap between separable cohort models and nonseparable ones
V:11	D.A. Vasilyev, S.V. Belikov, and A.I. Krysov	Blue whiting: results of stock assessment using filtered catch-at-age-data
V:12 Poster	M.A. Pérez, A. Aubone, M. Renzi, A. Madirolas, M. Ehrlich, G. Irusta, and M. Simonazzi	Overfishing indications in the hake (*Merluccius hubbsi*) stock south of 41 S. southwest Atlantic Ocean

THEME SESSION ON COOPERATIVE RESEARCH WITH THE FISHING INDUSTRY: LESSONS LEARNED (W)

W:01	James A. Boutillier	Getting to yes with stakeholders in fisheries resource assessment - a paradigm shift
W:02	Ross Claytor, Jacques Allard, Allen Clay, Claude LeBlanc, and Ghislain Chouinard	Fishery acoustic indices for assessing Atlantic herring populations
W:03	Pablo Durán Muñoz and Esther Román Marcote	Spanish experimental fishings: A cooperative research initiative between scientifics and the local fishing industry
W:04	Pablo Durán Muñoz, Esther Román Marcote, and Fernando González	Results of a deep-water experimental fishing in the North Atlantic: An example of cooperative research with the fishing industry
W:05	R.S.T. Ferro and G.N. Graham	A recent UK joint initiative to revise technical conservation measures regulating the design of mobile gears
W:06	K.H. Hauge	Fisheries scientists' struggle for objectivity

W:07	William A. Karp, Craig S. Rose, John R. Gauvin and Sarah K. Gaichas, Martin W. Dorn, and Gary D. Stauffer	Government-industry cooperative research in the Northeast Pacific. Provisions under the Magnuson-Stevens Fishery Conservation and Management Act and examples from the Gulf of Alaska and the Eastern Bering Sea
W:08	Peter A. Koeller	Co-managing the Scotian Shelf Shrimp Fishery – so far so green
W:09	Richard McGarvey and Michael Pennington	Designing and evaluating length-frequency surveys for trap fisheries
W:10	J. Ferreira Dias, J. Cruz Filipe, J. Menezes, and J. Gonçalves Dias	Economics impact of sardine scarcity on the Portuguese canned fish industry: a system dynamics study
W:11	Richard D. Methot, John R. Wallace, and Charles W. West	Introducing a new trawl survey for US West Coast slope groundfish
W:12	Martin.A. Pastoors, J.J. Poos and A.D. Rijnsdorp	On the use of skipper's logbook data in the interpretation of trends in fisheries
W:13	Paul J. Rago, Steve Murawski, Kevin Stokesbury, William DuPaul, and Michael McSherry	Integrated management of the Sea Scallop Fishery in the Northeast USA: Research and commercial vessel surveys, observers, and vessel monitoring systems
W:14	A. Salthaug and O.R. Godø	Analysis of CPUE from the Norwegian bottom trawl fleet
W:15	Daniel F. Schick and Michael Brown	Cooperative government/industry efforts in gear development and gear acceptance in the State of Maine Silver hake fishery
W:16	Aril Slotte,	Use of data from the commercial fishing industry in the management of Norwegian spring spawning herring (*Clupea harengus* L.)
W:17	Rob Stephenson, Gary Melvin, Mike Power, Jack Fife, dan Lane, and Don Aldous	Cooperative research with the Scotia-Fundy herring fishing industry: Lessons learned
W:18	Withdrawn	
W:19	Withdrawn	
W:20	K.C.T. Zwanenburg and S. Wilson	The Scotian Shelf and Southern Grand Banks Atlantic halibut (*Hippoglossus hippoglossus*) survey - Collaboration between the fishing and fisheries science organisation
W:21	Philip MacMullen	The unintended impacts of gill netting in European waters - quanitfying and mitigating the ghost fishin phenomenon

THEME SESSION ON THE DEVELOPMENT OF REFERENCE POINTS AND MANAGEMENT SYSTEMS FOR FISHERIES AND THE MARINE ECOSYSTEM (X)

X:01	Sue Brown	The precautionary approach: a User's View
X:02	R.M. Cook	Complementing the ICES advisory process with stakeholders input
X:03	Barrie Deas	Fisherman and scientists: Collaboration as the basis for stock recovery
X:04	François Gauthiez	Multi-annual strategies: improving stock management and the dialogue between scientists and managers
X:05	Joe Horwood	Regime shifts and fisheries management
X:06	Martin.A. Pastoors, Peter Bailey, and Kjellrun Hiis-Hauge	Analysis of communication over and understanding of the 'precautionary approach'
X:07	Laura J. Richards	Developing a wild salmon policy for Pacific Canada
X:08	Ingolf Røttingen	A review of the process leading to the establishment of limit and precautionary reference points for the stock of Norwegian spring spawning herring
X:09	Sigurdur Tor Jónsson and Einar Hjörleifsson	Stock assessment bias and variation, analyzed retrospectively from ICES quality control sheets, and introducing the PA-residual

THEME SESSION ON DOWNTURN IN NORTH ATLANTIC SALMON ABUNDANCE (Y)

Y:01	Kerim Aydin	ENSO- and regime-scale variation in the biogeography of Gulf of Alaska micronekton as a driving mechanism for observed growth trends in Pacific salmon
Y:02	Withdrawn	
Y:03	Arni Isaksson	Status of Iceland salmon stocks
Y:04	A.F. Youngston, R.J. Fryer, and J.C. MacLean	Rod catches as indicators of abundance in the Scottish salmon fisheries
Y:05 Poster	Gloria Blanco Lizana, Y. Borrell, E. Vázquez, and J.A. Sánchez	Microsatellite variation and estimation of genetic relatness in Atlantic salmon
Y:06 Poster	José Sánchez, M.D. Ramos, H. Pineda, Y. Borrel, E. Vázquez, and G. Blanco	The application of genetic variation at microsatellite loci in Atlantic salmon (*Salmo salar* L.) stock identification
Y:07	N O'Maoiléidigh	Summary of ICES Working Group on North Atlantic Salmon
Y:08	Malcolm Windsor and Peter Hutchinson	Recent development in salmon conservation through international cooperation in NASCO

THEME SESSION ON GENERAL FISHERIES AND MARINE ECOLOGY (Z)

Z:01	Alexander Arkhipkin and David Middleton	Squid interspecific competition: possible impact of *Illex argentinus* onto *Loligo gahi* recruitment in the Southwest Atlantic
Z:02	Dariusz P Fey	Temperature and growth rate effect on the otolith size - fish size relationship estimated for Baltic herring from the Vistula Lagoon
Z:03	Kristin Helle, Bjarte Bogstad, Geir Ottersen, and Michael Pennington	Some environmental factors that influence the growth of Arcto-Norwegian cod from the early juvenile to the adult stage
Z:04	Withdrawn	
Z:05	Iwona Psuty-Lipska	Eelpout as an index of changes in the fish community of Gdansk Bay in 1985-1999
Z:06	Yu.I. Bakay	Parasites and pigmented patches as indicators of intraspecific structure of *Sebastes mentella* in the Irminger Sea
Z:07	Philip Percival and Chris Frid	The impact of fishing disturbance on benthic nutrient regeneration and flux rate
Z:08	Withdrawn	
Z:09 Poster	Paulino Lucio, M. Santurtun, and I. Quincoces	Tagging experiments on hake, anglerfish and other species in the Bay of Biscay
Z:10 Poster	Paulino Lucio, M. Santurun, A. Martínez Murgía, and I Quincoces	Experiments on horse mackerel in captivity. (An experiment of survival of this species tagged with external and internal tags).
Z:11 Poster	Hilario Murua, M. Santurtun, I Quincoces, and Paulino Lucio	Oocyte diameter evaolution along the year and batch fecundity of hake in the Bay of Biscay (ICES Divisions VIIIa, b, d)
Z:12 Poster	Anna Terrats, Kostas I. Stergiou, and G. Petrakis	Histological study of the gonadal development of armed gurnard, *Peristedion cataprhactum* (L. 1758)
Z:13 Poster	Lies Van Nieuwerburgh, Ingrid Wänstrand, and Pauli Snoeijs	Pigment transfer from phytoplankton to copepods in nutrient-enriched mesocosms

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FISHERIES TECHNOLOGY COMMITTEE (B)

Agenda

1. **Opening**

2. **Appointment of Rapporteur**

3. **Adoption of Agenda**

4. **Arrangements for the meeting in Bruges**

5. **Committee Business**

   Reports of the Working Groups

   Working Group on Fishing Technology and Fish Behaviour
   Working Group on Fisheries Acoustic Science and Technology
   Report of the Joint Session of WGFAST and WGFTFB
   Report of the Study Group on Methods for Measuring the Selectivity of Static Gears
   Report of the Study Group on Mesh Measurement Methodology

6. **Consultative Committee Matters**

7. **Upcoming Symposia and Conference topics**

8. **Publications**

9. **Census of Marine Life**

10. **Recommendations**

11. **Any Other Business**

12. **Closing of the Meeting**

FISHERIES TECHNOLOGY COMMITTEE (B)

Order of the Day

Monday 25 September 2000, 09.30–13.30 (Erasmus Room)

		Time
1.	**Opening**	09.30
2.	**Appointment of Rapporteur**	09.40
3.	**Adoption of Agenda**	09.45
4.	**Arrangements for the meeting in Bruges**	09.50
5.	**Committee Business**	10.00
	Reports of the Working Groups	
	Working Group on Fishing Technology and Fish Behaviour	10.00
	Coffee break	10.30
	Working Group on Fishing Technology and Fish Behaviour (cont.)	11.00
	Working Group on Fisheries Acoustic Science and Technology	11.30
	Report of the Joint Session of WGFAST and WGFTFB	12.30
	Report of the Study Group on Methods for Measuring the Selectivity of Static Gears	12.50
	Report of the Study Group on Mesh Measurement Methodology	13.10

FISHERIES TECHNOLOGY COMMITTEE (B)

Order of the Day

Friday 29 September 13.30–18.00 (Ambassadeur Room)

		Time
5.	**Committee Business**	
	WGFTFB & WGFAST, Seattle, April, 2001	13.30
	WGFTFB Chairman	13.45
6.	**Consultative Committee Matters**	
	ICES Strategic Plan	14.15
	FTC Workplan	14.30
7.	**Upcoming Symposia and Conference topics**	
	Theme Session topics for ICES ASC in Oslo, 2001	15.00
	Acoustic Symposium 2002	15.15
	Coffee Break	15.30
8.	**Publications**	
	Echo Trace Classification Cooperative Research Report	16.00
9.	**Census of Marine Life**	16.30
10.	**Recommendations**	
	Working Groups	17.00
11.	**Any Other Business**	17.30
12.	**Closure of the Meeting**	18.00

OCEANOGRAPHY COMMITTEE (C)

Agenda

1. Opening

1.1 Appointment of Rapporteur

1.2 Adoption of Agenda

1.3 Practical arrangements

2. Committee Matters

2.1 Matters referred by the Consultative Committee

2.1 Matters referred by the ACME

2.3 ICES Five-year Strategic Plan

3. Reports from the Working Groups, including Draft Resolutions and reviews thereof

3.1 Report on WGSSO (C:05)

3.2 Report on WGPE (C:10)

3.3 Report on SGPHYT (C:13)

3.4 Report on WGHABD (C:06)

3.5 Report on WGMDM (C:08)

3.6 Report on WGOH (C:07)

3.7 Report on WGSE (C:04)

3.8 Report on WGZE (C:09)

3.9 Report on WGRP (C:03)

3.10 Report on SGPRISM (C:01)

3.11 Report on WGCCC (C:11)

3.12 Report on WKDGC (C:12)

3.13 General discussion

4. Proposals for Theme Sessions and Mini-symposia for 2001 and 2002

5. Election of New Working Group Chairs

6. Election of Committee Chair

7. Any Other Business

8. Closing

OCEANOGRAPHY COMMITTEE (C)

Order of the Day

Monday 25 September 2000, 14.00–18.00 (Erasmus Room)

		Time
1.	**Opening**	14.00
	1.1 Appointment of Raporteur	
	1.2 Adoption of Agenda	
	1.3 Practical arrangements	
2.	**Committee Business**	14.15
	2.1 Matters referred by the Consultative Committee	
	2.1 Matters referred by the ACME	
	2.3 ICES Five-year Strategic Plan	
	Coffee break	15.30
3.	**Reports from Working Groups**	
	3.1 Report on WGSSO (C:05)	16.00
	3.2 Report on WGPE (C:10)	16.30
	3.3 Report on SGPHYT (C:13)	
	3.4 Report on WGHABD (C:06)	17.00
	3.5 Report on WGMDM (C:08)	17.20
	3.6 Report on WGOH (C:07)	17.40
	Adjournment	18.00

OCEANOGRAPHY COMMITTEE (C)

Order of the Day

Friday 29 September 2000, 13.30–18.00 (Morus Room)

		Time
6.	**Election of Committee Chair**	13.30
3.	**Working Group Reports**	
	3.7 Report on WGSE (C:04)	14.00
	3.8 Report on WGZE (C:09)	14.20
	3.9 Report on WGRP (C:03)	14.40
	3.10 Report on SGPRISM (C:01)	
	3.11 Report on WGCCC (C:11)	15.00
	3.12 Report on WKDGC (C:12)	
	Coffee break	15.30
	3.13 General discussion	16.00
4.	**Proposals for Theme Sessions and Mini-symposia for 2001 and 2002**	16.30
5.	**Election of New Working Group Chairs**	17.00
7.	**Any Other Business**	17.15
8.	**Closing**	18.00

RESOURCE MANAGEMENT COMMITTEE (D)

Agenda

1. **Opening**
2. **Introduction, appointment of Rapporteur, adoption of agenda and timetable**
3. **ICES Strategic Plan**
4. **RMC Workplan**
5. **Reports to RMC, and matters arising**
6. **Recommendations for Working Groups/Study Groups**
7. **Recommendations for Theme Sessions, Symposia, etc.**
8. **Information from groups of relevance to RMC**
9. **Election of new Chair**
10. **Other Business**
11. **Closing**

RESOURCE MANAGEMENT COMMITTEE (D)

Order of the Day

Monday 25 September 2000, 09.30–13.30 (Ambassadeur Room)

		Time
1.	**Opening**	9.30
2.	**Introduction** Appointment of Rapporteur Roll call Adopt agenda and timetable	9.30
3.	**ICES Strategic Plan** Discuss Strategic Plan, new Advisory structure, and results of Open Forum (Sept. 26)	9.45
	Coffee break	10.30
4.	**RMC Workplan** Introduction and first discussion of new draft of Committee action plan and work programme	11.00
5.	**Reports to RMC** Report of RMC activities Working Group, Study Group and Workshop reports Matters arising from above reports	12.00
6.	**Recommendations for Working Groups/Study Groups** First discussion of draft terms of reference	12.30
7.	**Recommendations for Theme Sessions, Symposia, etc.** First discussion of draft terms of reference	13.00
	Closing of session	13.30

RESOURCE MANAGEMENT COMMITTEE (D)

Order of the Day

Friday 29 September 2000, 13.30–18.00 (Erasmus Room)

		Time
	Minutes of First Session and Introduction to Second Session	13.30
4.	**RMC Workplan (continued)**	13.45
6.	**Recommendations for Working Groups/Study Groups (continued)** Final discussion of draft terms of reference	14.30
9.	**Election of new Chair**	15.00
	Coffee break	15.30
7.	**Recommendations for Theme Sessions, Symposia, etc.** Final discussion of draft terms of reference	16.00
8.	**Information from Groups of Relevance to RMC**	17.00
10.	**Other Business**	17.30
11.	**Closing**	18.00

MARINE HABITAT COMMITTEE (E)

Agenda

1. **Opening**
2. **Appointment of Rapporteur**
3. **Adoption of Agenda**
4. **Practical arrangements**
5. **Overview on the ICES strategic planning process**
6. **Marine Habitat Committee – Scientific Progress: WG/SG Reports**
7. **Recommendations**
8. **Scientific Progress on the 2000 ASC**
9. **Election of Chair**
10. **Matters referred by other ICES Committees**
11. **Any other business**
12. **Closing**

MARINE HABITAT COMMITTEE (E)

Order of the Day

Monday 25 September 2000, 09.30–18.00 (Vives Room)

		Time
1.	**Opening**	09.30
2.	**Appointment of Rapporteur**	
3.	**Adoption of Agenda**	
4.	**Practical arrangements**	
5.	**Overview on the ICES strategic planning process**	09.45
	Coffee break	10.30
6.	**Marine Habitat Committee – Scientific Progress: WG/SG Reports**	10.45
	Lunch	12.45
	Marine Habitat Committee – Scientific Progress: WG/SG Reports (ctd.)	14.00
	Coffee break	15.30
7.	**Recommendations**	16.00

MARINE HABITAT COMMITTEE (E)

Order of the Day

Friday 29 September 2000, 13.30–18.00 (Vives Room)

		Time
8.	**Scientific Progress on the 2000 ASC**	13.30
	Coffee break	15.30
9.	**Election of Chair**	16.00
10.	**Matters referred by other ICES Committees**	16.30
7.	**Recommendations (ctd.)**	16.50
11.	**Any other business**	17.30
12.	**Closing**	18.00

MARICULTURE COMMITTEE (F)

Agenda

1. Opening

2. Appointment of Rapporteur

3. Introduction

3.1 Adoption of Agenda and Timetable

3.2 Practical Arrangements for the 2000 ASC

4. Discussion of Mariculture Committee Workplan

5. Presentations and Discussion of Working Group Reports

5.1 Working Group on the Application of Genetics in Fisheries and Mariculture: Presentation and Recommendations

5.2 Working Group on Environmental Interactions of Mariculture: Presentation and Recommendations

5.3 Working Group on Marine Fish Culture: Presentation and Recommendations

5.4 Working Group on Pathology and Diseases of Marine Organisms: Presentation and Recommendations

5.5 Working Group on Introductions and Transfers of Marine Organisms: Presentation and Recommendations

5.6 Discussion

6. Approval of Working Group Terms of Reference

7. Proposals of Theme Sessions for 2001 ASC

Justifications and Adoption

8. Proposals of Theme Sessions for 2002 ASC

9. Consideration of Workshops, Mini-Symposia and Symposia

10. Matters Referred by the CONC and ACME

11. Committee Interaction and Other Business

MARICULTURE COMMITTEE (F)

Order of the Day

Monday 25 September 2000, 14.00–18.00 (Morus Room)

		Time
1.	**Opening**	14.00
2.	**Appointment of Rapporteur**	14.05
3.	**Introduction**	14.10
	3.1 Adoption of Agenda and Timetable	
	3.2 Practical Arrangements for the 2000 ASC	
4.	**Discussion of Mariculture Committee Workplan**	14.20
5.	**Presentations and Discussion of Working Group Reports**	
	5.1 Working Group on the Application of Genetics in Fisheries and Mariculture: Presentation and Recommendations	14.45
	5.2 Working Group on Environmental Interactions of Mariculture: Presentation and Recommendations	15.15
	Coffee Break	15.30
	5.3 Working Group on Marine Fish Culture: Presentation and Recommendations	15.45
	5.4 Working Group on Pathology and Diseases of Marine Organisms: Presentation and Recommendations	16.45
	5.5 Working Group on Introductions and Transfers of Marine Organisms: Presentation and Recommendations	17.15
	5.6 Discussion	

End of Session

MARICULTURE COMMITTEE (F)

Order of the Day

Friday 29 September 2000, 13.30–18.00 (Descartes Room)

		Time
6.	**Approval of Working Group Terms of Reference**	13.30
7.	**Proposals of Theme Sessions for 2001 ASC** Justifications and Adoption	14.00
8.	**Propósals of Theme Sessions for 2002 ASC**	14.30
9.	**Consideration of Workshops, Mini-Symposia and Symposia**	15.00
	Coffee Break	15.30
10.	**Matters Referred by the CONC and ACME**	16.00
11.	**Committee Interaction and Other Business**	16.30
Adjournment		18.00

LIVING RESOURCES COMMITTEE (G)

Agenda

1. Opening

1.1 Appointment of Rapporteur

1.2 Roll call of Committee Members

1.3 Adoption of Draft Agenda and Timetable

1.4 Overview of Committee tasks and the ASC 2000

1.5 Procedures

2. Committee Business

2.1 The ICES Strategic Plan (and the Open Forum on Tuesday 26 September)

2.2 The new Advisory Committee structure

2.3 Committee Work Programmes and Action Plan

2.4 Interactions with other Science Committees

2.5 Committee Research and Topic Groups

2.6 Plans for the ASC in 2001 and 2002: Speakers, Themes, Mini-symposia, Open Sessions

2.7 Working-, Study-, Planning Group and Workshop Reports (G1-G13)

2.8 Matters arising from item 2.6

2.9 Approval of new chairs for Working-, Study-, Planning Group and Workshops

2.10 Matters referred to the Committee by the Consultative and Advisory Committees

2.11 Discussion and adoption of Recommendations

2.12 Election of New Chair of Living Resources Committee

3. Any Other Business

4. Election of new Chair

5. Closure of the Meeting

LIVING RESOURCES COMMITTEE (G)

Order of the Day

Monday 25 September 2000,14.00–18.00 (**Ambassadeur Room**)

		Time
1.	**Open meeting**	14.00
	Appoint Rapporteur, take Roll Call, agree Draft Agenda, overview tasks and ASC	
	Announce time and procedure for election of new Chair of Living Resources Committee	14.20
2.	**Committee Business**	
	Discuss Strategic Plan, New Advisory Structure, Open Forum Session (26 September)	14.30
	Discuss new draft of Committee Action Plan, Work Programme, Research and Topic Grps	15.00
	Coffee break	15.30
	Speakers, Themes, Mini-symposia and Open Sessions for ASC 2001 and 2002	16.00
	Recommendations: procedures and existing proposals for 2001	16.30
	Matters referred to Committee by Consultative and Advisory Committees	16.50
	Presentation and adoption of Working Group and Study Group Reports (details later)	17.00
	Closing of Session	18.00

LIVING RESOURCES COMMITTEE (G)

Order of the Day

Friday 29 September 2000, 13.30–18.00 (**Picard Room**)

		Time
2.	**Committee Business (cont.)**	
	Presentation and adoption of remaining Working and Study Group reports (details later)	13.30
	Working Group and Workshop matters arising including approval of new chairs	15.00
	Feedback on Open Forum	15.15
	Coffee break	15.30
	Commitment to Action Plan, Work Programme, and Research and Topic Groups	15.45
	Matters arising regarding interaction with other Science Committees	16.15
	Adopt proposed Speakers, Themes, Mini-symposia, Open Sessions for ASC 2001/2002	16.30
	Final discussion and adoption of Recommendations	17.00
3.	**Any other business**	17.15
4.	**Election of new Chair**	17.30
5.	**Closure of Committee Meetings**	18.00

BALTIC COMMITTEE (H)

Agenda

1. **Opening**

   Introduction

   Adoption of Agenda

   Introduction to Workplan

2. **Reports from Working/Study Groups, including Recommendations**

   2a. Baltic International Fish Survey Working Group [WGBIFS]

   2b. Study Group on Baltic Cod Age Reading [SGBCAR]

   2c. Study Group on the Scientific Basis for Ecosystem Advice in the Baltic [SGSBEAB]
   Review initial recommendations
   Prepare final recommendations

   2d. GEOHAB report – experiment in the BALTIC?

3. **Proposals for Theme Sessions and Mini-symposia for 2000 and 2001**
   Mini-Symposium in 2001
   Predicting Effects of Expected Change in the Baltic Sea

4. **Baltic GEF Update**

5. **Conclusions of First Session, writing assignments, and review of arrangements for Second Session**

6. **Final endorsement of recommendations/draft resolutions**

7. **Matters from Consultative Committee and Advisory Committees**
   Workplan

   Baltic GEF

8. **Committee Matters**
   New Chair to be elected in 2001

9. **Any other Business**

10. **Closure of meeting**

BALTIC COMMITTEE (H)

Order of the Day

Monday 25 September 2000, 09.30–13.30 (Morus Room)

		Time
1.	**Opening**	9.30
2.	**Reports from Working/Study Groups, including Recommendations**	9.50
	Coffee break	10.30
2.	**Reports from Working/Study Groups, including Recommendations (cont.)**	11.00
3.	**Proposals for Theme Sessions and Mini-symposia for 2001 and 2002**	12.30
4.	**Baltic GEF Update**	12.45
5.	**Conclusions of First Session, writing assignments, and review of arrangements for Second Session**	13.00

BALTIC COMMITTEE (H)

Order of the Day

Friday 29 September 2000, 13.30–18.00 (Chambers S. Stevin)

		Time
6.	**Final endorsement of recommendations/draft resolutions**	13.30
7.	**Matters from Consultative Committee and Advisory Committees**	14.00
	Coffee break	15.30
8.	**Committee Matters**	16.00
9.	**Any other Business**	17.30
10.	**Closure of meeting**	17.50

MINI-SYMPOSIUM
on
Defining the Role of ICES in Supporting Biodiversity Conservation

Agenda and Order of the Day

Wednesday 27 September 11.30–13.00 (Ambassadeur Room)
Wednesday 27 September 14.00–16.00 (Ambassadeur Room)
Wednesday 27 September 16.30–18.00 (Ambassadeur Room)

		Time
1.	**Opening**	11.30
2.	**Introduction**	
3.	**Presentation of papers**	
Code	*authors(s)* + title	11.35
Mini:05	*Jake Rice*: ICES and species at risk	11.35
Mini:07	*Rob Stephenson and Ellen Kenchington*: Conserving fish stock structure is a critical aspect of preserving biodiversity	12.00
Mini:01	*Chris Frid and Leonie Robinson*: Ecological reference points for North Sea benthos: can we manage benthic biodiversity?	12.30
	Lunch break	13.00
Mini:04	*Thomas Osborn and Richard T. Barber*: Why are large, delicate, gelatinous organisms so successful in the ocean's interior?	14.00
Mini:10	*Anna Was and R. Wenne*: Biodiversity at the population genetic level: microsatellite DNA poplymorphism in the sea trout population from southern Baltic	14.25
Mini:09	*Filip A.M. Volckaert, Edgar Daemen, Tom Cross, and Frans Ollevier*: The genetic structure of European eel revisited and implications for its conservation	14.50
Mini:06	*Marie-Joëlle Rochet, Verena Trenkel and Isabelle Péronnet*: Using discards estimates for assessing the impact of fishing on biodiversity	15.15
Mini:11	*H.M. Winkler, K. Skora, R. Repecka, M. Pliks, E. Urtans, A. Gushin, and H. Jespersen*: Checklist and state of Baltic Sea fish species	15.40
	Coffee break	16.00
Mini:03	*Sarah Jones, Stephan Lutter and Simon Cripps*: Scientific advice for marine ecosystem management – an NGO perspective	16.30
Mini:08	*Mark L Tasker, Paul Knapman, David Donnan, Clare Eno, Barry Haynes and Bob Hastings*: How ICES can help integrate biodiversity consideration into fisheries advice	16.55

Mini:02 *Chris Frid, Stuart Rogers. Mike Nicholson, Jim Ellis, and Steve Freeman*: Using biological characteristics to develop new indices of ecosystem health 17.20

4. General discussion (including any comments on the posters) and summing up 17.45

5. Conclusions and Proposals

6. End of Session

Posters

Mini:12 *A.V. Dolgov:* New data on composition and distribution of the Barents Sea ichthyofauna

Mini:13 *Michele Gristina, G. Garofalo, G. Bono, and D. Levi*: Effects of commercial trawl fishing in the Straits of Sicily on the diversity of demersal resources

Mini:14 *Yves Samyn and Edward Vanden Berghe*: Faunistics as the impetus for conservation of sea cucumbers (Echinodermata: Holothuroidea) in the littoral waters of Kenya

Mini:15 *Edward Vanden Berghe and Yves Samyn*: The use of databases for conservation of sea cucumbers (Echinodermata: Holothuroidea) in the littoral waters of Kenya

THEME SESSION J
on
Efficiency, Selectivity, and Impacts of Passive Fishing Gears

Agenda and Order of the Day

Saturday 30 September 09.30–10.30 (Erasmus Room)
Saturday 30 September 11.00–12.30 (Erasmus Room)
Saturday 30 September 13.30–15.30 (Erasmus Room)

		Time
1.	**Opening**	09.30
2.	**Introduction**	09.35
3.	**Presentation of papers**	
Code	*authors(s)* + title	
J:09	*I. Huse and A. V. Soldal:* Mortality in pelagic longline fisheries for haddock	09.40
J:13	*H.O. Milliken, H.A. Carr, H. McBride, and M. Farrington:* Selectivity studies in the Northwest Atlantic longline fishery	09.55
J:01	*Pascal Bach, L. Dagorn, and C. Misselis*: The role of bait type on pelagic longline efficiency	10.10
	Coffee break	10.30
J:04	*Daniel L. Erickson, Susan Goldhor, and Radu Giurca*: Efficiency and species selectivity of fabricated baits used in Alaska demersal longline fisheries	11.00
J:06	*René Holst, David Wileman, and Niels Madsen*: The effect of twine thickness in cod gill nets	11.15
J:11	*F.M. Lucena, C.M. O'Brien, and E.G. Reis*: The effect of fish morphology and behaviour on the efficiency of gill nets, their selectivity and by-catch: two examples from southern Brazil	11.30
J:12	*Tonjes Mentjes and Kay Panten*: Relative size and girth selectivity of cod gillnets in the Western Baltic	11.45
J:07	*René Holst and Rasmus J. Nielsen*: A longitudinal study of the selectivity parameters estimated from experimental gillnet catch data for herring, *Clupea harengus*	12.00
J:08	*Odd-Børre Humborstad and D.M. Furevik*: Ghostfishing gillnets in Norwegian waters	12.15
	Lunch break	12:30

J:03 *H. Arnold Carr*: Methods for measuring the selectivity of static gear: A progress review of the manual 13.30

J:05 *Hallvard Godøy, Dag. M. Furevik and Svein Løkkeborg*: Reduced bycatch of red king crab (*Paralithodes camtschatica*) in the cod gillnet fisheries in northern Norway. Fishing trials with norsel-mounted gillnets 13.45

J:14 *E. Urtans and J. Priednieks*: The present status of seabird bycatch in Latvian coastal fishery of the Baltic Sea 14.00

J:10 *Svein Løkkeborg*: Review and evaluation of three mitigation measures – bird-scaring line, underwater setting, and line shooter – to reduce seabird bycatch in the Norwegian longline fishery 14.15

J:02 *Arne Bjørge, Nils Øien, Siri Hartvedt, and Trine Bekkby*: Dispersal and by-catch mortality in grey, *Halichoerus grypus*, and harbour, *Phoca vitulina*, seals tagged at the Norwegian coast 14.30

4. General discussion and summing up 14.45

5. Conclusions and Proposals 15.15

6. End of Session 15.30

Posters

J:15 *Gerald Brothers*: Testing square mesh panels in trap nets to reduce the catch of juvenile Atlantic Cod

J:16 *Leili Järv, T. Drevs, and A. Järvik*: Size-species selectivity of gillnets in the Estonian coastal zone: regulation efficiency

J:17 *G.A. Petrakis, A. Chilari, and A. Terrats*: Gillnet metier of blackspot seabream in the Ionian Sea

J:18 *Ahto Järvik and Tiit Raid*: On biological, technical and socio-economical aspects of Baltic herring pound net fishery in Estonia

THEME SESSION K
on
Incorporation of External Factors in Marine Resource Surveys

Agenda and Order of the Day

Wednesday 27 September 16.30–18.00 (Morus Room)

		Time
1.	**Opening**	16.30
2.	**Introduction + 7 posters**	
3.	**Presentation of papers**	
Code	*authors(s)* + title	
K:24	*Michael Pennington*: Survey-based stock assessments: Are they more reliable than catch-based assessments?	16.44
K:23	*Michael Pennington, Liza Burmeister, and Vidar Hjellvik*: Assessing trawl-survey estimates of frequency distributions	
K:33	*David Somerton and Ken Weinberg*: The effect of water speed on bottom contact and escapement under the footrope of a survey trawl	17.09
K:01	*Sara Adlerstein and Siegfried Ehrich*: Effect of deviation from vessel target speed over ground, trawl speed through water and time of day and catch rates of several fish species in North Sea surveys	17.26
K:20	*R.P. Oeberst, P. Ernst, and C.C. Friess*: Inter-calibrations between German demersal gears HG 20/25 and TV3 520, as well as between the gears TV3 520 and TV3 930	17.43

THEME SESSION K
on
Incorporation of External Factors in Marine Resource Survey

Agenda and Order of the Day
Thursday 28 September 09.30–10.30 (Erasmus Room)
Thursday 28 September 11.00–12.30 (Erasmus Room)
Thursday 28 September 14.00–16.00 (Erasmus Room)
Thursday 28 September 16.30–18.00 (Erasmus Room)

1.	**Introduction + 5 posters**	09.30
K:15	*Oleg M. Lapshin, Y.V. Gerasimov, Y.G. Izumov, and I.G. Istomin:* The influence of polymorphic characteristics on the Alaska pollack (*Theragra chalcogramma*) fishing efficiency	09.39
K:26	*G.A. Petrakis, D.N. MacLennan, and A.W. Newton*: North Sea trawl surveys: Diel and depth effects on the catch rates	09.56
K:30	*Jacques Rivoirard*: Testing the effects of vessel, gear, and daylight on catch data from the International Bottom Trawl Survey in the North Sea	10.13
	Coffee break	10.30
K:31	*Jacques Rivoirard and Kai Wieland*: Correcting daylight effect in the estimation of fish abundance using kriging with external drift, with an application to juvenile in the North Sea	11.00
K:28	*D.G. Reid, D.G. J.-C. Mahe, P. Connolly, C.G. David, and A. Newton*: Quantifying variability in gear performance on IBTS surveys: Swept area and volume with depth	11.17
K:12	*Astrid Jarre, Liz Clarke and Bo Lundgren*: Adult gadoids in the North Sea: A view from IBTS and generalised additive models	11.34
K:13	*Astrid Jarre, Liz Clarke and Bo Lundgren*: Abundance of juvenile gadoids in the North Sea: Habitat descriptors derived from IBTS data using generalised additive models, and implications for stock assessment	11.51
K:21	*R. Oeberst*: Proposal for the stratification of the Baltic Sea for the Baltic International Trawl Survey	12.08
	Discussion of survey proposal	12.25
	Lunch break	12.30
K:27	*Gerjan Piet*: Evaluation of the incorporation of external information using GAM on the catch-at -age index estimation for North Sea plaice and sole	14.00
K:34	*Boonchai K. Stensholt, Kathrine Michalsen, and Olav Rune Godø*: Behavioural rhythm of cod during migration in the Barents Sea	11.17

K:14	*Cecilie Kvamme, Leif Nøttestad, Bjørn Axelsen, Are Dommasnes, Anders Fernö and Ole Arve Misund*: A sonar study of the migration pattern of Norwegian spring-spawning herring (*Clupea harengus* L.) in July	14.34
K:17	*Ramon Muiño and Pablo Carrera*: Sardine (*Sardina pilchardus* Walbaum) characterisation off the Spanish Atlantic coast	14.51
K:02	*D.J. Beare, D.G. Reid, and P. Petitgas*: Spatio-temporal patterns in herring school abundance and size in the NW North Sea: Modelling space time dependencies to allow examination of the impact of local school abundance on school size	14.08
K:04	*D.J. Beare and D.G. Reid*: Investigating the complexity of spatio-temporal patterns evidenced in the triennial mackerel and horse-mackerel egg survey data	15.25
K:18	*C.M. O'Brien and J.C. Fox*: Incorporating temportal information in ichhyoplankton surveys using a model-based approach: cod (*Gadus morhua* L.) in the Irish Sea	15.42
	Coffee break	16.00
K:36	*M. Verdoit and D. Pelletier*: Characterizing the spatial and seasonal dynamics of exploited populations from the analysis of commercial catch and effort data	16.30
K:25	*Pierre Petitgas*: On the clustering of fish schools at two scales and their relation with meso-scale physical structures	16.47
K:35	*Rune Vabø*: The effects of removing behaviourally based biases from acoustic estimates of wintering NSS-herring	17.04
K:09	*Liz Clarke and John Simmonds*: Spatio-temporal models of North Sea herring	17.21
	Discussion	17.38
	Posters	
K:03	*D.J. Beare, D.G. Reid, P. Petitgas, J. Masse, P. Carrera, and S. Georgakarakos*: Spatio-temporal patterns in pelagic fish school abundance and size: a study of pelagic fish aggregation using acoustic surveys from Senegal to Shetland	
K:05	*Nicolas Bez and Jacques Rivoirard*: Collocation indices to compare spatial distributions of populations	
K:07	*Patrice Brehmer, F. Gerlotto, and B. Samb*: Measuring fish school avoidance during acoustic surveys	
K:10	*Janet Coetzee, Ole Arvid Misund, and David Boyer*: Survey vessel avoidance reaction of Sardinella off Angola	
K:11	*T.R. Hammond and C.M. O'Brien*: Persistence of acoustically observed fish biomass in a 220 km^2 survey region	
K:16	*R.B. Mitson*: Fish avoidance: the vessel noise factor	
K:19	*C.M. O'Brien, S. Adlerstein, and S. Ehrich*: Accounting for spatial-scale and temporal information in research surveys: combined analyses of English and German groundfish surveys in the North Sea	
K:29	*D.G. Reid*: The relationship of herring school size and abundance with seabed characteristics in the NW North Sea	

K:32 *John Simmonds, Jacques Rivoirard, and Paul Fernandes*: Vessel, gear, and day/night effects in the estimation of herring abundance and distribution from the IBTS surveys in North Sea

K:37 *Charles W. West and John R. Wallace*: Measurements of distance fished during the trawl retrieval period

K:38 *Pablo Carrera and Ramón Muiño*: Evidence of a change in the aggregation pattern of coastal pelagic fish species in the Bay of Biscay after a period of high intensity rain

K:39 *E.J. Simmonds, E. Toresen, E. Torstensen, C. Zimmermann, E. Götze, D.G. Reid and A.S. Couperus*: 1999 ICES Coordinated Acoustic Survey of ICES Divisions IIIa, IVa, IVb and VIa (north)

THEME SESSION L
on
North Atlantic Processes

Agenda and Order of the Day

Wednesday 27 September 11.30–13.00 (Erasmus Room)
Wednesday 27 September 14.00–16.00 (Erasmus Room)
Wednesday 27 September 16.30–18.00 (Erasmus Room)

		Time
1.	**Opening**	11.30
2.	**Introduction**	11.40
3.	**Presentation of papers**	
L:02	*Eugene Colbourne*: Interannual variation in the transport of the Labrador Current on the Newfoundland Shelf	11.45
L:17	*Igor M. Yashayaev*: 12-year hydrographic survey of the Newfoundland Basin: seasonal and interannual variability in water masses	12.00
L:18	*Igor M. Yashayaev, Allyn Clarke, and John Lazier*: The recent decline of the Labrador Sea Water	12.15
L:12	*John Mortensen*: Repeated seasonal hydrographic observations in the northern Irminger Sea in 1997 to 1999	12.30
	Discussion	12.45
	Lunch break	13.00
L:10	*Sven-Aage Malmberg*: Fresh/polar water input in the East Icelandic Current	14.00
L:11	*S-A Malmberg, H. Valdimarsson, and S. Jonsson*: Hydrographic conditions in the inflow of Atlantic water into North Icelandic waters in relation to NAO	14.15
L:19	*Walter Zenk*: Direct observations of the Iceland Basin cyclone at mid depths	14.30
L:07	*Gerd Krahmann, Martin Visbeck, and Gilles Reverdin*: Formation and propagation of temperature anomalies in the North Atlantic Current	14.45
L:15	*Gilles Reverdin, H. Valdimarsson, and P. Jaccard*: Surface waters of the North Atlantic subpolar gyre in recent years	15.00
L:16	*Tom Rossby, A. Bower, P. Richardson, M. Prater, H. Zhang, H. Hunt, and S. Fontana* : Direct observations of warm water pathways in the northern North Atlantic	15.15

L:01 *Y. Bochkov, E. Sentyabov, and A. Karsakov*: The relation between long-term variations of water temperature in the North Atlantic and Nordic Seas 15.30

L:03 *Bogi Hansen, Steingrimur Jónsson, William Turrell, and Svein Østerhus*: Seasonal variations in the Atlantic water inflow to the Nordic Seas 15.45

L:09 *Karin Larsen, Bogi Hansen, Regin Kristiansen, and Svein Østerhus*: Internal tides in the waters surrounding the Faroe Plateau 16.30

L:04 *Pierre Jaccard, G. Reverdin, H. Svendsen, S. Østerhus, and T. Rossby*: First results of upper ocean variability in the North Atlantic between the North Sea and Greenland from repeat ADCP and thermo-salinograph measurements onboard the container vessel 'Nuka Arctica' 16.45

L:14 *V. Ozhigin, A. Trofimov, and V. Ivshin*: The Eastern Basin Water and currents in the Barents Sea 17.00

L:06 *E. Karasiova and A. Zezera*: On influence of long-term variability of temperature regime in the Gdansk Deep of the Baltic Sea on the sprat reproduction and the offspring survival 17.15

L:08 *S. Kydersky and A. Zezera*: Multidecadal changes in the Baltic marine ecosystem under hydroclimatological forcing 17.30

4. General discussion and summing up 17.45

5. Conclusions and Proposals 17.50

6. End of Session 18.00

Posters

L:20 *Randi Invaldsen, Lars Asplin, and Harald Loeng*: Transport of Atlantic water through the Barents Sea

L:21 *H-Ch. John , V. Mohrholz, and J. Lutjeharms* : Cross-front structures in hydrography and fish larvae at the Angola-Benguela Frontal Zone

L:22 *V. Mohrholz, M. Schmidt, J. Lutjeharms, and H-Ch. John* Space-time behaviour of the Angola-Benguela Frontal Zone during the Benguela Niño of April 1999

THEME SESSION M
on
Theme Session on Environment – Plankton – Fish Linkages

Agenda and Order of the Day

Thursday 28 September 09.30–10.30 (Vives Room)
Thursday 28 September 11.00–12.30 (Vives Room)
Thursday 28 September 14.00–16.00 (Vives Room)
Thursday 28 September 16.30–18.00 (Vives Room)

		Time
1.	**Opening**	09.30
2.	**Introduction**	
3.	**Presentation of papers**	
Code	*author(s)* + title	
M:08	*Are Edvardsen, Dag Slagstad, Kurt S. Tande, and Pierre Jaccard*: Measurements and modelling of ocean climate and zooplankton in the Barents Sea	09.30
M:20	*Dag Slagstad, K. Tande, W. Melle, B. Ellertsen, and F. Carlotti:* Regional dynamics of *Calanus* in the Norwegian Sea in response to ocean climate in 1997	09.45
M:04	*Ann Bucklin, O.S. Astthorson, Astthor Gislason, and Peter H. Wiebe: Calanus finmarchicus* in Icelandic waters: population genetics and ecology at the Norwegian Sea/N. Atlantic Ocean boundary	10.00
M:10	*Erica Head:* Interannual variations in hydrography and spring bloom dynamics, and their effect on *Calanus finmarchicus* distribution and reproduction on the Scotian Shelf in the late '90s and 2000	10.15
	Coffee break	10.30
M:15	*David Mountain, Joseph Kane, and John Green*: Environmental forcing of variability in zooplankton abundance and cod recruitment on Georges Bank	11.00
M:18	*Doug Sameoto*: Decadal changes in zooplankton and krill abundance on the Scotian Shelf and western Atlantic	11.15
M:23	*Kazuaki Tadokoro, Toshiro Saino, and Takashige Sugimoto*: Geographical variation of Chl-a seasonality, and its interannual variation in the subarctic North Pacific Ocean	11.30
M:13	*Kosei Komatsu, Matsukawa, N. Nakata, T. Ichikawa, and K Sasaki*: Seasonal variation of plankton dynamics in the Kuroshio extension region based on a 3-D ecosystem model	11.45
M:14	*A. M'harzi, S. De Galan, M. Tackx, M.H. Daro, and L. Goeyens*: Plankton size distribution and predator-prey relationship in the Belgian coastal zone	12.00

M:01 *Cyril Ajuzie and Guy T. Houvenaghel*: *Prorocentrum lima* (*Microalgae: Dinoflagellata*): killer food for zooplankton 12.15

Lunch break 12.30

M:05 *Robin Clark and Chris Frid*: Long-term changes in the North Sea – A two model system? 14.00

M:19 *K. Sherman, Joseph Kane, Steven Murawski, William Overholtz, and Andrew Solow:*: Zooplankton as an ecological indicator in a fish stock recovery assessment 14.15

M:06 *P. Dalpadado, Bjarte Bogstad, Nina Borkner, H. Gjøsæter, Sigbjørn Mehl, and H.R. Skjoldal*: Are the macrozooplankton populations in the Barents Sea controlled by predation? 14.30

M:09 *Astthor Gislason and Olafur S. Astthorsson*: On the food of herring in the western part of the Norwegian Sea 14.45

M:16 *Lutz Postel*: Interannual variations of the amount of herring in relation to plankton biomass and activity, temperature and cloud coverage in the Baltic Sea 15.00

M:12 *Ahmet E. Kideys*: The role of plankton fluctuations in the production of pelagic fishes in a sensitive ecosystem 15.15

Discussion 15.30

Coffee break 16.00

M:03 *L.J. Buckley, E.C. Caldarone, R.G. Lough, and T.L. Ong*: Patterns in growth, ingestion and survival probability of Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*) larvae on Georges Bank 16.30

M:17 *J.A. Runge, J. Quinland, E. Durbin, L.Incze, G. Lough, J. Manning, D. Mountain, B. Niehoff, S. Plourde, and F. Werner*: The effect of spatial and temporal variations of zooplankton concentrations on larval cod growth and survival on Georges Bank: a sensitivity analysis based on modelling and observations 16.45

M:24 *F.E. Werner et al.* Modelling growth and advection of larval cod and haddock on Georges Bank in evolving flow and prey fields: a synthesis of observations and model results for spring 1995 17.00

M:07 *K.F. Drinkwater, K.T. Frank, and B. Petrie*: The effects of *Calanus* on the recruitment, survival, and condition of cod and haddock on the Scotian Shelf 17.15

M:21 *John Steele*: How to get more fish: ecosystem and environmental problems 17.30

4. **Session Summary** – *R. Harris* 17.45

Posters

M:25 *Gustavo L. Alvarez Colombo, and A. Madirolas*: Sound scattering from macrozooplankton aggregations off Patagonia at 38 kHz

M:26 *Kerim Aydin, Patricia Livingston, and Robert C. Francis*: Carrying capacity of apex predators and the frequency and cadence of physical forcing in marine foods webs

M:27 *James J. Bisagni*: The seasonal cycle of nitrate supply and potential new production in the Gulf of Maine and Georges Bank Regions

M:28 *S. Chiba, T. Ishimaru, G.W. Hosie, and M. Fukuchi*: Large scale interaction between sea ice dynamics and zooplankton community off east Antarctica

M:29 *S.S. Drobysheva and V.N. Nesterova*: Reasons of plankton biomass dynamics in the southern Barents Sea

M:30 *D.S. Neto, B.B. Sangolay, C.A. Ruby, M.L. Silva, and H.S. Marques*: Phytoplankton biomass across and along the Angola-Benguela frontal zone in April 1999

M:31 *E. L. Orlova, A. V. Dolgov, V. N. Nesterova, M. Yu. Antsiferov, and L. L. Konstantinova*: Pecularities of feeding behaviour in Arcto-Norwegian cod in the southern Barents Sea when major food objects are in deficiency

M:32 *E. L. Orlova, E. I. Seliverstova, and V. N. Nesterova*: Some features of distribution and feeding of the Atlantic herring (*Clupea harengus* L.) in the Barents Sea

M:33 *E.V. Sentyabov and N.V. Plekhanova*: Rapid variations of the Norwegian Sea water heat content during 1995–1999 and their influence on condition of the feeding plankton

THEME SESSION N
on
Spatial and Temporal Patterns in Recruitment Processes

Agenda and Order of the Day

Friday 29 September 08.30–10.30 (Ambassadeur Room)
Friday 29 September 11.00–12.30 (Ambassadeur Room)

		Time
1.	**Opening**	08.30
2.	**Introduction**	
3.	**Presentation of papers**	
Code	*authors(s)* + title	
N:03	*Jesper Boje and E. Hjörleifsson:* Nursery grounds for the West Nordic Greenland halibut stock – where are they?	08.35
N:04	*Robert K. Cowen, C.B. Paris, Kamazima M.M. Lwiza, and D.B. Olson:* Long distance dispersal versus local retention as a means of replenishing Carribean marine fish populations	08.50
N:19	S. *Mahévas, P. Petitgas, and P. Lazure:* Stochastic (Markov) modelling of larval survival condition along tracks of particles in a hydrodynamic model	09.05
N:13	*Sukgeun Jung and Edward D. Houde:* Scale and pattern in recruitment processes of bay anchovy in Chesapeake Bay	09.20
N:14	*Ryo Kimura, D.H. Secor, E.D. Houde, and P.M. Piccoli:* Migration/dispersal patterns of YOY bay anchovy *Anchoa mitchilli* in the Chesapeake Bay: Sr:Ca analysis on a ubiquitous species	09.35
N:28	*Christoph Stransky:* Migration of juvenile deep-sea redfish (*Sebates mentella* Travin) from the East Greenland shelf into the central Irminger Sea	09.50
N:10	*Allain Gwenhael, P. Petitgas, P. Grellier, and P. Lazure:* Coupling the otolith growth history of anchovy larvae with the physical history of water masses tracked in a hydrodynamic model	10.05
N:22	*Peter Munk:* Spatial patterns in growth rate variability of Arctic cod in Disko Bay, West Greenland	10.20
	Coffee break	10.30
N:24	*Pierre Pepin, John F. Dower, and Fraser Davidson:* A dynamic and spatially explicit analysis of growth and mortality in larval radiated shanny (*Ulavria subbifurcata*)	11.00
N:21	*Piotr Margonski:* The abundance, growth rate, and mortality of the early life stages of herring (*Clupea harengus*) and smelt (*Osmerus eperlanus*) in the Vistula Lagoon (southern Baltic Sea) during 1998-1999	11.15

N:18 *R.G. Lough, C.G. Hannah, P. Verrien, D. Brickman, J.W. Loder, and J.A. Quinlan:* Oceanic factors in cod and haddock egg and larval distributions on Georges Bank (1977-87) and processes which may govern interannual variability in recruitment 11.30

N:25 *J.A. Quinlan, R.G. Lough, W. Michaels, M. Fogarty, L.J. Buckley, J.P. Manning, E. Durbin, J.A. Runge, and F.E. Werner:* Examining the potential effects of vertebrate predation on Georges Bank larval cod: A modeling study for the 1995 field study 11.45

N:27 *M.A. St. John, H. Mosegaard, H.-H. Hinrichsen, P. Grønkjær, F. Köster, K. Hüssy, and R. Neilsen:* Baltic cod: resolving processes determining spatial, and temporal windows of survival 12.00

N:23 *E.W. North and E.D. Houde:* Time, space, physics and food: the temporal and spatial distribution of anadromous fish larvae in an Estuarine Turbidity Maximum (ETM) 12.15

THEME SESSION N
on
Spatial and Temporal Patterns in Recruitment Processes

Agenda and Order of the Day

Saturday 30 September 09.30–10.30 (Ambassadeur Room)
Saturday 30 September 11.00–12.30 (Ambassadeur Room)
Saturday 30 September 13.30–15.30 (Ambasssadeur Room)

N:11	*Mike Heath and Alejandro Gallego:* Modelling the spatial and temporal structure of survivorship to settlements in North Sea and west of Scotland haddock	09.30
N:12	*S. Hinckley, A.J. Hermann, and B.A. Megrey:* An evaluation of the utility of spatially-explicit biophysical models in recruitment studies	09.45
N:15	*Birgitt Klenz:* Abundance and distribution of larval of commercially important fish species in the western Baltic Sea during the period 1993-1998	10.00
N:09	*Tomas Gröhsler, Uwe Böttcher, and Eberhard Götze:* Horizontal and vertical distribution of sprat in the southern Baltic Sea during spawning time. First results on the 1999 German June acoustic survey	10.15
	Coffee break	10.30
N:07	*V.N. Feldman and T.G. Vasilieva:* Inter- and intra-annual variability in meso- and large-scale horizontal distribution, abundance, and population structure of Baltic sprat	11.00
N:29	*Konrad Thorisson and Thor H. Asgeirsson:* Cod larval catches in Icelandic waters in 1998	11.15
N:32	*Michala Aschan, Bjørn Ådlansvik, and Sigurd Tjelmeland:* Spatial and temporal patterns in recruitment of shrimp *Pandalus borealis* in the Barents Sea	11.30
N:05	*Paul D. Eastwood and Geoff J. Meaden:* Spatial modelling of spawning habitat suitability for the sole (*Solea solea* L.) in the eastern English Channel and southern North Sea	11.45
N:02	*M.A. Bleil and R. Oeberst:* Reproduction areas of the cod stock in the western Baltic Sea	12.00
N:26	*Marie-Joëlle Rochet:* Spatial and temporal patterns in age and size at maturity and spawning stock biomass of North Sea gadoids	12.15
	Lunch break	
N:20	*Andrei Makarchouk and Galina Grauman:* The temporal and spatial changes in the observed size of cod eggs in the eastern Baltic	13.30
N:06	*Martin D. Ehrlich, P. Marthos, and R.P. Sánchez:* Causes of spawning pattern variability of anchovy and hake on the Patagonian shelf	13.45

N:17 *Jesús García Lafuente, Alberto García, Salvatore Mazzola, Luis Quintanilla, Javier Delgado, Angela Cuttita, and Bernardino Patti:* Influence of the surface circulation on the spawning strategy of the Sicilian Channel anchovy 14.00

N:16 *F.W. Köster, H.-H. Hinrichsen, D. Schnack, M.A. St. John, B.R. MacKenzie, J. Tomkieqicz, C. Möllmann, M. Plikshs, and A. Makachouk:* Recruitment of Baltic cod and sprat stocks: Identification of critical life stages and incorporation of environmental variability and spatial heterogeneity into stock-recruitment relationships 14.15

N:01 *G.A. Beggs, G. Marteinsdottir, and S. Jónsson:* Incorporating spawning origins of pelagic juvenile cod and environmental variation in the stock-recruitment relationship 14.30

N:08 *Øyvind Fiksen and Aril Slotte:* Recruitment variability in Norwegian spring-spawning herring (*Clupea harengus* L.): the effect of temperature in larval drift trajectories 14.45

4. General discussion and summing up 15.00

5. Conclusions and Proposals 15.20

6. End of Session

Posters

N:30 *Hirashi Kubota, Yoshioki Oozeki, and Ryo Kimura:* Distributions of larvae and juveniles of small pelagic fishes in the northwest Pacific off east Japan

N:31 *T. Thangstad, J. H. Fosså, A. Fernö, and A: Johannessen:* Factors affecting the distribution of wrasses (*Pisces: Labridae*) in a fjord system: analysis by generalised linear models

THEME SESSION O
on
Sustainable Aquaculture Development

Agenda and Order of the Day

Wednesday 27 September 14.00–16.00 (Vives Room)

		Time
1.	**Opening**	14.00
2.	**Introduction**	
3.	**Presentation of papers**	
Code	*authors(s)* + title	
	Monitoring:	
O:04	*Arne Ervik:* Monitoring programmes – a vital part of mariculture regulation	14.10
	Discharged wastes:	
O:01	*Ian M. Davies:* Waste production in salmon farming	14.20
	Stock enhancement:	
O:02	*Daan Delbare and Rudy De Clerck:* Release of reared turbot in Belgian coastal waters as a tool for stock enhancement	14.30
	Genetics:	
O:05	*Svein-Erik Fevolden:* Prospects for selective breeding for stress tolerance in aquacultured fish	14.40
O:03	*Inge Døskeland and Pia Kupka Hansen*: Geographic information systems (GIS) are tools for better integrated coastal zone planning and management (ICZP/M)	14.50
O:06	*N. Koueta, A. Le Calvé, B. Noel, and E. Boucaud-Camou*: Changes of digestive enzymes during growth of cultured juvenile cuttlefish *Sepia officinalis* L. (*Mollusca Cephalopoda*). Effect of an enriched diet and ration	15.00
	Hans Ackefors: MARAQUA – an EU Project for coastal marine aquaculture	15.10
	Harald Rosenthal: Sustainability of various indices used to evaluate aquaculture	15.30
		16:00
	Posters	
O:07	*Thomas T. Noji, Lasse H. Petterson, Dominque Durand, Henrik Soiland, Einar Svendsen, Steve Groom, Samantha Lavender, and Ola M. Johannessen*: Satellite observations and forecasting can mitigate effects of toxic algae blooms	
O:08	*Emilia Vázquez, C. Fernández-Pato, C. Martínez-Tapia, G. Blanco, and J.A. Sanchez:* Some growth data of cold shock triploids in turbot (*Scophthalmus maximus*)	

THEME SESSION P
on
New Trends in Fish Feeding in Aquaculture

Agenda and Order of the Day

Wednesday 27 September 16.30–18.00 (Vives Room)

		Time
1.	**Opening**	16.30
2.	**Introduction – Dr Sachi Kaushik and Dr John Castell – Co-Conveners**	16:35
3.	**Presentation of papers**	
Code	*author(s) + title*	
P:04	*Clive Talbot and Antonio García-Gómez.* The role of technology transfer in the development of new fish species for aquaculture	16:45
P:01	*P. Coutteau, S. Ceulemans, R. Robles, A. Oliva-Teles, S. Chatzifotis, A. Van Halteren, and P. Verstraete.* Fish meal/fish oil replacement in practical diets for European sea bass *Dicentrarchus labra* and Gilthead sea bream *Sparus aurata*	17.00
P:02	*Gro-Ingunn Hemre and Kjartan Sandnes.* By-catch and offal feed from the herring industry – performance of Atlantic salmon as concerns growth, feed utilization, and fillet quality	17.15
P:03	*Anne-Katrine Lundeby, Bjarne Bøe, and Kåre Julshamn.* Documenting seafood safety: contaminant concentrations in Norwegian fish feeds and mariculture products	17.30
4.	**General discussion and summing up**	17.45
5.	**Conclusions and Proposals**	17.55
6.	**End of Session**	18:00
	Posters	
P:05	*Peter Coutteau, L. Tort, J. Rotllant, and S. Ceulemans.* Screening of immunostimulants for the gilthead seabream *Sparus aurata*	
	Relevant contribution from other Theme Session:	
Z:13	*Lies Van Nieuwerburgh, Ingrid Wänstrand, and Pauli Snoeijs.* Pigment transfer from phytoplankton to copepods in nutrient-enriched mesocosms	

THEME SESSION Q
on
Trophic Dynamics of Top Predators: Foraging Strategies and Requirements, and Consumption Models

Agenda and Order of the Day

Friday 29 September 08.30–10.30 (Erasmus Room)
Friday 29 September 11.00–12.30 (Erasmus Room)

		Time
1.	**Opening**	08.30
2.	**Introduction**	
3.	**Presentation of papers**	
Q:02	*A.V. Dolgov*: Feeding and food consumption by the Barents Sea predatory fishes in the 1980-90s	08.35
Q:10	*D.J. Uzars, T.Baranova, and E. Yula*: Variation in environmental conditions, feeding, and growth of cod in the eastern Baltic	09.00
Q:11	*F. Velasco and I. Olaso*: Hake food consumption in the southern Bay of Biscay estimated from a gastric evacuation model	09.25
Q:12	*F.Velasco, J. Riis-Vestergaard, L. Hill and I.Olaso*: Food consumption of European hake (*Merluccius merluccius*) estimated by the application of two bioenergetic models: Is the growth of hake underestimated ?	09.50
Q:09	*D. Righton, K. Turner, and J.D. Metcalfe*: Behavioural switching in North Sea cod: Implications for foraging strategy ?	10.05
	Coffee break	10.30
Q:05	*V. Lapko, K. Aydin, V. Radchenko, and P. Livingston*: A comparison of the Eastern and Western Bering Seas as seen through predation-based food web modeling	11.00
Q:03	*R.W. Furness*: Impacts of fisheries on seabird community stability	11.25
Q:08	*W.A. Montevecchi and G.K. Davoren*: Prey selectivity, capelin, and inter-annual variation in the diets of common murre chicks in the Northwest Atlantic	11.50
	Posters	12.15
Q:13	*L. Hill and M.F. Borges*: A comparison of the seasonal abundance of hake (*Merluccius merluccius*) and its main prey species off the Portuguese coast	
Q:14	*T. Tamura and Y. Fujise*: Geographical and seasonal changes of prey species and prey consumption in the western North Pacific minke whales	
Q:15	*V.N. Feldman, F.A. Patokine and N.A. Kalinina*: Diet composition, feeding rhythms, and daily rations of the Baltic herring in the Gdansk basin	
Q:16	*K. Kilongo*: Geographical distribution versus feeding habits of large-eye dentex (*Dentex macrophathalmus*) off Namibia and Angola	
	End of session	12.30

THEME SESSION Q
on
Trophic Dynamics of Top Predators: Foraging Strategies and Requirements, and Consumption Models

Agenda and Order of the Day

Saturday 30 September 11.00–12.30 (Morus Room)

3.	**Presentation of papers (cont.)**	**Time**
Q:04	*S. Garthe and W.A. Montevecchi*: Foraging strategies of seabirds: the northern Gannet (*Sula bassana*) as a model	11.00
Q:07	*U. Lindstrøm, A. Harbitz, T. Haug, and T. Pedersen*: Foraging behaviour of minke whales (*Balaenoptera acutorostrata*) in the southern Barents Sea	11.25
Q:01	*Bjørge, T. Bekkby, V. Bakkestuen, and E. Framstad*: Harbour seal (*Phoca vitulina*) habitat use and interaction with fisheries as explored by a combined GIS and population energetic model	11.50
4.	**General discussion and summing up**	12.15
5.	**Conclusions and Proposals**	
6.	**End of Session**	12.30

THEME SESSION R
on
The Application of Experimental Laboratory Studies to Fisheries Science

Agenda and Order of the Day

Thursday 28 September 09.30–10.30 (Ambassadeur Room)
Thursday 28 September 11.00–12.30 (Ambassadeur Room)

		Time
1.	**Opening**	09.30
2.	**Introduction**	
3.	**Presentation of papers**	
Code	*author(s) + title*	
R:12	*N. Chr. Stenseth, J. Gjøsæter, K. Lekve, and A. Frigessi:* Modeling the population dynamics of cod along the Norwegian Skagerrak coast: what we need to understand better before we have a reliable population model	09.35
R:02	*Ø. Fiksen, E. Otterlei, and A. Folkvord:* Experiments and models as reciprocal tools to understand environmental links in recruitment dynamics	09.50
R:01	*J.-D. Dutil, Y. Lambert, and D. Chabot:* Estimating natural mortality of wild cod from controlled feeding and starvation experiments conducted in the laboratory	10.05
	Discussion	10.20
	Coffee break	10.30
R:04	*H. Høie, A. Folkvord, and A. Johannessen:* A multivariate analysis of the condition of herring larvae from different environmental regimes	11.00
R:07	*T. Rasmussen, M. Aschan, and J. S. Christiansen:* The implementation of laboratory studies to shrimp recruitment modelling – a brief review of experimental procedures	11.10
R:08	*T. Svåsand, A.M. Ajiad, G.R. Carvalho, C. Clemmesen, G. Dahle, L. Hauser, W.F. Hutchinson, T. Jakobsen, O.S. Kjesbu, E. Moksness, H. Otteraa, H. Paulsen, D. Schnack, P. Solemdal, and A. Thorsen:* Demonstration of maternal effects of Atlantic cod: Combining the use of unique mesocosm and novel molecular techniques – A new EU-project	11.20
R:09	*P.R. Witthames, T.E. Andersen, and O.S. Kjesbu:* The application of tank experiments to the study of reproductive potential in teleosts using *Gadus morhua* as a test model	11.35
R:05	*A. Nissling, L. Westin, and O. Hjerne:* Spawning success in relation to salinity of three flatfish species (*Pleuronectes limanda*), plaice (*Pleuronectes platessa*), and flounder (*Pleurone flesus*), in the brackish water Baltic Sea.	11.50

4. General discussion and summing up 12.05

5. End of Session 12.30

Posters

R:10 *A. Moreira, P. B. Machado, and I. Figueiredo:* The use of known ageing techniques to enhance growth bands on the second dorsal spine of the gulper shark (*Centrophorus granulosus* Schneider, 1801) and the portuguese dogfish (*Centroscymnus coelolepis* Bocage & Capello, 1864)

R:11 *L. Vallin and A. Nissling:* Maternal effects on egg size and egg buoyancy of Baltic cod, *Gadus morhua*. Implications for stock structure effects on recruitment

THEME SESSION S

on

Temporal and Spatial Trends in the Distribution of Contaminants and their Biological Effects in the ICES Area

Agenda and Order of the Day

Thursday 28 September 14.00–16.00 (Ambassadeur Room)
Thursday 28 September 16.30–18.00 (Ambassadeur Room)

		Time
1.	**Opening**	14.00
2.	**Introduction**	14.00
3.	**Presentation of papers**	
Code	*author(s) + title*	
S:02	*Stuart Fleming, R.W. Furness, and Ian M. Davies*: Contemporary patterns and historical rates of increase of mercury contamination in different marine food chains	14.00
S:07	*Hans J.C. Klamer, Willem M.G.M. van Loon, L.A. Villerius, A.E. van de Zande, and J.F. Bakker*: QID: an innovative instrument for identification and verification of environmental toxicity	14.15
S:11	*Kevin V. Thomas, Mark R. Hurst, Jacqueline Lavender, Peter Matthiessen, John E. Thain, and Mike J. Waldock*: Characterizing hazardous substances in the UK marine environment	14.30
S:09	*Rolf Schneider, Doris Schiedek, and Gitte I. Petersen*: Baltic cod reproductive impairment: ovarian organochlorine levels, hepatic EROD activity, development success of eggs and larvae, challenge tests	14.45
S:01	*H. v. Westernhagen, V. Dethlefsen and M. Haarich*: Temporal trends in malformations of pelagic fish embryos from the southern North Sea in relation to anthropogenic xenobiotics	15.00
S:03	*Ketil Hylland, Birger Bjerkeng, and Norman Green*: Is there a relationship between accumulated contaminants and biomarker responses in Atlantic cod, *Gadus morhua*?	15.15
S:06	*Mark F. Kirby, Mark Hurst, Carole A. Kelly, Sonia J. Kirby, Paula Neall, Tina A. Tylor, Steven Morris, and Peter Matthiessen*: EROD and ChE measurements in flounder (*Platichthys flesus*) as monitoring tools in English estuaries	15.30
S:10	*J. Thain, Y. Allen, S. Kirby, and J. Reed*: The use of Sediment Bioassays in Monitoring and Surveillance Programs in the UK: A preliminary assessment	15.45
	Coffee break	16.00
S:04	*Ketil Hylland*: Strategies to investigate links between community response and individual response to environmental contaminants	16.30

S:08 *Peter Matthiessen, Yvonne Allen, John Bignell, John Craft, Steve Feist, Gary Jones, Ioanna Katsiadaki, Mark Kirby, Fiona Robertson, Sandy Scott, Christie Stewart and John Thain*: Studies of endocrine disruption in marine fish – progress with the EDMAR programme 16.45

S:12 *W. Wosniok, T. Lang, V. Dethlefsen, S.W. Feist, A.H. McVicar, S. Mellergaard, and A.D. Vethaak*: Analysis of ICES long-term data on diseases of North Sea dab (*Limanda limanda*) in relation to contaminants and other environmental factors 17.00

S:05 *Ketil Hylland*: Biological effect of contaminants in pelagic marine ecosystems – a practical workshop 17.15

4. General discussion and summing up 17.30

5. Conclusions and Proposals 17.50

6. End of Session 18.00

Posters

S:13 *A.D. McIntosh, L. Webster, and D. Richardson*: Temporal trend observations in fish and sediments in the Clyde estuary

S:14 *A.D. McIntosh, L. Webster, and B. Gowland*: Biomarkers and PAH concentrations of the common mussel, *Mytilus edulis*, in an industrially polluted sea loch

S:15 *A.D. McIntosh, L. Webster, and D. Richardson*: PAH concentrations and bile metabolite measurements in plaice and flounder from the Firth of Forth

THEME SESSION T
on
Classification and Mapping of Marine Habitats

Agenda and Order of the Day

Friday 29 September 08.30–10.30 (Morus Room)
Friday 29 September 11.00–12.30 (Morus Room)

		Time
1.	**Opening**	08.30
2.	**Presentation of papers**	
Code	*author(s) + title*	
	"I. Mapping habitats"	
T:11	*Alexander Korolev and Marine Fetter*: The mapping of benthic biocenoses in the coastal zone of Latvia	08.30
T:02	*C.J. Brown, K.M. Cooper, W.J. Meadows, D.S. Limpenny, and H.L. Rees*: An assessment of two acoustic survey techniques as a means of mapping seabed assemblages in the Eastern English Channel	08.50
T:13	*Thomas Noji, Terje Thorsnes, and Jan Helge Fosså*: Marine habitat mapping for the Norwegian Sea	09.10
T:03	*David W. Connor*: The BioMar marine habitat classification – its application in mapping, sensitivity and management	09.30
T:06	*S. Degraer, V. van Lancker, G. Moerkerke, M. Vincx, P. Jacobs, and J.P. Henriet*: Intensive evaluation of the evolution of a protected benthic habitat: HABITAT	09.50
T:05	*D.J. de Jong*: Ecotopes in the Dutch marine tidal waters	10.10
	Coffee break	10.30
	"II. Imaging Techniques"	
T:12	*Ron McHugh*: The potential of synthetic aperture sonar in seafloor imaging	11.00
T:15	*Maria J. Rendas and Jon Side*: Using autonomous underwater vehicles for seabed habitat mapping	11.15
T:07	*D.C. Gordon, E.L.R. Kenchington, K.D. Gilkinson, D.L. McKeown, G. Steeves, M. Chen-Yee, W.P. Vass, K. Bentham, and P.R. Boudreau*: Canadian imaging and sampling technology for studying marine benthic habitat and biological communities	11.30
T:16	*B.J. Todd, V.E. Kostylev,G.B.J. Fader, R.C. Courtney, and R.A. Pickrill*: New approaches to benthic habitat mapping integrating multibeam bathymetry and backscatter, surficial geology and sea floor photographs: a case study from the Scotian Shelf, Atlantic Canada	11,45
T:10	*A.J. Kenny et al.*: An overview of seabed mapping technologies in the context of marine habitat classification	12.00

THEME SESSION T
on
Classification and Mapping of Marine Habitats

Agenda and Order of the Day

Saturday 30 September 13.30–15.30 (Morus Room)

	"III. Classifying habitats"	
T:14	*Daniel Pauly, Villy Christensen, Rainer Froese, Alan Longhurst, Trevor Platt, Shubha Sathyendranath, Kenneth Sherman and Reg Watson*: Mapping fisheries onto marine ecosystems: a proposal for a consensus approach for regional, oceanic, and global integrations	13.30
T:08	*H.Gary Greene, M.M Yoklavich, V.M. O'Connell, R.M. Starr, W.W. Wakefield, C.K. Brylinsky, J.J. Bizzarro, and G.M. Cailliet*: Mapping and classification of deep seafloor habitats	13.50
T:01	*Rebecca .J. Allee*: A proposed ecosystem and habitat classification system for United States marine and estuarine waters	14.10
T:04	*Cynthia E. Davies and D. Moss*: The EUNIS habitat classification	14.30
	"IV. Future challenges"	
T:09	*Eric Jagtman*: Marine habitat classification and mapping within ICES: where to go from here?	14.50
3.	**Conclusions and Proposals**	15.15
4.	**End of Session**	15.30

THEME SESSION U
on
Marine Biological Invasions: Retrospectives for the 20th Century – Prospectives for the 21st Century

Agenda and Order of the Day

Saturday 30 September 09.30–10.30 (Vives Room)
Saturday 30 September 11.00–12.30 (Vives Room)
Saturday 30 September 13.30–15.30 (Vives Room)

		Time
1.	**Opening** *James T. Carlton*	09.30
2.	**Introduction** *James T. Carlton*: Introduction: Marine Biological Invasions and the ICES Working Group on Introductions and Transfers of Marine Organisms	09.35
3.	**Presentation of papers**	
Code	*author(s)* + title	
U:13	*Dan A. Minchin*: A conceptual approach for management of exotic species; modes of life, time-tunnels, and exotic species cells	09.45
U:06	*Oliver Floeri and Graeme J. Inglis*: Marine bioinvasions: quantifying the potential of a transfer vector by analysing its relationship with the donor region	09.55
U:08	*Chad L. Hewitt*: Marine biological invasions in Australian coastal waters: Current status and future trends	10.05
	Discussion	10.15
	Coffee break	10.30
U:01	*Allegra A. Cangelosi and Ivor T. Knight:* Comparing the bioeffectiveness of ballast water treatments	11.00
U:12	*Daniel Masson*: Ballast water research in France: current status	11.10
U:15	*Henn Ojaveer, S. Gollasch, S. Olenin, V. Panov, and E. Leppäoski*: Distribution and ecosystem impacts of exotic species in the Baltic Sea	11.20
U:14	*E.N. Naumenko and Yu. Yu Polunina*: New Cladocera species – *Cercopagis pengoi* (Ostroumov, 1891) (Crustacea) in the Vistula Lagoon in the Baltic Sea	11.30
U:16	*Henn Ojaveer, M. Simm, and A. Lankov*: Consequences of invasion of a predatory cladoceran	11.40
U:05	*Elena Ezhova and L.V. Rudinskaya:* Ecological impact of *Marenzelleria viridis* (Polychaeta; Spionidae) in the Vistula lagoon, Baltic Sea	11.50
U:04	*Karel Essink and Rob Dekker*: Invasion ecology of *Marenzelleria c.f. wireni* (Polychaeta; Spionidae) in the Dutch Wadden Sea	12.00

U:17	*Giulio Relini, M Relini, and G. Torchia*: Fish population changes following to invasion of the allochthonous alga *Caulerpa taxifolia* in the Ligurian Sea (NW-Mediterranean)	12.10
	Discussion	12.20
	Lunch break	12.30
U:18	*Sigal Sheffer, Eli Geffen and Avigdor Abelson*: The invasion of Red Sea species to the Mediterranean Sea: defining invasion mechanisms by assessment of transport modes and routes	13.30
U:10	*Ahmet E. Kideys, Zina Romanova, Galina A. Finenko, and Levent Bat*: Alien wars in the Black Sea	13.40
U:19	*Susan D. Utting*: Introductions of molluscan shellfish – past experience and future considerations	13.50
U:20	*Gro I. van der Meeren, Kees O. Ekeli, Knut E. Jørstad, and Stein Tveite:* Americans on the wrong side – the lobster *Homarus americanus* captured in Norwegian waters	14.00
U:11	*V.V. Krylov:* An optimum annual catch of snow crab *Chionoecetes opilio*	14.10
U:07	*A. Gudimov and Elena Gudimova*: Towards biological consequences of the introduction of red king crab *Paralithodes camtchatica* in the Barents Sea	14.20
U:03	*Clare Eno and John P. Hamer*: The nature conservation implications of marine biological introductions	14.30
4.	**General Discussion and Summing Up**	14.40
5.	**Conclusions and Proposals**	15.00
6.	**End of Session**	15.25
	Posters	
U:21	*S.A. Kuzmin*: Distribution of snow crab *Chionoecetes opilito* (Fabricius) in the Barents Sea	
U:22	*Inger Wallentinus:* Introduced macrophytes – do they have as large an impact on the ecosystem and fisheries as animals?	

THEME SESSION V
on
Medium-Term Forecasts in Decision-Making

Agenda and Order of the Day

Friday 29 September 08.30–10.30 (Vives Room)
Friday 29 September 11.00–12.30 (Vives Room)

		Time
1.	**Opening**	08.30
2.	**Presentation of papers**	
	Invited Lecture: A. Laurec: Could formulation of advice be developed to improve support for decision-making ?	08.30
Code	*author(s)* + title	
	Case Studies	
V:11	*D.A. Vasilyev, S.V. Belikov, and A.I. Krysov*: Blue whiting: results of stock assessment using filtered catch-at-age data	08.45
V:09	*V.L. Tretyak*: Modelling of age-dependent instantaneous coefficients of natural mortality for Northeast Arctic cod	09.00
V:02	*Tenno Drevs*: On the flounder yield and spawning stock medium-term forecasts in Estonian waters	09.15
V:01	*Bjarke Bogstad, Ingolf Røttingen, Per Sandberg, and Sigurd Tjelmemand*: The use of medium-term forecasts in advice and management decisions for the stock of Norwegian spring spawning herring *(Clupea harengus)*	09.30
V:07	*H.-J. Rätz, J. Lloret, J. Casey, A. Aglen, and S.A. Schopka*: Variation in fish condition between Atlantic cod (*Gadus morhua*) stocks and implications for their management	09.45
	Environment and Ecosystem Considerations	
V:04	*Johannes Hamre*: Effects of climate and stock interactions on the yield of Northeast Arctic cod. Results from multispecies model runs	10.00
V:05	*C.L. Needle, C.M. O'Brien, and C.D. Darby*: The use of recruitment time-series structure and environmental information in medium-term projections	10.15
	Coffee break	10.30

Methods and Models

V:10 *D.A. Vasilyev*: Triple-separable VPA (TSVPA), or a stone to bridge the gap between separable cohort models and nonseparable ones 11.00

V:03 *Stratis Gavaris, K.R. Patterson, C.D Darby, P. Lewy, B. Mesnil, A.E. Punt, R.M. Cook, L.T. Kell, C.M. O'Brien, V.R. Restrepo, D.W. Skagen, and G. Stefánsson*: Comparison of uncertainty estimates in the short term using real data" 11.15

V:08 *V.R. Restrepo, K.R. Patterson, C.D Darby, S. Gavaris, P. Lewy, B. Mesnil, A.E. Punt, R.M. Cook, L.T. Kell, C.M. O'Brien, D.W. Skagen, and G. Stefánsson*: Do different methods provide accurate probability statements in the short term ? 11.30

V:06 *K.R. Patterson, C.D Darby, S. Gavaris, P. Lewy, B. Mesnil, A.E. Punt, R.M. Cook, L.T. Kell, C.M. O'Brien, V.R. Restrepo, D.W. Skagen and G. Stefánsson*: Validating three methods for making probability statements in fisheries forecasts 11.45

4. General discussion and summing up 12.00

5. Conclusions and Proposals 12.20

6. End of Session 12.30

Poster

V:12 *M.A. Pérez, A. Aubone, M. Renzi, A. Madirolas, M. Ehrlich, G. Irusta and M. Simonazzi*: Overfishing indications in the hake (*Merluccius hubbsi*) stock south of 41 °S, southwest Atlantic Ocean

THEME SESSION W
on
Cooperative Research with the Fishing Industry: Lessons Learned

Agenda and Order of the Day

Thursday 28 September 09.30–10.30 (Morus Room)
Thursday 28 September 11.00–12.30 (Morus Room)
Thursday 28 September 14.00–16.00 (Morus Room)

		Time
1.	**Opening**	09.30
2.	**Introduction**	
3.	**Presentation of papers**	
Code	*authors(s)* + title	
W:01	*James A. Boutillier:* Getting to yes with stakeholders in fisheries resource assessment – a paradigm shift	09.35
W:02	*Ross Claytor, Jacques Allard, Allen Clay, Claude LeBlanc, and Ghislain Chouinard:* Fishery acoustic indices for assessing Atlantic herring populations	09.48
W:03	*Pablo Durán Muñoz and Esther Román Marcote:* Spanish experimental fishings: A cooperative research initiative between scientifics and the local fishing industry	10.01
W:04	*Pablo Durán Muñoz, Esther Román Marcote, and Fernando González:* Results of a deep-water experimental fishing in the North Atlantic: An example of cooperative research with the fishing industry	10.14
	Coffee break	10.30
W:05	*R.S.T. Ferro, G.N. Graham, and F.G. O'Neill:* A recent UK joint initiative to revise technical conservation measures regulating the design of mobile gears	11.00
W:06	*K.H. Hauge:* Fisheries scientist's struggle for objectivity	11.13
W:07	*William A. Karp, Craig S. Rose, John R. Gauvin, and Sarah K. Gaichas:* Government-industry cooperative research in the United States. Provisions under the Magnuson-Stevens Fishery Conservation and Management Act and examples from the Gulf of Alaska and the Eastern Bering Sea	11.26
W:08	*Peter A. Koeller:* Co-managing the Scotian Shelf Shrimp Fishery – so far so green	11.39

W:09	*Richard McGarvey and Michael Pennington:* Designing and evaluating length-frequency surveys for trap fisheries	11.52
W:10	*J. Ferreira Dias, J. Cruz Filipe, J. Menezes, and J. Gonçalves Dias:* Economics impact of sardine scarcity on the Portuguese canned fish industry: a system dynamics study	12.05
W:11	*Richard D. Methot, John R. Wallace, and Charles W. West:* Introducing a new trawl survey for West Coast slope groundfish	12.18
	Lunch break	12.30
W:12	*Martin A. Pastoors, J.J. Poos, and A.D. Rijnsdorp:* On the use of skipper's logbook data in the interpretation of trends in fisheries	14.00
W:13	*Paul J. Rago, Steve Murawski, Kevin Stokesbury, William DuPaul, and Michael McSherry:* Integrated management of the Sea Scallop Fishery in the Northeast USA: Research and commercial vessel surveys, observers, and vessel monitoring systems	14.13
W:14	*A. Salthaug and O.R. Godø:* Analysis of CPUE from the Norwegian bottom trawl fleet	14.26
W:15	*Daniel F. Schick and Michael Brown:* Cooperative government/industry efforts in gear development and gear acceptance in the State of Maine Silver hake fishery	14.39
W:16	*Aril Slotte:* Use of data from the commercial fishing industry in the management of Norwegian spring spawning herring (*Clupea harengus* L.)	14.52
W:17	*Rob Stephenson, Gary Melvin, Mike Power, Jack Fife, Dan Lane, and Don Aldous:* Cooperative research with the Scotia-Fundy herring fishing industry: Lessons learned	15.05
W:20	*K.C.T. Zwanenburg and S. Wilson:* The Scotian Shelf and Southern Grand Banks Atlantic halibut (*Hippoglossus hippoglossus*) survey – Collaboration between the fishing and fisheries science organisation	15.18
W:21	*Philip MacMullen:* The unintended impacts of gill netting in European waters – quantifying and mitigating the ghost fishing phenomenon	15.31
4.	**General discussion and summing up**	15.44
5.	**End of Session**	

THEME SESSION X
on
Development of Reference Points and Management Systems for Fisheries and the Marine Ecosystem

Agenda and Order of the Day

Wednesday 27 September 11.30–13.00 (Morus Room)
Wednesday 27 September 14.00–16.00 (Morus Room)

		Time
1.	**Opening:** (Co-Chairs: Mike Sissenwine, Gerald van Balsfoort, Alain Laurec; Rapporteur: Niels Axel Nielsen)	11.30
2.	**Introduction :** Joe Horwood	11.30
	Alain Laurec	11.35
3.	**Presentation of papers**	
X:08	*Ingolf Røttingen*: A review of the process leading to the establishment of limit and precautionary reference points for the stock of Norwegian spring spawning herring	11.40
	Discussion	
X:09	*Sigurdur Tor Jónsson and Einar Hjörleifsson*: Stock assessment bias and variation, analyzed retrospectively from ICES quality control sheets, and introducing the PA-residual	12.00
	Discussion	
X:07	*Laura J. Richards*: Developing a wild salmon policy for Pacific Canada	12.20
	Discussion	
X:02	*Robin Cook*: Complementing the ICES advisory process with stakeholders' input	12.40
	Discussion	
	Lunch break	13.00
X:06	*Martin A. Pastoors, Peter Bailey, and Kjellrun Hiis-Hauge*: Analysis of communication over and understanding of the 'precautionary approach'	14.00
	Discussion	
X:01	*Sue Brown*: The precautionary approach: a User's view	14.20
	Discussion	
X:04	*François Gauthiez*: Multi-annual strategies: improving stock management and the dialogue between scientists and managers	14.40
	Discussion	
X:03	*Barrie Deas*: Fisherman and scientists: Collaboration as the basis for stock recovery	15.00
	Discussion	
X:05	*Joe Horwood*: Regime shifts and fisheries management	15.20
	Discussion	
4.	**General discussion and summing up:** (Co-convenors: Mike Sissenwine, Gerald van Balsfoort, Niels Axel Nielsen, and Joe Horwood with Alain Laurec)	15.40
5.	**Conclusions and Proposals**	15.55
6.	**End of Session**	16.00

THEME SESSION Y
on
Downturn in North Atlantic Salmon Abundance

Agenda and Order of the Day

Wednesday, 27 September 11.30–13.00 (Vives Room)

	Session I	**Time**
1.	**Opening and introduction of Session I**	11.30
2.	**Appointment of rapporteur**	11.35
3.	**Presentation of papers:**	
Y:07	*N. Ó. Maoiléidigh*: ICES Working Group on North Atlantic Salmon (Stock status summary)	11.40
Y:04	*A.F. Youngston, R.J. Fryer, and J.C. McLean*: Rod catches as indicators of abundance in the Scottish salmon fisheries	12.00
Y:03	*Arni Ísaksson and S. Óskarsson*: Status of Icelandic salmon stocks	12.15
Y:08	*Malcolm Windsor and Peter Hutchinson*: Recent Developments in Salmon Conservation through International Cooperation in NASCO	12.30
	Discussions and conclusions	12.45
4.	**End of Session I**	13.00

THEME SESSION Y
on
Downturn in North Atlantic Salmon Abundance

Agenda and Order of the Day
Saturday, 30 September 09.30–10.30 (Morus Room)

Session II

1.	**Opening and introduction of Session II**	09.30
2.	**Presentation of papers**	
Y:01	*Kerim Aydin* (keynote): ENSO- and regime-scale variation in the biogeography of Gulf of Alaska micronekton as a driving mechanism for observed growth trends in Pacific salmon	09.35
3.	**Discussion regarding a salmonid platform within the ICES Annual Science Conference**	09:55
4.	**Conclusions and Proposals**	10:15
5.	**End of Session**	10:30

Posters

Y:05 *G.B. Lizana, Y. Borrell, E. Vásquez, and J.A. Sánchez*: Microsatellite variation and estimation of genetic relatedness in Atlantic salmon

Y:06 *P. Sánchez, M.D. Ramos, H. Pineda, Y. Borrel, E. Vázquez, and G. Blanco*:
The application of genetic variation at microsatellite loci in Atlantic salmon (*Salmo salar* L.) stock identification

THEME SESSION Z
on
General Fisheries and Marine Ecology

Agenda and Order of the Day

Thursday 28 September 16.30–18.00 (Morus Room)

		Time
1.	**Opening**	16.30
2.	**Introduction**	
3.	**Presentation of papers**	
Code	*author(s) + title*	
Z:06	*Yu.I. Bakay*: Parasites and pigmented patches as indicators of intraspecific structure of *Sebastes mentella* in the Irminger Sea	16.35
Z:05	*Iwona Psuty-Lipska*: Eelpout as an index of changes in the fish community of Gdansk Bay in 1985–1999	16.45
Z:07	*Philip Percival and Chris Frid*: The impact of fishing disturbance on benthic nutrient regeneration and flux rate	16.55
Z:01	*Alexander Arkhipkin and David Middleton*: Squid interspecific competition: possible impact of *Illex argentinus* onto *Loligo gahi* recruitment in the Southwest Atlantic	17.05
Z:02	*Dariusz P. Fey*: Temperature and growth rate effect on the otolith size – fish size relationship estimated for Baltic herring from the Vistula Lagoon	17.15
Z:03	*Kristin Helle, Bjarte Bogstad, Geir Ottersen, and Michael Pennington*: Some environmental factors that influence the growth of Arcto-Norwegian cod from the early juvenile to the adult stage	17.25
4.	**General discussion and summing up, conclusions and proposals**	17.35
5.	**End of Session**	18.00
	Posters	
Z:09	*Paulino Lucio, M. Santurtun, and I Quincoces*: Tagging experiments on hake, anglerfish, and other species in the Bay of Biscay	
Z:10	*Paulino Lucio, M. Santurun, A. Martínez Murgía, and I Quincoces*: Experiments on horse mackerel in captivity. (An experiment of survival of this species tagged with external and internal tags)	

Z:11 *Hilario Murua, M. Santurtun, I Quincoces, and Paulino Lucio*: Oocyte diameter evolution along the year and batch fecundity of hake in the Bay of Biscay (ICES Divisions VIIIa, b, and d)

Z:12 *Anna Terrats and G. Petrakis*: Histological study of the gonadal development of armed gurnard, *Peristedion cataprhactum* (L. 1758)

Z:13 *Lies Van Nieuwerburgh, Ingrid Wänstrand, and Pauli Snoeijs*: Pigment transfer from phytoplankton to copepods in nutrient-enriched mesocosms

Abstracts to the 2000 Annual Science Conference

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MINI-SYMPOSIUM

on

Defining the Role of ICES in Supporting Biodiversity Conservation (Mini)

CM 2000/Mini:01

Ecological reference points for North Sea benthos: can we manage benthic biodiversity?

C. Frid and L. Robinson

Fishing has a long history and the North Sea was already exploited by powered vessels prior to any major marine biological studies. We do not therefore have any data on the benthos of the North Sea in an unfished state. The direct effects of fishing on the benthos are now clearly established and there is a growing body of information on the indirect effects – changed predation pressure, increased opportunities for scavengers. We use historical data and the results of various experimental studies to hind cast the state of the 'unperturbed' North Sea benthos. We then consider properties of these communities that might be suitable for use as ecological reference points within the framework of ecosystem management. Many of the available data suggest that subtle changes in infaunal communities result from moderate levels of exploitation and that indirect effects actually play a greater role in driving change than the direct effects of fishing. Easily measured and interpreted reference points are crucial to effective management and we discuss suitable metrics for the benthic system against the background of long-term and wide-spread indirect ecologcial impacts.

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ICES CM 2000/Mini:02

Using biological characteristics to develop new indices of ecosystem health

C. Frid, S. Rogers, M. Nicholson, J. Ellis, and S. Freeman

Traditionally, environmental monitoring of habitat degradation relies upon measures of species richness and variations in species relative abundance or biomass. This takes no account of ecosystem function, and does not recognise that different species may perform similar ecological roles. We have incorporated biological traits of epibenthic marine organisms, such as life-history, ecology and morphology, to validate the idea that a suite of such traits can be used to assess both the diversity and health of a community. These characteristics will reflect the sensitivity, habitat complexity and trophic structure of the biotopes, and thereby provide valuable information on ecosystem health. It is based on the assumption that different species, but which occupy environments with similar properties, can have similar characteristics. The traits used can include body form (e.g. streamlined or branching), mobility, reproductive potential and trophic role (e.g. filter feeder or scavenger). This approach will allow the ecological status of the marine benthos to be characterised and the degree of deviation from the expected pattern will provide evidence of the response of a community to a specified impact (e.g. fishing activity or dredging). This paper describes the results of such an analysis using samples of macro- benthic organisms collected from extensive areas of the western coastal and shelf seas of the UK. In principle the technique should be applicable to other components of the ecosystem, and the value of incorporating organisms from other trophic levels is discussed.

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ICES CM 2000/Mini:03

Scientific advice for marine ecosystem management - an NGO perspective

S. Jones, S. Lutter, and S. Cripps

Scientific advice is a fundamental component of integrated marine management working towards protecting the structure, function and robustness of marine ecosystems. Legislation, policy and work programmes on an international, regional and European level rely on scientific advice for setting, achieving and sustaining operational objectives to meet their requirements. The OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic (1992) and the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area (1992) are working towards implementing the requirements of the Convention of Biodiversity (1993) on a regional seas level. The EU Common Fisheries Policy has competence over fisheries in European waters but the policy and its management is poorly integrated with other frameworks. We have identified

two "sets" of objectives which work towards protecting the structure, function and robustness of marine ecosystems: 1) Nature Conservation Objectives 2) Sustainable Use Objectives. We argue that management plans to achieve nature conservation objectives and management plans to achieve sustainable use objectives are interdependent. These plans must be based on scientific which is fully integrated and operational. We consider the role of management tools such as the setting of reference points and "benchmarks" for target and non-target species, marine protected areas and the use of no-take zones for fisheries management.

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ICES CM 2000/Mini:04

Why are large, delicate, gelatinous organisms so successful in the ocean's interior?

T. Osborn and R.T. Barber

A recent accomplishment of biological oceanography is the discovery that the pelagic ocean has an extremely abundant fauna of large, delicate, gelatinous organisms. What makes this body plan so successful in the ocean interior? The large gossamer design has been exploited by several phyla, emphasizing the adaptive advantage of this unusual life form. The classical large, gossamer, gelatinous phyla are the "jellies", cnidaria and ctenophores (Matsumoto and Robison 1992; Robison et. Al. 1998), but recent exploration of the mesopelagic realm (200 - 1000 m) by both manned and unmanned vehicles has found other phyla such as tunicates (larvaceans) and mollusks (pteropods), both of which exploit this life form by producing huge feeding structures (Hammer and Robison 1992). The size of these delicate organisms ranges from about 0.3 - 3.0 m, but sonic-imaging reveals some organisms over 30 m in length (Robison 1993, 1995). These magnificent animals are never represented in the mangled specimens harvested by nets.

This gossamer design has one large vulnerability: habitats with strong shearing motions destroy these delicate organisms. As a result, this design is absent in coastal waters, least prevalent in turbulent polar waters, and only occasionally abundant in pelagic surface waters. They are most prevalent in the lower energy mesopelagic realm. Given that vulnerability to destruction by shearing motions is a severe liability, what enables these large, delicate animals to be so successful?

We suggest the large, delicate, gelatinous design is successful in the ocean interior because *i*) it provides a feeding benefit that cannot be obtained with a more compact body design, and *ii*) it reduces predation by providing an unrewarding meal for big predators and a danger to small predators.

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ICES CM 2000/Mini:05

ICES and species at risk

J. Rice

Conservation of species at risk of extinction has become one of the flagship areas of activism for biodiversity. Science has two key roles in conservation of species vulnerable to extinction; identification of species at risk and development of plans for recovery of such species.

The International Union for Conservation of Nature (IUCN) has played a lead role in this aspect of conservation biology since its inception. Its work on suitable classes for level of risk, and criteria for listing species in the various categories has strongly influenced both international groups, such as CITES, and most national jurisdictions. With the issuance of the 1996 Redbook the IUCN advanced the science of identifying and classifying species at risk of extinction significantly, by proposing and applying a set of empirical criteria which were intended to apply uniformly to all organisms from algae to whales. The text associated with these criteria noted there would be a number of special considerations for certain species groups, and species supporting commercial fisheries were identified as one class of taxa where special considerations might have to be addressed.

Starting at the 1996 IUCN meeting debate about the applicability of the IUCN criteria (or the minor variants of them adopted by other national and international bodies) to marine fish and invertebrates has raged in many settings. Some of the debate has enlightened and clarified technical issues; some has been acrimonious and hardened extreme positions. Throughout, ICES has contributed nothing to the science discussion of this key aspect of conservation of biodiversity.

In my talk I will highlight aspects of the history and background to scientific criteria for identifying species at risk of extinction that are not covered by other talks in the this mini-symposium. I will then focus on the types of expertise available within the ICES community. I will discuss how that expertise is relevant to the identification and application of criteria for species at risk. I will also discuss how the ICES Science Committee, Working Group, and Advisory Committee framework could address this issue. Because the issue of marine and anadromous species at risk is not going to go away on its own, I will even conjecture on possible

consequences for the credibility of ICES science and advisory roles if ICES continues to treat species at risk as a non-issue.

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ICES CM 2000/Mini:06

Using discards estimates for assessing the impact of fishing on biodiversity

M.-J. Rochet, V. Trenkel, J.-C. Poulard, and I. Péronnet

Assessing fisheries discards is an important point in assessing the impact of fisheries on biodiversity, hence an unavoidable step towards conservation. Whereas ICES working groups already put some effort into incorporating discard information in stock assessment of target species, less is done for non-target species. This paper focuses on how this assessment can be achieved, illustrated with an example from the Celtic Sea: i) Suitable discard sampling strategies, depending on whether the species of interest accounts for a high proportion of discards or not. ii) What is needed to predict discards without a full sampling effort? Is the information about target species given by landings useful? What about non-target species? iii) For non-target species: what would be needed to assess the impact on population dynamics of incidental catches? Can survey-based abundance indices be combined with discard estimates to detect the effects of fishing on populations? The high complexity of multispecies multifleet fisheries involving many countries implies a high cost for each of the above points. ICES might be an appropriate international forum to discuss the indices to be monitored and to propose operational sampling schemes.

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ICES CM 2000/Mini:07

Conserving fish stock structure is a critical aspect of preserving biodiversity

R. Stephenson and E. Kenchington

There is increasing attention to 'biodiversity' worldwide. In fisheries, the term biodiversity is being used more widely, and appears in several international agreements, but has not been defined adequately at the operational level. There is a range of scales at which biodiversity must be considered and defined. This paper discusses issues surrounding intraspecific biodiversity.

Common management strategies of (marine) fisheries assume single discrete populations, however there is a gradient of fish life history complexity, with species such as herring, cod and salmon exhibiting complex stock structure. Some problems in management of fisheries (reductions in distribution, decline in stock size, even collapses) have been accompanied by, perhaps even caused by, changes in spawning areas and times indicative of changes in stock structure.

In most cases it is unclear to what extent these changes represent a reduction in intraspecific biodiversity.

In this paper we review international statements and criteria pertaining to intraspecific biodiversity in relation to the development of objectives and reference points which may be considered by ICES. We discuss a number of potential performance measures for monitoring intraspecific biodiversity and summarize an attempt to apply these performance measures to a variety of marine species in the Scotian Shelf area of the Western Atlantic.

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ICES CM 2000/Mini:08

How ICES can help integrate biodiversity considerations into fisheries advice

M.L Tasker

Arguably the greatest strength of ICES is the broad breadth of marine scientists who are willing and able to work together in a politically neutral forum to gain a co-operative understanding of the marine environment and its processes. It is however regrettable that this broad range of expertise is not fully utilised in helping to manage human use of the marine environment. While there has been great progress in integration of advice from ICES in recent years, the symptoms of over-harvesting and excessive damage to non-harvested organisms persist.

ICES are, of course, not managers and for any advice to be effectively used it must be delivered into a management system that can respond accordingly. It is plain that the current fishery management regime in

Europe is having trouble in integrating the wider needs of the marine environment into the current way of working, despite there being many common objectives between biodiversity conservation and the sustainable management of fish stocks. There are a number of ways in which these common objectives might be better delivered – many of these will involve a wider range of interests in decision-making. Should an improved management structure for fisheries be established in Europe, ICES will need to change to not only provide advice on the state of fish stocks and recommended harvest levels, but also to provide advice on likely wider environmental effects of such decisions. For example, this may mean that environmental assessment of the various methods to catch fish will be required. A much wider constituency will likely be needed within the advisory structure of ICES.

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ICES CM 2000/Mini:09

The genetic structure of European eel revisited and implications for its conservation

F.A.M. Volckaert, E. Daemen, T. Cross, and F. Ollevier

The spawning population of European eel (*Anguilla anguilla* L.) has always been considered as panmictic. We test this hypothesis by screening glass eel from five locations (Ireland, Italy, Morocco, Sweden and U.K.) belonging to two cohorts, at the *Cytb locus* of the mitochondrion and at five nuclear microsatellite loci. Seventeen *Cytb haplotypes* were detected; the most common haplotype occurred in 47% of all fish. Phylogeographical structure based on the cytoplasmic marker revealed close similarity between British and Irish glass eel populations and weak differentiation among the British/Irish, Moroccan, Italian and Swedish populations respectively. Overall among population microsatellite differentiation (FST), due to two of the five microsatellite loci, was highly significant. In five of the six samples examined one locus showed highly significant deviations from Hardy-Weinberg proportions. The Moroccan sample did not exhibit such deviations and was genetically isolated from the other samples, as shown by phylogenetic analysis. Hardy-Weinberg proportions and the absence of linkage disequilibria at both differentiating loci suggest the presence of a single subpopulation in Morocco. We also estimated the effective population size from mitochrondrial and microsatellite genotypes. We conclude that the continental life phase of European eel does not constitute a panmictic population but includes an introgressed Icelandic population, a central/northern population and possibly a southern population. The current overfishing of European eel could have major repercussions on the long term genetic integrity.

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ICES CM 2000/Mini:10

Biodiversity at the population genetic level: microsatellite DNA poplymorphism in the sea trout population from southern Baltic

A. Was and R. Wenne

An important component of biodiversity is diversity between species and populations at the genetic level. Biodiversity conservation of species should include conservation of population genetic structures. In recent years, studies of microsatellite DNA polymorphism have become an exceptionally useful tool for identification and characterization of genetic diversity and differentiation within and among fish populations.

Brown trout (*Salmo trutta*) is an ecologically important and fishery (both sport and commercially) valuable species. Its migrating form: sea trout is dominant in Southern Baltic. In Poland, almost 90% of trout are descendent from artificial enhancing of natural populations by stocking. Therefore, the genetic consequences of stocking on natural populations can be strong. In this paper are presented results of studies on genetic differentiation of the sea trout populations from six Polish rivers: Rega, Parseta, Wieprza, Vistula, Slupia and Drweca. Five microsatellites Ssa 85, Ssa 171, Ssa 197, Str 15, Str 73 were studied. The presented results can be useful for future management of genetic resources of the sea trout.

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ICES CM 2000/Mini:11

Checklist and state of Baltic Sea fish species

H.M. Winkler, K. Skora, R. Repecka, M. Pliks, E. Urtans, A. Gushin, and H. Jespersen

Ichthyologists of the "Working Group of shallow water fish ecology" have collected and analysed data concerning the recent occurrence, the geographical distribution and the state of Baltic Sea fish species. The collected data stem from various sources: literature, collected material in museums, records on rare fishes, fishery statistics and finally research catches which were performed by means of different kinds of gear.

Scientists from various countries surrounding the Baltic Sea contributed regional checklists and have made an attempt in order to give a representative overview and description of the situation in the entire Baltic Sea. The area under consideration includes the Baltic Proper as well as the lagoons and estuaries provided that these are brackish.

Once recorded each species was listed in the checklist. Each of the listed species is characterized by the following information: indigenous/nonindigenous, ecological group (marine, freshwater and diadromos), type of occurrence (permanent, regular or accidental visitor), frequency of occurrence, restrictions to certain water quality (salinity), occurrence in the different geographical units of the Baltic Sea, national or international conservation state and some additional information. The checklist consist of more than 150 species. 93 % of them are indigenous, 65 % are marine, 26% freshwater and 9 % diadromos species. Depending on ecological conditions, the geographical distribution of a particular species various strongly within the Baltic Sea.

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ICES CM 2000/Mini:12 Poster

New data on composition and distribution of the Barents Sea ichtyofauna

A.V. Dolgov

A large body of qualitative 1940-1990 data on cod feeding, obtained onboard research and commercial vessels and available at PINRO, are not presently used in calculation of food consumption. The paper therefore compares data for 1984-1996 from qualitative and quantitative analyses of feeding of the Barents Sea cod made at different levels of temporal and spatial data aggregation (the entire sea – ICES Divisions, all year – quarters). A possibility to define total weight of stomach content by fullness degree (visual estimation of stomach fullness) is discovered for both a separate specimen and a sample containing several individuals. The existence of a relationship between weight portion of a food object and frequency of its occurrence is proved for most prey species (especially for capelin and young cod). The most explicit relationships were revealed for the data on the entire sea and the whole year, least distinctive – for the quarterly data by ICES Divisions. Options of using feeding data for calculation of food consumption by the Barents Sea cod are suggested.

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ICES CM 2000/Mini:13 (Poster)

Effects of commercial trawl fishing in the Straits of Sicily on the diversity of demersal resources

M. Gristina, G. Garofalo, G. Bono, and D. Levi

In this paper, the effects produced by commercial trawl fishing on the diversity of demersal resources in two areas of the Straits of Sicily subjected to different fishing effort, were analysed. Intensive fishing occurs along the first area (North/West Lampedusa) in the central part of the Strait of Sicily (Area "A"), while negligible or null fishing effort occurs in the second one (South/Est Malta), placed in the eastern portion of the Strait (Area "B"). Data on fishing effort, recorded since 1995, come from the Harbour Office and have been verified from interviews to crews and captains of Mazara del Vallo trawl fisheries. Data, coming from the hauls ranging from 200 to 500 m. of two trawl surveys (GRUND project) carried out in October 1997 and October 1998, were utilised to analyse structure and diversity of the demersal resources. The cluster analysis (employing the Bray-Curtis similarity matrix among species) shows the presence of two distinct group of hauls corresponding to the areas with different fishing effort. High values of the main diversity indexes seems to characterize the hauls subjected to a more intensive fishing effort. K-dominance curves for the two areas show that, in Area "A" the main part of the catch is concentrated on commercial species (*Merluccius merluccius, Parapenaeus longirostris*), while in Area "B" the catch is mainly characterized by massive species, Elasmobranchs and Crustaceans with low or null commercial value.

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ICES CM 2000/Mini:14 Poster

Faunistics as the impetus for conservation of sea cucumbers (*Echinodermata:Holothuroidea*) in the littoral waters of Kenya

Y. Samyn and E.V. Berghe

Aspidichorotid sea cucumbers (*Echinodermata: Holothuroidea*) are heavily fished in the littoral waters of Kenya, which results in plummeting stocks.

In order to conserve and manage these natural resources appropriate conservation and management plans have to be developed. This can only be done if high quality research on different levels broadens our understanding of the stocks in question. This poster discusses the importance of faunistics (based on correct nomenclature, taxonomy & systematics) in the fine tuning of conservation efforts. In addition the role of education in creating awareness at the community level is briefly discussed.

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ICES CM 2000/Mini:15 Poster

The use of databases for conservation of sea cucumbers (*Echinodermata: Holothuroidea*) in the littoral waters of Kenya

E. Berghe and Y. Samyn

Standard taxonomic nomenclature should be the basis of any form of management of living natural resources. In spite of the importance of this common vocabulary' as a basis for management and planning, little time and effort has been spend to inventorise available resources for the Western Indian Ocean. A case in point are the holothurians, where no faunistic lists exists for the region. In the light of recent interest in conservation of these heavily fished natural resources this lack becomes even more glaring, especially as it is one of the key factors to take into account when planning Integrated Coastal Zone Management. This poster discusses the objectives and the uses of MASDEA (Marine Species Database for Eastern Africa) in attaining conservation-efforts towards the group of interest, Holothuroidea.

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THEME SESSION

on

Efficiency, Selectivity and Impacts of Passive Fishing Gears (J)

CM 2000/J:01

The role of bait type on pelagic long-line efficiency

P. Bach, L. Dagorn, and C. Misselis

Long-line catches depend on the response of individuals to baited hooks. The choice of bait can therefore considerably affect the number and species composition of catches. More than 180 experimental pelagic long-line sets were conducted in French Polynesia to study the effects of different types of bait (squids, sardines, herrings) on bites and catches, with a total of 2000 captures for 90,000 hooks. The long-line was equipped with time depth recorders and hook timers to record timing bites of fish and to estimate respective depth. For each set, the gear was deployed in order to uniformly sample the pelagic habitat in the vertical dimension (maximum fishing depths ranged from 300 m to 550 m regarding physical characteristics of the habitat). For each type of bait, we study (i) its attractive efficiency by analysing the distribution of the percentage of hooks with bites or catches, (ii) its hooking efficiency by studying the relationships between the number of catches (total, target species, and by-catch species) and the number of bites, (iii) its temporal efficiency. A qualitative impact of each type of bait on the large pelagic fish community is proposed.

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ICES CM 2000/J:02

Dispersal and by-catch mortality in grey, *Halichoerus grypus*, and harbour, *Phoca vitulina*, seals tagged at the Norwegian coast

A. Bjørge, N. Øien, S. Hartvedt, and T. Bekkby

A total of 3,571 grey seals and 630 harbour seals were tagged at the Norwegian coast between 1975 and 1998, and 259 grey and 79 harbour seal tags were recovered. The seals were tagged as pups, and all recovered tags were from dead seals. Incidental mortality in fishing gear accounted for the majority of causalities, and bottom set net was the most important gear type. In total, 6% of the tagged seals (both grey and harbour seals) were incidentally caught in fishing gear. The seals were most vulnerable to incidental mortality in fishing gear during the first two months after tagging, but high incidental mortality prevailed during the first eight to ten months. Thereafter, the incidental mortality continued at low levels. Directed mortality from hunting or culling at fish farms accounted for part of the mortality. Harbour seals were exposed to hunting when they were almost one and almost two years, probably due to seasonality in hunting effort. Grey seals were most exposed to hunting mortality after they reached sexual maturity. Grey seals dispersed more widely (mean distance: 120 km) than harbour seals (mean distance: 69 km). The maximum distance traveled was 739 km and 463 km for grey and harbour seals, respectively. For sexually mature grey seals, a clear annual cycle in distribution was observed. During breeding season, all recoveries of adult grey seals were made in close proximity to the site of tagging. The sample size of adult harbour seals was too small for describing their annual cycle.

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ICES CM 2000/J:03

Methods for measuring the selectivity of static gear; A progress review of the manual

H. A. Carr

The Study Group on Methods for Measuring the Selectivity of Static Gear (SGMMG) has met twice and worked intersessionally to organize and construct the manual as directed by the terms of reference. The terms of reference for SGMMG are: a) to write a manual of methods for measuring the selectivity of static gear; and b) review selectivity studies on fish traps, fyke nets and pots to determine whether the information available on techniques for studying the selectivity of these gears is sufficient to warrant inclusion in the methods manual. The gillnet and longline sections are progressing and these sections will be reviewed with special attention to content and problem issues. Three other sections, selectivity of traps, selectivity of pots, and the statistics section, are not as complete, but the contents and relevance of these sections will also be addressed. Discussion on this manual at this time will provide a

means for further input and comment relative a critical time in the development of the manual.

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ICES CM 2000/J:04

Efficiency and species selectivity of fabricated baits used in Alaska demersal longline fisheries

D.L. Erickson, S. Goldhor, and R. Giurca

A species-selective fabricated bait was developed and tested for the Alaska demersal longline fishery targeting sablefish (*Anoplopoma fimbria*) and Pacific halibut (*Hippoglossus stenolepis*). Trials took place on commercial longline vessels near Seward, Alaska during July and September, 1999. The fabricated bait fished as well or better than herring (control bait) for sablefish and Pacific halibut, while reducing by-catch of spiny dogfish shark (*Squalus acanthias*), skate (*Raja* spp.), arrowtooth flounder (*Atheresthes stomias*), and Pacific cod (*Gadus macrocephalus*) by more than 10x. Hook timers demonstrated that this novel bait released attractants over a longer period of time than herring. This project was a collaborative effort among numerous individuals from Alaska Fisheries Development Foundation, Alaska SeaLife Center, Center for Applied Regional Studies, MARCO Marine, Seattle, and Wildlife Conservation Society. The research was funded by Alaska Science and Technology Foundation.

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ICES CM 2000/J:05

Reduced by-catch of red king crab (*Paralithodes camtschatica*) in the cod gillnet fisheries in northern Norway. Fishing trials with norsel mounted gillnets

H. Godøy, D.M. Furevik, and S. Løkkeborg

By-catch of red king crab (*Paralithodes camtschatica*) in stationary fishing gears, especially gillnets, is an increasing problem to the inshore fishermen in the northern part of Norway (Finnmark county). The results are large by-catches of king crabs together with the crabs' damages on the gear and catch. In the cod gillnet fisheries, the problem might be solved by using specially made gillnets ('norsel-mounted' nets) where the net itself is floated 0.5 meters above the seabed. The norsel-mounted nets were compared with standard nets in the Varangerfjord (eastern Finnmark) in the period 17 March–28 May, 1999. The trials showed that norsel nets needed more floats than the standard nets to get the net to stand properly in the sea (to get the norsels stretched out suitably). By using extra float (rings) on the norsel mounted nets the by-catches of king crab were reduced to an acceptable level with an average of 0.6 crabs/net, compared with 3.3 crabs/net on standard and 6.7 crabs/net on norsel nets without extra float. Norsel nets caught only about 1/3 as many fish as standard nets.

The catch results indicated that the gear configuration functioned in order to reduce the by-catch of red king crab. Loss of fish up to 65% is, however, not satisfying. Further work is needed to find a solution that gives a minimal loss of fish. Knowledge about the different species' behaviour is of importance in the further development of a more selective gear.

Keywords: by-catch, gill-nets, king crab.

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ICES CM 2000/J:06

The effect of twine thickness in cod gill nets

R. Holst, D. Wileman, and N. Madsen

Sea trials were carried out on a Danish commercial vessels measuring the size selectivity and fishing power of gill nets used to catch Baltic cod (*Gadus morhua*). A comparison was made of two different twine thicknesses at two different times of the year. Normal mesh sizes of 70–130 mm were used. Method of capture, condition factor and girths were measured for sub-samples of the cod caught. A model of the size selectivity of the gill nets was adapted to the experimental conditions where two gears were fished on the same population and it was fitted to the catch data by set using a model of between-set variance. It was found that twine thickness and trials period had relatively little effect upon the shape of the selectivity curve. Twine thickness had a substantial effect upon the fishing power of the nets.

Keywords: Baltic cod, *Gadus morhua*, gill nets, selectivity, fishing power.

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ICES CM/J:07

A longitudinal study of the selectivity parameters estimated from experimental gill net catch data for herring, *Clupea harengus*

R. Holst and J. Rasmus Nielsen

Size selection investigations were performed on experimental fishery in the Sound with multi-panel gillnets equipped with a broad range of stretched mesh sizes of 18.5, 21, 26, 27, 28, 29, and 34 mm targeting herring (*Clupea harengus*). Catch at length data were collected during 20 experimental fishery surveys. The surveys covered the central Sound from Helsingør-Helsingborg (north) to Drogden-Klagshamn (south), which was divided into 13 geographical strata and the experiments took place during the autumn, winter and spring periods from 1993-98.

Selection parameters were estimated for each stratum within each survey using the method described by Millar and Holst (1997) and first analysed in Poulsen *et al.* (2000). Almost all surveys showed a high between-stratum variation, which was partly related to variation in background measurements of environmental variables and partly allocated to random variation. Plots of the estimated selectivity parameters over the investigation period indicated a seasonal pattern.

The paper aims to describe spatial and temporal variation in selectivity by allowing each stratum to exhibit its own level of selectivity and assuming a common seasonal variation over time. The temporal variation is modelled in an autoregressive time series. The data were analysed in a Bayesian framework using BUGS.

Keywords: Bayesian analysis, *Clupea harengus*, gill net longitudinal data, size selectivity, time series.

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ICES CM 2000/J:08

Ghostfishing gillnets in Norwegian waters

O.-B. Humborstad and D.M. Furevik

Catches in deliberately lost gillnets were studied during a ten day cruise conducted at Storegga 70 nm off the Norwegian coast in July 2000. Gillnet fleets were deployed at depths between 540 to 680 m, and soak time varied from 1–7 days. In addition, four fleets set 45 days earlier were retrieved during the cruise. Most of the catch (95 %) consisted of the targeted species Greenland halibut *(Reinhardtius hippoglossoides).* On board every individual was evaluated due to seven condition stages ranging from alive and no damages to dead and only bones remaining. Results revealed that individual fish could be fully decomposed/consumed within a 24-hour period probably due to amphipod and isopod scavengers. A decline in total catches was first observed after 7 days whereas catch composition remained stable with approximately 80–90% in stage 1–4 (commonly referred to as consumable- or fresh fish) the first seven days. After 45 days a relatively high total catch was obtained but only 25 % were in stage 1–4. In numbers the catch of fresh fish after 45 days was reduced to 25 % that of 5 days. The decrease of amphipod and isopod scavengers in fish after 45 days leads to the assumption that decomposition of fish changes from scavenging to bacterial after a while.

Keywords: ghostfishing, lost gillnets.

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ICES CM 2000/J:09

Mortality in pelagic longline fisheries for haddock

I. Huse and A.V. Soldal

By-catches of haddock (*Melanogrammus aeglefinus*) below legal size (44 cm total length) in the pelagic longline fisheries for haddock off the coast of Finnmark, northern Norway, are often high. The small fish are not taken onboard the vessel, but are torn off the hook at the vessel side by means of a crucifier or a gaff and returned to sea. It is generally thought that most of the discarded haddock die. An investigation aimed at quantifying this mortality was undertaken during summer 1997.

Undersized haddock, torn off the long-line hook at the

vessel side were recaptured by gently catching them in a landing net as they reached the sea surface. Two groups of fish were compared:

1) Haddock torn of the hook by means of a crucifier alone.
2) Haddock torn off the hook by means of a gaff.

The fish were transferred in salt water tanks onboard a vessel to holding pens made of small meshed knotless netting floating at the sea surface. They were visually monitored for 5–11 days. Fish dying during the monitoring period as well as live fish at the end of the experiment were examined for external damage.

The experiments showed a total mortality of 34% of fish torn off the hook by means of a crucifier, and 64% mortality of fish released by means of a gaff.

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ICES CM 2000/J:10

Review and evaluation of three mitigation measures – bird-scaring line, underwater setting and line shooter – to reduce seabird by-catch in the Norwegian longline fishery

S. Løkkeborg

Seabirds scavenge baits from the hooks of commercial longlines resulting in incidental seabird mortality and bait loss. As interactions between seabirds and lingline fishing may cause decline in seabird populations and reduces gear efficiency, the potential of solving this problem by means of various mitigation measures have been tested. Four fishing experiments have been conducted in commercial longlining in the north Atlantic to investigate the effectiveness of bird-scaring line, underwater setting and line shooter in reducing seabird by-catch during longline setting. These results are reviewed and the performance of the mitigation measures is evaluated. Accidental catches of birds were reduced by all three methods, most pronounced by the bird-scaring line that had an efficiency of 98–100%. The experiments also demonstrated reduced bait loss and increased catch rates of target species, which are important incentives for fishermen to employ mitigation measures.

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ICES CM 2000/J:11

The effect of fish morphology and behaviour on the efficiency of gill nets, their selectivity and by-catch: two examples from southern Brazil

F.M. Lucena, C.M. O'Brien, and E.G. Reis

The catchability of fish and their size selection by gill nets are either affected by factors that are related to the characteristics of the net or to characteristics of the fish. The pelagic bluefish *Pomatomus saltatrix* and the demersal striped weakfish *Cynoscion guatucupa* are exploited in southern Brazil by surface and bottom gill nets, respectively. Catch rates are efficient for both species when body girth is equal to, or slightly greater than, the mesh perimeter (180 mm); i.e. a ratio of girth at capture to mesh perimeter equivalent to 1.0 and 1.1. However, fish are still caught even when this ratio is as high as 1.3 and 1.4 but such captures can be related to both the elastic properties of the nylon netting and to the compression capacity of the fish's body. Bluefish have a capacity of body compression to ease passage through the netting; superior to that of the striped weakfish. When estimating gill net selectivity the behaviour and body shape of the species should be taken into account. Both bluefish and striped weakfish have similar girths along their body length and each of the two species is a by-catch within the targeted fishery of the other species.

Keywords: bluefish; by-catch; gill net; selectivity; striped weakfish.

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ICES CM 2000/J:12

Relative size and girth selectivity of cod gillnets in the Western Baltic

T. Mentjes and K. Panten

During 3 years a lot of cod catch data were collected from different gill- and trammel-nets during commercial fisheries. For a rough estimation of the relative selectivity the retention curves from this experiments were fitted by one or two Gauss normal distributions by

the method of least squares. The results show, that there is no relevant difference in relative selectivity between gill- and trammel nets, but only in the efficiency. Because of the small differences in relative selectivity the catching process were investigated during the reported experiments in detail. Five catching modes were defined and the retained cod for each mode were recorded separately. The five modes are: cod enmeshed behind the gills, enmeshed at the head, hooked at the maxillaries or one gill cover and then entangled, caught by a mesh bar in the mouth and additionally enmeshed and caught by a mesh bar and additionally entangled in a pocket of gillnet meshes. The typical selectivity curve of a gillnet is not symmetric. The analysis of the data shows that the retention curve of each catch mode can be fitted by a normal density function. Gillnet selectivity is determined primarily by the girth. Therefore all cod caught are measured by length and girth.

The girth selectivity is not significant dependent from the seasons. The girth length relation were found to be changed by seasons and by different year classes corresponding to different relative size selectivity.

Keywords: Baltic Sea, cod, efficiency, fishery, fishing gear, fixed gear, gill nets, girth selectivity, mesh size, relative selectivity, relative efficiency, retention curve, selectivity, size selectivity, trammel nets.

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ICES CM 2000/J:13

Selectivity studies in the Northwest Atlantic longline fishery

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The National Marine Fisheries Service and the New England Fisheries Management Council closed George's Bank to groundfish fishing due to the extremely depleted nature of the groundfish stocks. A small group of Chatham longline fishermen petitioned the council to allow them to continue to fish on the bank citing both the conservative nature of their gear and their small percentage of groundfish effort; hook fishermen hold 53% of the groundfish permits in New England, yet in Massachusetts they account for only 5.5% of cod landings. Examinations of three different hook sizes as well as hook spacing experiments were conducted to investigate the selectivity of bottom set longline gear.

From the results of the experiments it was concluded that an increase from 11/0 to 15/0 hooks would significantly reduce the capture of sub-legal cod from the longline without affecting the capture of legal (49 cm and above) codfish while the results of the hook spacing experiments did not show any significant changes between the two spacings tested.

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ICES CM 2000/J:14

The present status of seabird by-catch in Latvian coastal fishery of the Baltic Sea

E. Urtans and J. Priednieks

The impact of different fishing gears on migrating and wintering bird populations was studied in the coastal fishery. The data were collected using fishermen 'observers' on basis of voluntary log-book system for different passive fishing gears. During the period 1995-1999 observations were carried out in different coastal areas of the Baltic Sea. The species composition and number of drawned seabirds in coastal fishing gears was investigated. The variation of seabirds by-catch by seasons and different coastal areas was analysed. Although the influence of Latvian coastal fishery on migrating and wintering seabirds was estimated as comparatively low, the possible consequences of increasing coastal fishery pressure and using of new net materials in nearest future can cause higher seabird mortality.

Keywords: Baltic Sea, coastal fishery, passive fishing gears, seabirds by-catch, species composition, season, area.

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ICES CM 2000/J:15 (Poster)

Testing square mesh panels in trap nets to reduce the catch of juvenile Atlantic Cod

G. Brothers

Thousands of traps averaging 100 meters on the rounds and 18 meters deep are operated around Newfoundland annually to catch Atlantic Cod. The catch of Cod in those traps often exceeds the small fish protocol of not more than 15% under 43 cm. In the past this has resulted in the closure of the Cod trap fishery in some areas. In 1997 traps operated in nine different locations on the West Coast of Newfoundland were modified with square mesh panels to reduce the catch of small fish. All square mesh panels measured six meters by six meters and were installed into the trap drying twine. Five of the panels were 102-mm mesh, and the other four were 117-mm mesh. Each trap had retainer bags attached to the square mesh panels to capture the escaping fish. Mesh sizes in the retainer bags varied from 57-mm to 102-mm. The nine traps were hauled up to two times each day during the June-July, traditional trap season. Samples of 250 fish were collected from each trap and retainer for each set, and the length measured. During the testing period, 40,200 kilograms of Cod were caught in 56 trap hauls. Cumulative length frequency graphs were generated for each trap and retainer showing the commutative percentage of fish caught at various fish lengths. The percentage of fish <43 cm. In three of the four traps with 117-mm square mesh panels was <15%, while only one of the traps with 102-mm square mesh panels had <15% small fish.

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ICES CM 2000/J:16 (Poster)

Size-species selectivity of gillnets in Estonian coastal zone: regulation efficiency

L. Järv, T. Drevs, and A. Järvik

During the last decade the intensity of inshore fishery strongly increased, caused mainly by drastic increase of number of semi-professional gillnet fishermen in Estonia. It has caused very high exploitation rate of many local perch, pike-perch, pike etc. freshwater species in coastal sea. Several stocks are overexploited. The gillnetting of flounder is also very intensive.

The possibilities to regulate the gillnet fishery using mesh limitation have been studied since 1994. The results of experiments with mesh sizes between 34–120 mm in main fishing areas along the Estonian coast are presented. Despite relatively good size selectivity for every particular species, the species selectivity has been low. Due to high variation of maturity length of different species, the by-catches of unwanted (undersized, temporary prohibited) fish were usually considerable.

As conclusion, it should be observed that the technical regulatory measures of gillnet fishery in Estonian coastal sea have not been effective enough. In this case, such measures as temporary closing of fishing areas for gillnet fishery and limitation of fishing intensity have been implemented recently.

Keywords: flounder, freshwater fish, gillnet, inshore, regulatory measures, selectivity,

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ICES CM 2000/J:17 (Poster)

Gillnet metier of blackspot seabream in the Ionian Sea

G. Petrakis, A. Chilari, and A. Terrats

Blackspot seabream (*Pagellus bogaraveo*) is a demersal fish common in the Mediterranean and in the Atlantic from Norway to Cape Blanco, Madeira and the Canaries. The gillnet fishery of the species was studied in the Ionian Sea. The data were collected during two fishing cruises in June 98. A multifilament gillnet of 84 mm mesh size was used. The height was 4 m and the length of each piece was 300 m. In total, 4 to 6 pieces of net were used each day. The depth ranged from 260 to 580 m. The catch consisted, in terms of number by 90.2% and in terms of weight by 58.3% of blackspot seabream. The average CPUE of blackspot seabream was 13.9 Kg/300 m of netting and ranged from 0 to 99.7 Kg/300 m of netting. The total length of blackspot seabream ranged from 16 to 42 cm. The majority of the fish were gilled or meshed. The age of blackspot seabream ranged from 2 to 11 years but most abundant were fish of 5 and 6 years old (30.2% and 40.5%, respectively). Important by-catch species were in terms of number blue mouth (2.54%) and Centrolophidae sp. (2.96%), whereas in terms of weight Centrolophidae sp. (30.8%) and hake (4.5%).

Keywords: black spot sea bream, gill net, Ionian Sea, *Pagellus bogaraveo*

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ICES CM 2000/J:18 (Poster)

On biological, technical and socio-economical aspects of Baltic herring pound net fishery in Estonia

A. Järvik and T. Raid

Appr. 10000 t, or 20–25 % of Estonia national herring quota, are taken by pound nets annually. This fishery is the main source of income for most inshore fishermen. Therefore, the ways towards of sustainable management of herring pound net fishery have been studied already since the 1970s. The studies include aspects of impact on herring stock, by-catch of non-target species, gear selectivity and catchability as well economic effects.

The pound nets show high selectivity in herring fishery, resulting in almost zero by-catch of undersized specimens. The comparison of composition of pound-net and trawl catches indicate significantly lower fishing mortality in pound-net fishery after taking the equal catch in weight.

However, since the pound net fishery takes place on spawning grounds, the increase of its intensity above certain value may have a substantial impact on herring reproduction. Also, the values of CPUE and, as result the economic efficiency of pound net fishery, being highly depending from the number of gears deployed. An approximate model for the optimisation of the number of gears allowed to fish in given area, depending on the stock size is presented. As a model implementation, the annual number of pound nets deployed in the most important area of this fishery - Pärnu Bay, was limited since the early 1980s.

The main by-catch species in herring pound net fishery are young pike-perch in the Pärnu Bay and flounder in the Western- Estonian Arcipelago and in the Gulf of Finland. Some technical measures for decreasing of those by-catches are discussed.

Keywords: Baltic herring, by-catch, catchability, pound net, regulation, selectivity.

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THEME SESSION
on
Incorporation of External Factors in Marine Resource Surveys (K)

ICES CM 2000/K:01

Effect of deviation from target trawling speed on catch rates in North Sea bottom trawl surveys

S. Adlerstein and S. Ehrich

Effort in trawl surveys is standardised, among others, by fishing time and vessel speed. Protocol for the North Sea International Bottom Trawl Survey (IBTS) establish hauls of 30 min duration at a speed of 4 knots. Here we analyse catch data from 30 hauls collected during a fishing experiment performed within these IBTS conditions to evaluate the effect on catch rates of departures from the targeted speed of the vessel over ground and also of the variation of speed of the trawl through water. The experiment was performed on the Walther Herwig III within a small area in northern North Sea during 5 days in November 1997. A current meter was set a few meters above the sea bottom at the centre of the sampled area to measure the current speed and direction simultaneously with trawling. Data analysis was performed using Generalised Additive Models. Catch rates were modelled as a function of vessel ground speed or speed through water and of time of day introduced as continuous variables. Species in the analysis are Norway pout (*Trisopterus esmarki*), haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*), dab (*Limanda limanda*), long rough dab (*Hippoglossoides platessoides*) and lemon sole (*Microstomus kitt*). Results showed a trend of increasing catch rates with vessel ground speed or with speed through water. We found catch rates of fish which are closely related to the sea bottom, such as dab and small haddock to increase significantly with speed over ground and catch rates of Norway pout, a species that is found off the sea bottom, to increase with the trawling speed trough water. Results also show that among what would have been considered valid IBTS hauls, catch rates of all species in the analysis but adult whiting fluctuate significantly within a 24 hr period. Levels varied typically within two fold differences between day and night.

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ICES CM 2000/K:02

Spatio-temporal patterns in herring school abundance and size in the NW North Sea: Modelling space time dependencies to allow examination of the impact local school abundance on school size

D.J. Beare, D.G. Reid, and P. Petitgas

As part of the EU funded project CLUSTER a database was constructed of herring schools identified during a series of acoustic surveys in the NW North Sea. Among other descriptors, the database included each schools; height, length, S_a, and density. The number of schools per 1 n.mi. EDSU was also recorded. The relationship between these descriptors and a range of external variables (e.g. bottom depth, time of day, location, temperature, salinity, and seabed characteristics) were examined using a suite of multiple regression models.

The results indicate strong non-linear dependencies on time of day and water depth. Herring school count per EDSU tends to be high during the middle part of the day and lower at dawn and dusk. Furthermore, the "shape" of this dependence on time of day is non-constant and changes with location. In some areas, for example, herring school count peaks in the morning, and is unimodal; in others it can be bimodal with a peak in the afternoon. Possible explanations for such patterns will be discussed.

Since regression models allow variability due to a mix of explanatory covariates to be assayed and divided, the overall framework can then be used to explore further into the relationships. In this paper we will present results showing the density dependent relations among herring schools in the North Sea. I.e. to what extent does the local school abundance influence the size (energy) of a given school. To achieve this we use the regression models to remove the effect of time of day, longitude, latitude and bottom depth. After this the impact of local school abundance on school size can be ascertained by careful examination of the residuals. The results of this analysis and its implications will be described and discussed.

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ICES CM 2000/K:03

Spatio-temporal patterns in pelagic fish school abundance and size: a study of pelagic fish aggregation using acoustic surveys from Senegal to Shetland.

D.J. Beare, D.G. Reid, P. Petitgas, J. Masse, P. Carrera, and S. Georgakarakos

As part of the EU funded project CLUSTER databases were constructed of pelagic fish schools identified during a series of acoustic surveys in the NW North Sea, Bay of Biscay, western Mediterranean and Agean Seas and off Senegal. Among other descriptors, the databases usually included each schools; height, length, S_a and density. The number of schools per 1 n.mi. EDSU was also recorded. The relationship between these descriptors and a range of external variables (e.g. bottom depth, time of day and location) were examined using a suite of multiple regression models.

The results indicate strong non-linear dependencies in some of the surveys on time of day and water depth. School count per EDSU tended to be high during the middle part of the day and lower at dawn and dusk. Furthermore, the "shape" of this dependence on time of day is non-constant and changes with location and year. Possible explanations for such patterns and the differences and similarities between the survey areas will be discussed, as well as the impact of these findings on the conduct and analysis of acoustic surveys. In addition, we have examined the spatio-temporal pattern of sampling in each of the survey series and we will present an analysis of the impact of survey design on the potential for such spatio-temporal modelling studies.

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ICES CM 2000/K:04

Investigating the complexity of spatio-temporal patterns evidenced in the triennial mackerel and horse-mackerel egg survey data.

D.J. Beare and D.G. Reid

Surveys of mackerel and horse-mackerel spawning activity along the western continental shelf edge have been done triennially by various EU marine laboratories since 1977. Once the stage I egg data have been collected and assimilated, an estimate of the total number of eggs spawned during a season is made (the total annual egg production). This figure can then be used to gauge the total number of sexually mature females and thenceforth the size of each stock. Total annual egg production is estimated according to one of two procedures. In the first procedure, (The Traditional Method) stage I egg data are divided into crude space/time "blocks" within which averages are calculated. These averages are then linearly extrapolated into unsampled "blocks". Where a block has no immediate neighbour, a zero is assigned. The second method involves fitting multiple regression models (e.g. Generalised Additive Models, GAMs) to the data where mean stage I egg densities are modelled as "smooth" functions of various important "stimulus" variables, e.g. Julian Day and Distance from the 200m contour.

Considerable recent research effort has been expended attempting to gauge the relative precision and bias of these different statistical procedures. The authors strongly support this, but also feel that the biological interpretations of such analyses can often receive a relatively low emphasis. It is debatable whether modern regression techniques have lower biases than the Traditional Method, but they are certainly capable of revealing interesting information on patterns of spawning activity that may have been inaccessible in the past. We set out to use the output from GAMs fitted to Stage 1 egg data to address specific scientific, rather than statistical questions.

Based on this we have concentrated our investigations on:

1) The seasonal pattern of spawning activity with location and between years;
2) The spatio-temporal pattern of spawning within and between years;
3) The influence of abiotic variables (e.g. temperature and salinity).

The results of these studies will be presented and their interpretation discussed.

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ICES CM 2000/K:05

Collocation indices to compare spatial distributions of populations

N. Bez and J. Rivoirard

In this paper we propose simple tools to describe, summarise and compare spatial distributions of fish. All the domain-based statistics such as means, variances, or coefficient of correlation are fragile in this regard as the domain on which they are computed can be not relevant simultaneously for all the spatial distributions of concern. Global statistics such as the centre of gravity of

the location of the individuals of a population or their inertia, are not affected by null samples and are well adapted for describing spatial distributions, in particular when limits are diffuse.

Because of the spreading of the populations around their centres of gravity, it is convenient to look at how geographically distinct two populations are by comparing the difference between their mean locations to the mean distance between individuals taken from both populations. This is exploited in a global index of collocation.

To refine the comparison between distributions, a local index of collocation is defined measuring the collocation of populations at the sample size. When two spatial distributions are identical or proportional, this index is 1. On the other end, when no individuals of two different populations are found simultaneously in any sample location, it is equal to 0. Illustrations concern some relevant species of the International Bottom Trawl Surveys in the North Sea, and the anchovy, sardine, mackerel and horse mackerel egg populations observed during the BIOMAN98 survey (AZTI-Spain) where a CUFES system was deployed.

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ICES CM 2000/K:07

Measuring fish school avoidance during acoustic surveys.

P. Brehmer, F. Gerlotto, and B. Samb

Evidence of different avoidance patterns for a pelagic species (*Sardinella aurita*) is given by comparing data on three different stocks in the tropical Atlantic (Venezuela, Senegal and Ivory coast). The effect of these differences is that no simple correction can be input in abundance estimates by acoustic surveys. We propose to measure in situ and continuously the avoidance characteristics of pelagic fish schools in order to correct the biomass estimates. The fish schools are observed using adapted acoustic devices. We use a high resolution (455 Khz) multi-beam sonar in a vertical plane, and a long range (24 Khz) omnidirectional sonar in the horizontal one. The bias is calculated from the avoidance speed and the average position of the schools at several distances and depths from the vessel. The main patterns of fish avoidance are explored by comparing the data in the three areas. Avoidance reactions present significant differences among the three areas and a single species may present different avoidance strategy (variations of swimming speed and direction). A preliminary list of hypothesis on the major factors producing avoidance reactions

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ICES CM 2000/K:09

Spatio-temporal models of North Sea herring

L. Clarke and J. Simmonds

International Bottom Trawl survey (IBTS) data for 1983-1997 are analysed using generalised additive models (GAMs) to assess the changes in spatial distribution of North Sea herring over age and time. The descriptive powers of spatial and environmental covariates such as latitude, longitude, depth, salinity, temperature and sun elevation are explored. IBTS protocol aims to standardise the trawls for tow duration, speed, gear etc. so these covariates are not considered. The modelling is performed in two parts, first modelling the presence/absence of herring in the catch, then, for trawls in which herring were caught, modelling the number caught. Abundance indices obtained using predictions from these models are compared with those obtained by averaging across ICES rectangles, which is the method currently used by the Herring Assessment Working Group. Model selection and bootstrap variance estimation are also discussed.

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Survey vessel avoidance reaction of Sardinella off Angola

J. Coetzee, O. Arve Misund, and D. Boyer

Survey vessel avoidance reactions and near-surface schooling of Sardinella (*Sardinella aurita* and *Sardinella maderensis*) were investigated off the coast of Angola. Experiments were conducted during 1997 and 1998 with a small work-boat, equipped with a 38 kHz Simrad EY500 portable echo sounder. Comparison of echo-recordings made by the small boat and the survey vessel indicated considerable underestimation of Sardinella in the surface layers by the research vessel. In addition, overall more schools were encountered by the small boat compared to that of the research vessel. Although little vertical avoidance of the research vessel was noted, horizontal dilution and reduction of school

density was observed when comparing school morphological and density characteristics with that measured by the small boat. The decrease in school density was attributed to a decrease in target strength of the Sardinella as a result of changed orientation. This decrease in target strength was in some cases responsible for a decrease in school density of 50 % or higher.

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Persistence of acoustically observed fish biomass in a 220 km^2 survey region

T.R. Hammond, and C.M. O'Brien

Short-term harvest refuges have attracted the interest of fisheries managers as a means to protect juvenile fish. Implementation would require fishermen to report high catch rates of juveniles in a small area, whereupon the area would be closed to fishing for a specified period, perhaps two weeks. In this way, the juveniles are protected in the short-term, but fishing grounds remain available to the fleet in the long-term. Naturally, such management makes assumptions about the persistence of juvenile fish in the harvest refuge. We consider how to design a survey whose primary objective is to address spatial persistence. Acoustic surveys are particularly suited to this question, and we describe the design and analysis of acoustic survey data collected over a 220 km^2 survey region off the coast of Yorkshire. We employed generalized additive models to investigate space/time interactions and to partition temporal variation into diel and persistence components. We also consider how trawl catch can supplement the acoustic survey. Finally, we demonstrate visual data analysis techniques that provide a summary of fish behaviour in the region. Our analysis suggests that the total biomass in the area could fall by as much as 50% in a period of three days. We take this to indicate that larger areas would be required for effective protection of young fish.

Keywords: fisheries, generalized additive modelling, refuges, temporal persistence.

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Adult gadoids in the North Sea: A view from the IBTS and Generalised Additive Models

A. Jarre, L. Clarke, and B. Lundgren

The abundance of adult (age 3+) cod, whiting and haddock in the North Sea is modelled using the International Bottom Trawl Survey (IBTS) dataset for the first quarter during 1983-1997. The influence of biotic as well as abiotic factors is analysed using Generalised Additive Models. Biotic covariates are derived from the age-specific catch composition of the IBTS target species herring, sprat, Norway pout, whiting, cod and haddock in each haul using Principal Component Analysis. Depth, temperature, salinity, median sediment grain size, geographic coordinates and sun elevation are explored as abiotic covariates. The resulting distribution of each of the three species is mapped through time, and the abundance indices are compared to the results of the ICES assessment.

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Abundance of juvenile gadoids in the North Sea: Habitat descriptors derived from IBTS data using Generalised Additive Models, and implications for stock assessment

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The abundance of age 2 cod, whiting and haddock in the North Sea is modelled using the International Bottom Trawl Survey (IBTS) data set for the first quarter during 1983–1997. The influence of biotic as well as abiotic factors is analysed using Generalised Additive Models. Biotic covariates are derived from the age-specific catch composition of the IBTS target species herring, sprat, Norway pout, whiting, cod and haddock in each haul using Principal Component Analysis. Depth, temperature, salinity, median sediment grain size, geographic coordinates and sun elevation are explored as abiotic covariates. The resulting distribution of each of the three species is mapped through time, and the derived abundance indices are compared to the IBTS standard indices and the ICES assessment. The robustness of the models is discussed.

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A sonar study of the migration pattern of Norwegian spring-spawning herring (*Clupea harengus* L.) in July

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During two transect surveys in the Norwegian Sea during July 1995 and 1996, acoustic data on nearly 700 schools of Norwegian spring-spawning herring (*Clupea harengus* L.) were collected by multi-beam sonar. The herring stock usually concentrates in the area west of Lofoten in July/August, and it was therefore expected that the herring would swim eastwards towards the coast during the survey periods. Each school was classified as migrating, avoiding or undetermined. The survey area was divided into three areas based on fish length, habitat and distance from main wintering area in Lofoten. Migrating schools had a mean swimming and migration speed of 0.89 and 0.60 m/s respectively. The schools were generally small (mean = 434 m^2), and were feeding high (0-60 m) in the water column all day and night. A total of 29 % migrating, 7 % avoiding and 64 % undecided schools were categorised. A potentially high proportion of feeding schools with high dynamic tendency may explain the dominance of undetermined schools. A westerly migration direction dominated in the coastal areas both years. The schools probably left the coastal areas because of sub-optimal feeding conditions. Echo sounder data indicate that the feeding conditions were better near the continental slope. Thus by migrating westwards the herring could improve their feeding conditions and thus extend their feeding season. This study quantifies the migration pattern in July, and shows that feeding conditions probably were the most important external factor. The results also indicate that the herring generally migrates westwards in July where sub-optimal conditions may be pronounced, with less concentration of zooplankton prey in the more coastal areas as compared to along the continental shelf and offshore areas.

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The influence of polymorphic characteristics on the Alaska Pollack (*Theragra chalcogramma*) fishing efficiency

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Interspecies behavioural polymorphism of captured populations promote to high level of selectivity in catching populations. This can decrease the polymorphism level and accordingly worsen biological parameters of captured populations. On the first stage we have made researches on the role of polymorphism (phenetic characteristics) on reaction of fishes (sabalo, *Prohilodus lineatus*; bream, *Abramis brama L.*) on active gears in model and natural conditions. In researches of fish populations in common use two groups of indications - morphological and genetical-biochemical. Morphological indications (the majority of them are polygenic) traditionally are considered adaptably important. In our work the selection was investigated on a combination of indications of a spinal column. The data on samples from the basic commercial fisheries districts of a north-east part of the Pacific Ocean were assembled for identification basic interspecies polymorph of Alaska pollack. We have identified two groups in Alaska pollack population: "longtail" and "shortail" (in dependence on an amount of spondyles in a caudal department). We suppose that "longtail" fish have better swimming ability that influence on the probability of hitting fishes to the trawl. It means, that modern trawl fishing promotes exception from a population "shorttail" fishes.

Keywords: Alaska pollack, behavioural polymorphism, spinal column, trawl.

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Fish avoidance: The vessel noise factor

R.B. Mitson

Many observations of fish reacting to or avoiding vessels have been reported during the past four decades. The responses have not always been consistent when observing a known species from a particular vessel. This has often been related to environmental conditions and to the physiological state of the fish. Whilst these factors are undoubtedly important, there is also the significant variability of underwater noise radiated by most research vessels currently operating. Many of these vessels have a long life ahead of them and, if the possibility of them causing avoidance behaviour is to be minimised; certain measures need to be taken. These will involve some knowledge of the vessel's noise signature so that, for example, optimum propeller and engine revolutions can be set for particular operations. This paper gives details of the likely sources, the magnitude and directionality of underwater-radiated noise for a number of vessels. The distance for a potential response from several commercial species is given in relation to these levels. A comparison is made with the recommendation for maximum underwater noise levels contained in *ICES Cooperative Research Report* No. 209.

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Sardine (*Sardina pilchardus* Walbaum) characterisation off the Spanish Atlantic coast.

R. Muiño and P. Carrera

In 1983 both Spain and Portugal began to conduct acoustic surveys in the Atlantic waters of the Iberain Peninsula. The main goal for these surveys was the assessment of the main pelagic fish species, but focussed on sardine. Some years the surveyed area was extended as far as the distribution of blue whiting, but in general covering only the continental shelf. Since 1988 the Spanish surveys are undertook in spring, during the spawning period of this fish species. As most of the pelagic fish species sardine occurs in schools. From the school data base gathered during the acoustic surveys, the echo-traces were allocated into fish species following a criteria. This scrutiny is based on the fish proportion found at the fishing station, but a learning process was also used which consisted in relating school characteristics (shape and energy) and its location (geographical location, distance to the coast, sea bottom typology among others) with fish species. This paper describes the main characteristics of the sardine schools, which have been extracted manually from paper echograms from 1992 to 1997 surveys (except 1994). A series of variables for each school were obtained: position (latitude, longitude, time, distant to the next school, distant to coast, minimum school depth and total water column depth), morphologic (height, length, area and perimeter), energetic (school energy -SA value- and density -energy/area-) and environmental parameters (temperature and salinity). These were described by box plot, scatter plot and other basic exploratory methods. From this analysis, differences among years and geographic areas have been found in sardine schools. The relation of such changes with the total sardine abundance estimates as well as the implication in the survey design were also discussed.

Keywords: Iberian Peninsula, sardine, schools.

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Incorporating temporal information in ichthyoplankton surveys using a model-based approach: cod (*Gadus morhua* L.) in the Irish Sea

C.M. O'Brien, and C.J. Fox

Ichthyoplankton surveys are increasingly being employed for the purpose of assessing the spawning stock biomass of species. To investigate trends in egg production generalized additive models (GAMs) can be used to model the spatial-temporal distribution of egg density. Time is treated as a continuous variable and egg production is modelled as a function of location, time, and oceanographic and environmental variables. Survey series often include large numbers of stations where eggs of a particular species are not observed. The application of two-stage models is recommended in these cases, where the presence/absence of eggs is firstly modelled as a binary process and a model-based surface subsequently fitted to egg production (conditional on their presence). By integrating under the predicted egg production surfaces, a cumulative production curve can be generated and a GAM-based estimate of annual egg production produced. The successful application of GAMs, however, requires a survey design with good coverage in both space and time. Ichthyoplankton samples were collected in 1995, over the period February to June, on a series of eleven cruises covering most of the Irish Sea. Cod (*Gadus morhua* L.) is used to illustrate the application of the

model-based estimation of annual egg production and the calculation of its coefficient of variation. The methods will be applied to analyses of the year 2000 surveys recently conducted in the Irish Sea as part of a collaborative EU-funded project.

Keywords: generalized additive modelling, simulation, spawning.

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Accounting for spatial-scale and temporal information in research surveys: combined analyses of English and German groundfish surveys in the North Sea

C.M. O'Brien, S. Adlerstein, and S. Ehrich

Routine research surveys are a major source of fisheries independent information for estimating stock abundance. Bottom trawl surveys are routinely performed at a coarse spatial scale and their abundance estimates consist of global means derived with standard formulae that give imprecise estimates. Model-based approaches have been proposed to increase precision and to allow the incorporation of environmental variables. When estimates are derived from coarse surveys they do not account for spatial variation occurring at finer scales. In this paper we present the results of a study to investigate the value of using high-resolution spatial catch data; together with environmental and biological information, to improve model-based estimates of fish stock abundance and distribution. Intuitively, information that improves understanding of the variability of fish distribution should be helpful in specifying models to describe fish abundance. The scale of the two surveys from which data are considered ranges from a coarse spatial resolution with a grid covering the whole North Sea (English groundfish survey, EGFS) to a fine-scale in several delimited areas (German small-scale bottom trawl survey, GSBTS). North Sea cod (*Gadus morhua* L.) is presented as a timely case study and model-based age-disaggregated abundance indices are produced using generalised linear/additive models that combine data from the two bottom trawl surveys. The benefits of combining the small- and large-scale surveys are discussed in the context of the analyses presented.

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Inter-calibrations between German demersal gears HG 20/25 and TV3 520 as well as between the gears TV3 520 and TV3 930

R. Oeberst, P. Ernst, and C.C. Friess

Since 1985 different attempts were carried out to establish an international co-ordinated demersal trawl survey in the Baltic Sea. An essential precondition for such a survey is the inter-calibration of the different gears used in the national surveys. Schulz and Grygiel (1984, 1987) described the results of the inter-calibration between the gears used by the research vessels "Eisbär" (GDR) and "Dr. Lubecki" (Poland).

New activities started 1995 (ICES 1995) in order to co-ordinate the national survey surveys. These investigations are funded by the EU in the form of study projects. Besides the establishment of a database for the previous and new data new standard gears were developed and were tested.

During the German national demersal trawl surveys in November 1999 and March 2000 inter-calibration experiments were carried out between the national gear HG 20/25 and the planned new standard gear TV3 520. In accordance with the proposal of the ICES "Workshop on Baltic trawl experiments" (ICES 1999) the experiments were realised as paired hauls on the same station. Additional comparisons were carried out between both new standard gears TV3 520 (small) and TV3 930 (large) March 2000.

The analyses showed which factors influence the conversion factors between the gears essentially. Furthermore, it was assessed how many inter-calibration experiments must be realised additionally in order to get the conversion factors corresponding to a required accuracy.

Keywords: Baltic Sea, cod, flounder, gear, inter-calibration.

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Proposal for the stratification of the Baltic Sea for the Baltic International Trawl Survey

R. Oeberst

Different national demersal trawl surveys are carried out in different parts of the Baltic Sea since 1962. These national surveys of the different countries were planed regarding the special scientific interests of the institutes. The results of these surveys were used to calculate indices of the year class strength of cod and other species. The estimated indices were use as tuning variables in the VPA, to assess the discards in the commercial fishery and the total mortality. Furthermore, these values were used as recruitment index, to estimate the food consumption of young cod, to estimate the maturity ogive, and to quantify the exchanges between both Baltic cod stocks. The first attempts to co-ordinate the different national surveys were carried out 1985 and were continued in the following years with different intensity in the following years. Besides the standardisation of the gears used and the inter-calibrations between the national and the new standard gear a common survey design is necessary. The development of the standard gears and the inter-calibrations of the gears were carried by a EU funded study project. The goal of the analyses presented is the optimisation of the relation between the possible amount for the surveys (vessel days, man power) and the accuracy of the estimated indices. Using the available data from the BITS data base the variance structure of the CPUE (catch per hour) were analysed in the different sub-divisions. The aim of the analyses was to find parameters which are correlated with the species density and the variance structure of the CPUE. These results are the basis for the development of the stratified survey design with the goal: optimisation of the relation between the possible amount for the surveys (vessel days, man power) and the accuracy of the estimated indices.

Keywords: Baltic Sea, demersal trawl survey, survey design.

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Assessing trawl-survey estimates of length-frequency distributions

M. Pennington, L. Burmeister, and V. Hjellvik

Marine trawl surveys catch a cluster of fish at each station and fish caught together tend to have more similar characteristics, such as length, age, stomach contents *etc.*, than those in the entire population. When this is the case, the effective sample size of estimates of the frequency distribution of a population characteristic can be much smaller than the number of fish sampled during a survey. As an example, it is shown that the effective sample size for length-frequency distributions generated by trawl surveys throughout the world is approximately one fish per tow. It is concluded that many more fish than necessary are measured at each station and that one way to increase the effective sample size for these surveys is to reduce tow duration and use the time saved to collect samples at more stations.

Keywords: cluster sampling; effective sample size, intra-haul correlation, trawl surveys.

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ICES CM 2000/K:24

Survey-based stock assessments: Are they more reliable than catch-based assessment?

M. Pennington

If commercial catch-at-age data are available, it is often assumed that a virtual population analysis (VPA) type assessment will be more accurate than one based on scientific surveys. It is also often implicitly assumed that the more 'data' used in an assessment, the more accurate it will be. Given the many uncertainties associated with catch data, such as the amount of discards at sea, misreporting of catch *etc.*, it is not clear whether or not a VPA-type assessment, in which survey data are used to 'tune' the model, more accurately estimates current stock conditions than survey-based assessments. In this paper, several examples are presented for which it appears that surveys have provided a more accurate and timely stock assessment than did the annual catch-based assessments. It is concluded that, given the unknown biases in catch statistics, a simple survey-based assessment of current conditions is often more reliable than one incorporating catch data in a complicated structural model.

Keywords: catch data, scientific surveys, virtual population analysis.

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On the clustering of fish schools at two scales and their relation with meso-scale physical structures

Pierre Petitgas

Line transect acoustic surveys provide digital echograms of fish schools. This enables to analyse structure in the occurrence of individual fish schools along the transect lines as if it were a spatiall point process. The paper characterizes two scales in the clustering of schools, clusters of schools (several kms) and clusters of clusters of schools (tens of kms), and analyses which structure can be related to physical characteristics of the water masses. Clustering of schools is analysed using the pair correlation function (an analog of the variogram but for point process) along the transects. Clusters of schools were modeled along transect lines by a correlation structure and a Matern point process. Clusters of clusters involved the regional 2D pattern on the map and were modeled with a trend surface. Physical structures considered are river plume, vertical water stratification and upwelling events. They are characterized using parameter outputs from a 3D hydrodynamic model. The trend was in best spatial coherence with the river plume. At the smaller scale, there was no environmental parameter to be related to the schools. It is hypothesized that the clustering of schools of a few kms is related to the behavioural schooling dynamics but that the meso scale aggregation of fish at tens of kms is related to the meso-scale physical structures and the food chain they support.

Keywords: Fish Schools, Aggregation, Clusters, Point Process

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North Sea trawl surveys: Diel and depth effects on the catch rates

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Data from the Scottish participation in the International Young Fish Survey for the period 1976 to 1993 were analysed to examine the effect of light level and depth on catch rates. The species selected for this study were common dab, herring, haddock and whiting. Differences between day and night were observed for the juvenile common dab and herring and for the adult common dab and haddock. Differences between shallow and deep water were observed for the juveniles of all the species and for the adults of common dab, haddock and whiting. The mean lengths and the composition of the common dab and whiting catches were affected by both light and depth, indicating behaviour differences between the juveniles and adults of these species. While light seems to have no effect on the mean length and the catch composition of herring, differences were observed between shallow and deep waters. In the case of haddock, neither the light level nor the depth had any noticeable effect on the mean length and catch composition of the catches. We conclude that the diel behaviour and he geographic distribution are important factors in determining the quantity and composition of trawl catches, but their effects are species dependent. When trawl surveys are not exact replicates in terms of fishing times and areas, the estimation of catch indices should allow for the possible bias introduced by these factors. There is a need for models of the capture process that take account of such effects.

Keywords: demersal fish, North Sea, trawl survey.

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The impact of external factors on plaice and sole catches in a beam trawl survey in the southern North Sea

G.J. Piet

In 1985 the Netherlands commenced with a beam trawl survey (BTS) covering the southern North Sea to provide fishery independent population abundance indices by age group of plaice and sole to tune the assessments. During this survey not only the catches of the two target species are recorded but also those of the other fish species and environmental characteristics such as depth, water temperature and time of day. Sediment data from other sources were used to determine the sediment grain-size at the sampled locations. In this study the uni- and multivariate relationships between the catches of the various age-groups of the two target species and these external factors were determined and used to provide improved population abundance indices for plaice and sole.

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Quantifying variability in gear performance on IBTS surveys: Swept area and volume with depth

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The International Bottom Trawl Surveys (IBTS) on the western shelf represent an important source of fisheries independent data on the abundance and distribution of many important commercial species. Trawl hauls on these surveys are standardised to thirty minutes and four knots. It is thus assumed that they will generally take equivalent samples. We examined trawl surveillance data on; headline height, wing spread, door spread, swept area and swept volume for a variety of surveys and hauls. The study showed that there was substantial variability in all these parameters, and of particular importance, swept area and volume. Additionally there was good evidence that swept area increased with the depth of the trawl haul. The implications of these findings and the potential for including corrections for the differences in the calculation of abundance indices are discussed.

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ICES CM 2000/K:29

The relationship of herring school size and abundance with seabed characteristics in the NW North Sea

D.G. Reid

It is common knowledge among fishermen that demersal fish schools tend to aggregate on or over seabeds with a specific characteristic. While the explanation for this relationship may be obvious in the case of demersal fish, it is less clear that the same should be true for pelagic fish. However, considerable anecdotal evidence exists suggesting that herring in the NW North Sea show a preference for aggregating in areas where there is a rapid change in water depth and where the seabed is rougher and harder.

This relationship was examined using a school database developed in the EU funded CLUSTER project. The database includes all herring schools extracted from acoustic surveys carried out in July from 1991 to 1997. Each school entry in the database includes a range of individual descriptors such as; length, height, area, energy (S_a) and density. Each school is also assigned to an individual one n.mi. EDSU. A database for the EDSU has also been compiled which includes; depth CV, a slope classification and a substrate classification. By cross relating these two databases it has been possible to assign schools to EDSU and hence to seabed characteristics. Analyses of these data will presented showing that herring schools are more likely to be encountered in areas of complex seabed, and less over flat, featureless areas. Furthermore, schools tended to be larger and denser over complex sea beds. The relevance of this to survey design and analysis will be discussed.

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ICES CM 2000/K:30

Testing the effects of vessel, gear and daylight on catch data from the International Bottom Trawl Survey in the North Sea

J. Rivoirard

More than ten vessels participate regularly to the IBTS in the North Sea. Because they survey different areas with different fish densities, the vessel effect has been investigated by selecting neighbouring trawl stations coming from each given pair of vessels. A Student test is then performed to see if the observed difference between those two vessels is significant given the variability of catches. This analysis has been conducted for cod, haddock and herring at ages 1, 2 and 3+ for each of quarters 1 and 3 from 1991 to 1997. The most striking result is the repeated significantly different level of catches by Scotia 2 used in quarter 3 (lower for what concerns cod and haddock, but not necessarily for herring). Those systematic differences are likely to be due to the use of a gear which is different from the other vessels. The effect of daylight on cod, haddock, whiting and herring at ages 1, 2 and 3+ in quarter 1 has been investigated by selecting neighbouring pairs of stations from the same vessel. A Student test has been performed to evaluate if catches at night are significantly different from, and for instance lower than, catches at day. The significance of the correlation of catches with sun elevation has also been assessed. By repeating the analysis for each year from 1983 to 1997, a positive effect of daylight on haddock and herring all ages and on cod 2 and 3+ has been evidenced. However, obtaining a response function on sun elevation from catch data, is, despite their number, problematic.

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ICES CM 2000/K:31

Correcting daylight effect in the estimation of fish abundance using kriging with external drift, with an application to juvenile gadoids in the North Sea

J. Rivoirard and K. Wieland

Kriging with external drift is a geostatistical method, which allows the estimation of a spatial variable when this is driven by a known external parameter. The great flexibility of the method lies in the fact that the response function to this parameter needs only be known up to constants. This is advantageous when the effect of the parameter exists or is postulated, but without being known precisely. A postulated day/night effect on catch rates in trawl survey data can thus be handled, even when the day and night levels are poorly known. Similarly the effect of time on catch rates can be handled, supposing for instance that it is linear in respect to sun elevation but with unknown coefficients. The methods are illustrated on some juvenile gadoid catches in the North Sea from the 1st quarter IBTS (International Bottom Trawl Survey) 1983–1997, where effects exist without being precisely known. The results of kriging the abundance with external drift are compared to Ordinary Kriging and to the IBTS standard abundance indices.

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ICES CM 2000/K:32

Vessel, gear and day/night effects in the estimation of herring abundance and distribution from the IBTS surveys in the North Sea

J. Simmonds, J. Rivoirard, and P. Fernandes

Data from 1983 to 1998 IBTS surveys were examined for evidence of vessel (or gear) effect and day / night differences in catch. Paired observations from different vessels were used to examine the differences in catch of herring among vessels. Kriging with external drift was used to show differences in spatial distribution resulting from differences in catch rate between daylight and darkness. Kriging with external drift is a geostatistical method which allows for the estimation of a spatial variable when this is driven by a known external parameter. This is advantageous when the effect of the parameter exists or is postulated, but is not explicitly known. A postulated day/night effect on catch rates in trawl survey data can thus be handled, even when the day and night levels are poorly known. The results of kriging the abundance with external drift are compared to Ordinary Kriging without compensation for time of day and to the IBTS standard abundance indices.

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ICES CM 2000/K:33

The effect of water speed on bottom contact and escapement under the footrope of a survey trawl

D. Somerton and K. Weinberg

Towing speed on bottom trawl surveys is usually specified in terms of speed over the ground (SOG) rather than speed through the water (STW). However, STW is likely more influential on catchability because of its more pronounced affects on trawl geometry and fish swimming speed. To answer this question we conducted an experiment in which SWT was measured with a trawl mounted current meter and distance of the footrope above the bottom was measured with a newly developed bottom contact sensor. Bottom contact in the bosom of the footrope was unstable at the standard towing speed (3 knots) and declined with increasing STW. At STW of 4.5 knots and above the trawl lifted completely above the bottom. Results of the study indicate that in areas subject to strong currents variation in survey CPUE could be reduced by reducing variation in STW using trawl mounted current sensors.

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ICES CM 2000/K:34

Behavioural rhythm of cod during migration in the Barents Sea

Boonchai K. Stensholt, K. Michalsen, and O. Rune Godø

To assess fish abundance by direct methods and to understand and model species interaction, it is important to have proper knowledge about behavioural patterns. Patterns in vertical distribution might strongly affect accessibility of the fish to survey methods and are of importance for modelling within and between species interaction and competition. Such information can be obtained on individual basis by using data storage tags (DST).

In this paper time series from 19 DSTs attached to large Northeast Arctic cod are analysed. Depth (pressure) and temperature were recorded with 2-hour intervals. The main purpose is to develop a statistical approach to extract information about rhythmic behaviour (diurnal, semi-diurnal), and to discuss possible ecological impacts of such behaviour of large cod in the Barents Sea. This includes vertical migration, temperature

distribution, and spatial-temporal interrelation caused by fish behaviour. To identify the dynamics in behaviour when fish penetrate stratified water masses, an approach using the rate of change of temperature in relation to change of depth was chosen.

The results show that rhythmic behaviour occurred temporarily in 12 of the tags. Spectral density distributions of depth and temperature time series show that rhythms within 24 hour are most common. In 11 out of 12 tags where diel vertical migration (DVM) were detected, this occurred during summer and autumn. In 7 out of 8 tags where semi-diurnal tidal cycles were detected in the temperature series, this occurred during April–May. In some tags diurnal or semidiurnal cycles appeared in both depth and temperature series. Diurnal rhythms are periodically important for large cod, but the results are not consistent for all tags and therefore no firm and general principal for such behaviour can presently be concluded.

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ICES CM 2000/K:35

The effects of removing behaviourally based biases from acoustic estimates of wintering NSS-herring

R. Vabø

An investigation of the effect of behavioural biases on acoustic abundance estimates of wintering Norwegian spring spawning herring is presented. The combined effects of vessel avoidance, depth-dependent target strengths and variable tilt angle distributions have been quantified and synthesised into a correction method. The method is based on the recalculation of acoustic densities on a depth and time basis, and mean acoustic values for eight winter surveys carried out in the 1990s were used. The method was applied by defining eight correction models that corrected acoustic densities differently for the behavioural factors. Four models were defined directly on the basis of measurement, while a further four were defined on the basis of results from an optimising procedure which tune behavioural correction parameters around measured values in order to identify models with minimum hourly fluctuation and no diurnal variation. Significant diurnal differences present in the original data material were reduced, mainly by the correction for vessel avoidance, while hourly fluctuations were reduced by combined corrections. On a relative or index-based level, all behavioural corrections increased the acoustic densities and the winter estimates became significantly higher. On an absolute level, i.e. with the application of a new target strength in relation to fish length, acoustic densities were generally decreased by an indirect correction for target strength. The combined effects of all behavioural factors resulted in acoustic abundance estimates which on an absolute level were around the same level as the present estimate.

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ICES CM 2000/K:36

Characterising the spatial and seasonal dynamics of exploited populations from the analysis of commercial catch and effort data.

M. Verdoit and D. Pelletier

Most demersal and benthic populations exhibit spatial and seasonal features in relation to their annual life cycle. There exist reproduction areas, and feeding areas, and fish often migrate from one area to the other at certain periods of the year. However, scientific surveys do not provide a sufficient seasonal coverage to help delineating the areas and periods that characterise the main demographic stages. Specific experiments would be too expensive and not even feasible. On the contrary, commercial data represent a lot of information with a good coverage over the year. This paper proposes an approach to utilise the information contained in commercial data, i.e. monthly CPUE computed at the spatial scale of the ICES statistical rectangle, in order to determine spatial and temporal distributions of recruitment and spawning stock of exploited populations. The approach is based on multivariate descriptive methods including ordination techniques and classification techniques and is applied to two important commercial species, the Norway lobster and whiting populations from the Celtic Sea.

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ICES CM 2000/K:37

Measurements of distance fished during the trawl retrieval period

C.W. West and J.R. Wallace

Observations of sampling trawl performance made during a multi-vessel groundfish trawl survey conducted during 1998 and again in 1999 raised concerns that the trawls might be continuing to fish during the retrieval period, after the end of the sampling period but before coming off bottom. Following the 1998 survey, a simple geometric analysis of times and positions recorded at critical moments during and following each sampling tow was developed to estimate the following

parameters: 1) the distance along the bottom that the gear swept during the retrieval period, and 2) the speed at which the trawl moved over the seabed. This analysis suggested that the distances swept were substantial, and systematically increased with the depth of the tow. The effective trawl speed approached or even exceeded the towing speed specified by the sampling protocols, and this varied systematically among the participating vessels. The same analysis was performed for sampling tows conducted during the 1999 survey and compared against trawl positions recorded during the same period by an ultra-short baseline acoustic positioning system. Both techniques yielded similar results, and were in accord with the findings from the 1998 data: distances swept by the trawls during the retrieval period were substantial and the trawls were moving at speeds comparable to fishing speed, and these effects varied systematically from depth to depth and vessel to vessel. Neglect of these effects could increase the impact of depth-related bias and inter-vessel variability on survey results while knowledge of them could help explain the "vessel effect" commonly observed when comparing the fishing performance of two or more vessels.

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ICES CM 2000/K:38 (Poster)

Evidence of a change in the aggregation pattern of coastal pelagic fish species in the Bay of Biscay after a period of high intensity rain

P. Carrera and R. Muiño

The coastal ecosystem of the inner part of the Bay of Biscay is dominated by a fewer number of pelagic fish species. In the Spanish area these are sardine (*Sardina pilchardus*), horse mackerel (*Trachurus trachurus* and *T. Mediterraneus*), chub mackerel (*Scomber japonicus*) and bogue (*Boops boops*). As most of the pelagic fish they occur in shoals At day time, these fish species are observed in isolated schools whereas at night this aggregative behaviour disappear becoming disperse. However, there is still possible to recognise social groups, mainly formed by sardine, at night which allowed acoustic surveys to be conducted either at day or night time. Nevertheless, since 1998 only daytime surveys were conducted in this area in spring by the Instituto Español de Oceanografía. Thus, the most typical aggregative pattern found in this area is the school. During the acoustic survey conducted in spring 2000 on board R/V Thalassa in this area, weather conditions changed drastically. After a period of relatively stable conditions, weather conditions were dominated by low pressures with an increase in the number of storms, resulting in a decrease in both temperature and salinity in the coastal waters due to an increase in the river flows.

The aggregation pattern of the pelagic fish species was observed with 5 days interval, which roughly corresponded with the change in the weather conditions. Before the decrease in temperature and salinity, fish were found in isolated schools and close to the sea shore. As the salinity became lower, fish started to avoid the coastal waters (i.e. first 2-3 nmi). A salinity front was observed and most of the schools were found close to this front. The aggregation pattern changed. Only big schools with significant differences in school structure to that observed previously were found. In addition they seemed to be multispecific. The relation of this change with the food availability induced by the salinity front is also discussed.

Keywords: acoustic, school behaviour.

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ICES CM 2000/K:39 (Poster)

1999 ICES Coordinated Acoustic Survey of ICES Divisions IIIa, IVa, IVb and VIa (north)

E.J. Simmonds, E. Toresen, E. Torstensen, C. Zimmermann, E. Götze, D.G. Reid, and A.S. Couperus

Five surveys were carried out during late June and July covering most of the continental shelf north of 54EN in the North Sea and Ireland to the west of Scotland to a northern limit of 62EN. The eastern edge of the survey area is bounded by the Norwegian and Danish coasts, and to the west by the Shelf edge between 200 and 400 m depth. he surveys are reported individually, and a combined report has been prepared from the data from all surveys. The combined survey results provide spatial distributions of herring abundance by number and biomass at age by statistical rectangle.

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THEME SESSION

on

North Atlantic Processes (L)

ICES CM 2000/L:01

The relation between long-term variations of water temperature in the North Atlantic and Nordic Seas

Yu. Bochkov, E. Sentyabov, and A. Karsakov

The paper presents the results of estimation of the character and value of the relation between long-term variations of the water thermal state in the North Atlantic and the adjacent Nordic Seas.

A close relation is found between large-scale variations of the water thermal state over the study area from the Labrador Sea to the Barents Sea. These long-range relations are of both synchronous and asynchronous character, which permits us to use them with the purpose of forecast.

Using data on the sea surface temperature in the North Atlantic (1982–2000), as well as data on the water temperature at the depth of 0–200 m in the Kola Section (the Barents Sea) as the base, a close synchronous relation between interannual variations of the temperature in the Barents Sea and the Gulf Stream areas (positive relation) and the Labrador Current (negative relation) is found. An important factor of formation of the large-scale and long-term variations in climatic systems of the North Atlantic and adjacent seas is the North Atlantic Oscillation.

The other character of the relation is revealed when comparing interannual (1959–1999) variations of temperature of the Atlantic waters in the Faeroe-Shetland Channel (Northeast Atlantic) and in the Kola Section (The Barents Sea). Here a close asynchronous relation is found. Temperature variations in the Kola Section are 10–12 months behind those in the Faeroe-Shetland Channel. Based on these grounds, a model is developed to make a long-term forecast of water temperature in the Barents Sea long in advance.

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ICES CM 2000/L:02

Interannual variations in the transport of the Labrador Current on the Newfoundland Shelf

E.B. Colbourne

During the past several decades' climate conditions in the Northwest Atlantic have been characterised by several extremes, from the warm 1960s and late 1990s to cold conditions of the early 1970s, mid-1980s and early 1990s. The magnitude of these variations is measured by the strength of the winter atmospheric pressure fields in the north Atlantic or the NAO index. Variations in the baroclinic component of the volume transport of the Labrador Current on the Newfoundland Shelf during these events are presented. The historical (1950–1999) summer temperature and salinity data along standard transects on the Newfoundland Shelf were used to compute geostrophic currents and to construct time series of baroclinic transports. The results generally show large interannual variations in transport, but the trend indicates higher-than-average transport during the warm 1960s (low NAO index) and lower than average values during the cold early 1970s and the mid-1980s (high NAO index). During the late 1980s the transport increased to above average values that continued into the mid-1990s, a period of high NAO index anomalies. The results are consistent with earlier work based on data up to the mid-1980s and with the hypothesis that increased transport of Labrador Current Water around the south-east Grand Bank during the warm 1960s on the Newfoundland Shelf resulted in colder ocean conditions further south on the Scotian Shelf. However, the higher-than-average transport for the high NAO index period of the early 1990s is not consistent with previous studies.

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ICES CM 2000/L:03

Seasonal variations in the Atlantic water inflow to the Nordic Seas

B. Hansen, S. Jónsson, W.R. Turrell, and S. Østerhus

The inflow of warm and saline Atlantic water to the Nordic Seas occurs through three separate branches. The westernmost of these, the North Icelandic Irminger Current, has been monitored since 1985 with moored Anderaa current meters and regular CTD cruises. The other two branches that flow through the Iceland-Faeroe and the Faeroe-Shetland gaps respectively have been monitored by moored ADCP's and CTD sections since 1994 within the Nordic WOCE and VEINS programmes. Although there are gaps in the observations, they allow a consistent picture of the total inflow to be constructed and they allow an estimate of

the seasonal variation of fluxes. This has implications for the possible driving mechanisms that can be considered for the Atlantic inflow.

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ICES CM 2000/L:04

First results of upper ocean variability in the North Atlantic between the North Sea and Greenland from repeat ADCP measurements onboard the container vessel 'Nuka Arctica'

P. Jaccard, G. Reverdin, H. Svendsen, S. Østerhus, and T. Rossby

The advection of warm subtropical waters east- and northward along the Sub-polar Front plays a central role in moderating the climate of the European subcontinent, reflecting the fact that the northern North Atlantic is much warmer than any other ocean at corresponding latitudes. Further, it is known that there exist low frequency (seasonal to inter-annual) variations in the circulation and hence pole-ward transport of mass and heat, but the lack of accurate information on currents has made this variability difficult to define and quantify.

In order to improve our ability to elucidate the spatial and temporal variability of the fluxes of North Atlantic Waters in the northern North Atlantic, a thermosalinograph (TSG) and an acoustic Doppler current profiler (ADCP) were installed on the Royal Arctic Lines' container vessel, the Nuka Arctica, in 1998 and 1999, respectively. In this paper we report on the results from about 15 transects the first year of operation with the 150 kHz ADCP. The ADCP reaches to 300 – 400 meters depth, depending upon weather and biomass/backscatter conditions. At this stage we focus our attention on the eddy activity with emphasis on the Iceland Basin, the Irminger Sea and the waters around Greenland.

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ICES CM 2000/L:06

On influence of long-term variability of temperature regime in the Gdansk Deep of the Baltic Sea on the sprat reproduction and the offspring survival

E.M. Karasiova and A.S. Zezera

Based on the long-term hydrographic data the peculiarities of temperature vertical distribution during the sprat-spawning season in cold and warm years were considered and discussed in relation to sprat spawning timing and offspring survival. It was assumed that while the temperature conditions in warm years are only one of prerequisites among others for successful survival, the temperature regime of cold years was possibly a key factor for sprat recruitment.

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ICES CM 2000/L:07

Formation and propagation of temperature anomalies in the North Atlantic Current

G. Krahmann, M. Visbeck, and G. Reverdin

A general circulation ocean model has been used to study the formation and advection mechanisms of North Atlantic Oscillation-generated temperature anomalies in the North Atlantic Current. In a set of experiments we have applied patterns of NAO-regressed windvector, windspeed and windstress anomalies modulated by fixed-frequency NAO-amplitudes. This idealised forcing generates temperature anomalies in the upper 440~m of the North Atlantic which spread similarly to observed temperature anomalies along the pathway of the North Atlantic Current (NAC). The analysis of individual components of the ocean heat budget reveals that anomalies in the upper 440~m heat content are primarily generated by anomalies of the oceanic heat transport divergence. The surface heat fluxes contribute only 1/3 of the total changes. The anomalous divergences result, both from anomalous currents created by the windstress anomalies, and from the advection of temperature anomalies from further upstream. Along the pathway of the North Atlantic

Current temperature anomalies of opposite sign are formed in the first and second halves of the pathway in response to both the surface heat flux and the windstress anomalies. The ratio between the idealised NAO forcing period and the time it takes an anomaly to travel from the first to the second half of the pathway determines how the locally formed anomalies and those advected from the first half interfere in the second half of the pathway. We find that for NAO-periods shorter than 4 years the response in the second half is mainly determined by the local forcing while for NAO-periods longer than 32 years the advected anomalies become dominant. Maximal amplitudes of the temperature anomalies are found when both timescales agree at about decadal NAO-periods. When the NAO-regressed forcing fields are modulated by the observed NAO-index we still get propagating temperature anomalies, but they agree only in the first half of the NAC's pathway with observations. Forced with the full NCEP/NCAR reanalysis forcing anomalies the model is able to reproduce the observed temperature anomalies.

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ICES CM 2000/L:08

Multidecadal changes in the Baltic marine ecosystem under hydroclimatological forcing

S. Kydersky and A. Zezera

There was examined an influence of the latitudinal displacement of Azores maximum on multidecadal changes in the Baltic Sea deep-water salinity. With Azores maximum migration to the North (from ca. 35-45°N latitude) a zone of sustainable western winds also shifts to the North. The later affects the North Sea and Danish Straits. This situation leads to marked inflows of the saline North Sea water to the Baltic Sea and, as a result, to improvement of the hydrographic conditions that relate to the reproductive success of the Baltic cod, the top predator of the Baltic marine ecosystem. The changes in the earth rotation speed are considering as possible driving forces contributing to the observed changes.

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ICES CM 2000/L:09

Internal tides in the waters surrounding the Faroe Plateau

K.M.H. Larsen, B. Hansen, R. Kristiansen, and S. Østerhus

In the period 1994–1999, long-term current measurements have been acquired from several sites around the Faroe Plateau from moored, upward-looking ADCP's. They provide a detailed description of the vertical current profiles, which allows an overview of the changes in tidal current with depth. The observations demonstrate the existence of pronounced internal tides, which we relate to the observed water mass characteristics in the area.

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ICES CM 2000/L:10

Fresh/Polar water input in the East Icelandic current

S.-A. Malmberg, H. Valdimarsson, and S. Jonsson

The cold water current system in the Iceland Sea north and east of Iceland, more or less fed by waters from the East Greenland Current and the Irminger Current, is known as the East-Icelandic Current. The current was an ice-free arctic current (S around 34.8) in the period 1948-1963, later it advanced south and eastwards and developed into a polar current (S less than 34.7) in 1964–1971, containing and preserving drift ice. Since than the salinity conditions were more stable but generally lower than prior to the ice-years in the late sixties, lowest during the years 1976–1979, 1982, 1988, and 1996–1998. One of the aims of the EU VEINS programme is to determine the fresh water flux in the East Icelandic Current. The present paper deals with the hydrographic conditions in the East Icelandic Current based on seasonal hydrographic investigations in the period 1970–1999, as well as estimated fresh water fluxes based on these data.

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ICES CM 2000/L:11

Hydrographic conditions in the inflow of Atlantic water into North Icelandic waters in relation to NAO

S.-A. Malmberg

Iceland is situated at fronts, i.e. the meeting place of warm (Irminger Current) and cold (East Greenland and East Icelandic Current) ocean currents. These different hydrographic conditions in Icelandic waters are reflected in the atmospheric or climatic conditions in and over the country and the surrounding seas, mainly through the Iceland Low and the Greenland High. Among the aims of the EU VEINS programme is to determine the flow of Atlantic water into North Icelandic waters, this one of the last outposts of the warm North Atlantic Current. Direct current measurements as well as hydrographic conditions were involved. The present paper deals with hydrographic conditions in North Icelandic waters - Siglunes Section - in comparison to annual air temperature in Akureyri, North Iceland, and Reykjavik, Southwest Iceland, since 1950. The results show that the hydrographic conditions in North Icelandic waters are coherent with the air temperature both in North and South Iceland. These time series in air and sea are both bound to three different phases - years prior to cold ice-years in the late sixties; the ice-years themselves; and again years after the ice-years. The forcing of the atmospheric pressure systems involved ("North Atlantic Oscillation") is also considered. This also reveals three different phases during the different time periods.

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ICES CM 2000/L:12

Repeated seasonal hydrographic observations in the northern Irminger Sea in 1997 to 1999

J. Mortensen

Since the start of the VEINS programme in 1997, hydrographic records have been obtained along the Faxafloi section 8 times. The section is located in the northern part of the Irminger Sea and crosses the Denmark Strait Overflow (DSO) layer ca. 360 km downstream the sill in Denmark Strait. Waters of Polar and Arctic origin are here transported southwards in a bottom layer over the East Greenland continental slope as part of the meridional overturning circulation of the North Atlantic. During the two and a half years period of observations energetic changes of the structure of the DSO layer were observed, resulting mainly from changes in strength of the different upstream sources contributing to the DSO and eddy activity. The changes in strength in the different upstream sources contributing to the DSO were mainly observed as property changes. Eddies were opposite associated with large overflow pulses characterised by one or two homogeneous near bottom layer(s) overlaid by a vertical temperature gradient layer. The temperature gradient layer was observed to be in direct contact above with the warmer and saltier intermediate water mass (IW), bypassing the normally intervening Labrador Sea Water (LSW) and Iceland-Scotland Overflow Water (ISOW) that were totally squeezed out.

Keywords: changes in source waters, Denmark Strait overflow, eddies and mixing, variability, VEINS, water mass.

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ICES CM 2000/L:14

The Eastern Basin water and currents in the Barents Sea

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The objective of the paper is to show that cold, high salinity water mass of the Eastern Basin is of local origin, being formed by a significant transformation of Atlantic water rather than brought by the Central current from the Northeast, as shown on the generally accepted map of the Barents Sea currents (Tantsyura, 1959).

Data on depth of the s_t surface 28.0 show a dome of dense bottom water in the Eastern Basin, and, consequently, indicate a cyclonic water motion in this area. There is a close asynchronous correlation between variations of temperature and salinity in the Eastern Basin and in the Kola section (r=0.70-0.81, lag=12 months). This testifies to the Atlantic origin of the Eastern Basin Water. The character of salinity distribution shows that frontal zones block the water flow from Northeast Barents Sea to the Eastern Basin. Ice edge positions in winter months and distribution of 0-group fish in August-September also indicate the absence of a strong current from the Northeast.

The results of numerical modelling suggest the existence of a well-pronounced cyclonic circulation in the Eastern Basin. By model results, no water transport from the Northeast Barents Sea to the study area is traced.

A revised map of currents is made on the basis of a critical review of all knowledge available about water circulation in the Barents Sea.

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ICES CM 2000/L:15

Surface waters of the North Atlantic sub-polar gyre in recent years

G. Reverdin, H. Valdimarsson, and P. Jaccard

We will discuss an on-going effort to investigate the hydrographic variability of the surface waters of the North Atlantic sub-polar gyre. The core body of data discussed will be from ships-of-opportunity between Iceland and Newfoundland (since 1993) and between Denmark and west Greenland (since 1997). The information from XBTs and surface T and S from thermosalinographs is complemented with data from hydrographic surveys, profiling floats and surface drifters. Different parts of the sub-polar gyre do not vary in phase, although recent data are compatible with the lag and lead relationships that have been commented on in earlier data (the Labrador Current variability preceding the eastern sub-polar gyre, and even more, the northern reaches of the Irminger Sea south of Iceland or the Faroes). We will particularly comment on the differences between the temperature and salinity signals in 1996–1997 in view of atmospheric forcing and what we can infer regarding changes in advection (based on a combination of Ekman currents estimated from ERS winds (at CERSAT) and mesoscale geostrophic currents (estimated from altimetry at CLS). We will also discuss an apparent recent decline in salinity in the waters south of Iceland.

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ICES CM 2000/L:16

Direct observations of warm water pathways in the northern north Atlantic

T. Rossby, A. Bower, P. Richardson, M. Prater, H. Zhang, H. Hunt, and S. Fontana

As part of the Atlantic Climate Change Experiment (ACCE) 115 isopycnal, acoustically-tracked RAFOS floats were deployed in the North Atlantic Current /Subpolar Front (NAC/SPF) and the Poleward Eastern Boundary Current (PEBC). These currents have been proposed as the most likely sources of the warm, salty water that is transformed into intermediate and deep waters in the subpolar region. The floats were programmed for 18-24-month missions, and ballasted for the sigma-theta = 27.5 surface (which ranges in depth from winter outcropping in the Labrador and Irminger Basins to 900 m along the eastern boundary).

Floats deployed in the SPF west of and over the mid-Atlantic Ridge identify two major spreading routes: 1) Northeast into the Iceland Basin indicating a warm poleward flow along the western flank of the Rockall/Hatton Bank complex, and 2) retroflecting sharply to the west into the Irminger Sea and north along the Reykjanes Ridge. The latter floats also highlight the surfacing of subtropical thermocline waters and thus the source of high nutrient waters in the Irminger Sea. These spreading patterns reveal remarkable structure to the poleward flow of subtropical waters, as part of which bottom topography and eastward spreading of Labrador Sea Waters must play an important role. The PEBC floats indicate little flow into Rockall trough, drifting instead into the Iceland Basin west of Rockall Bank, a strong indication that the PEBC is not a major northward conduit of Mediterranean waters. Several anticyclonic coherent vortices were observed near the eastern boundary south of 50N, with one possible 'meddy' apparently formed near 49°N, there is also evidence of some long-lived coherent vortices, especially just west of the MAR.

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ICES CM 2000/L:17

12-Year hydrographic survey of the Newfoundland Basin: seasonal and interannual variability in water masses

I.M. Yashayaev

During the 1980s and the early 1990s Soviet scientific ships conducted an extensive survey of the area to the Southeast off the Grand Banks. A special technique was designed to separate different water masses in the vicinity of a hydrographic front and applied to the hydrographic data collected in this experiment.

Subsequent time series analysis revealed distinct seasonal and interannual signals in the dominant water masses. Annual amplitudes are the highest in the surface layer over the shelf, whereas the greatest contribution of the cycle to the total variability and depth of its penetration is observed offshore of the Sub-polar Front. The interannual variability is also different on either side of the front. The most remarkable event in the shelf and slope regions is freshening and cooling in the mid-1980s. The appearance of this event in the shelf waters lagged that in the Labrador Current (at 100 m) by about 2 years. This event was traced back to its source in the western Labrador Sea. Its earlier occurrence at 100 m is a result of faster advection in the core of the Labrador Current than in the waters above and strong vertical stratification in the Newfoundland Basin. The upper waters to the Southeast of the Sub-polar Front warmed up and got saltier through the 1980s and early 1990s, by 2 C and 0.3 psu correspondingly.

Keywords: climate, Labrador Current, Newfoundland Basin, North Atlantic, salinity, seasonal cycle, temperature.

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ICES CM 2000/L:18

The recent decline of the Labrador Sea water

I. Yashayaev, A. Clarke and J. Lazier

Hydrographic observations across the Labrador Sea reveal large variations in the properties of the resident water masses. A series of severe winters in the early 1990s caused intense deep convection creating a homogeneous water mass called Labrador Sea Water (LSW). Since 1994, when the coldest water was found, convection has become gradually weaker leading to "relaxation" of intermediate layers and the coexistence of multiple versions of the water mass. Since that time, the deepest fraction of LSW hasn't been renewed, and is steadily becoming warmer and saltier. In 1999, temperature and salinity of the deep LSW were 0.5 and 0.03 higher compared to 1994. The weakening of convection also caused a change in integral characteristics of the water column. The recent warming of LSW caused a rise of the sea level in the central Labrador Sea by 7-8 cm from the 1994 level. That brought the level up to the state of 1960s.

Keywords: climate, convection, Labrador Sea, North Atlantic, salinity, sea level, temperature.

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ICES CM 2000/L:19

Direct observations of the Iceland Basin cyclone at mid depths

W. Zenk

In 1997 the Institute fur Meereskunde started its RAFOS float program in the eastern North Atlantic. So far, a total of 47 isobaric floats were launched during three cruises at a nominal depth of 1500 m east of Charlie Gibbs Fracture Zone and in the central Iceland Basin. While 16 floats are still on mission the surfaced ones delivered 26 eddy-resolving trajectories. They allow a unique insight into the circulation pattern of the Labrador Sea Water invading the eastern basins. Pathways split into three branches east of the Middle Atlantic Ridge – one parallels the Ridge southwards, a second spreads zonally towards Porcupine Bank, the third fills the eastern side of the Iceland Basin. In fact, a series of stagnation phases and eddy rotations were recorded on its pathways along the western flanks of Hutton Bank. They are superimposed on a northeastward drift. At the tip of the Basin floats feel a pronounced acceleration by incoming Iceland Scotland Overflow Water from the Faroese Bank Channel. In the coarse of the basin-wide cyclone the floats are swiftly advected along the Reykjanes Ridge. Finally, the depth keeping floats are detrained from the deepening Overflow core before the latter reaches Gibbs Fracture Zone. We expect the pertinent helical circulation and its fluctuations to effect directly transformation rates of all engaged watermasses.

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ICES CM 2000/L:20 (Poster)

Transport of Atlantic water through the Barents Sea

R. Ingvaldsen, L. Asplin, and H. Loeng

Current measurements along a section between Norway and Bear Island, and results from a three-dimensional numerical model are investigated. Previous investigations have indicated an inflow of Atlantic water to the Barents Sea in the southern part of the section, and an outflow further north. Our current observations show a much more complicated picture. We have identified several typical flow patterns across the section in addition to the classical pattern of inflow in the southern part. At times the net flow is from the Barents Sea towards the Norwegian Sea, and most extremely the flow can exist in several narrow cells (about 50 km wide) with inflow and outflow side by

side. The long term mean volume flux across the section is 1.5-2 Sv. We find the currents at the Norway - Bear Island section to be largely independent of depth, thus with the sea-surface elevation (as modified by the strong and rapidly changing wind fields) being a major driving force. Particle tracking experiments performed with the numerical model indicates that the flushing time of the Atlantic waters through the Barents Sea is 2–4 years.

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ICES CM 2000/L:21 (Poster)

Cross-front structures in hydrography and fish larvae at the Angola-Benguela frontal zone

H.-Ch. John , V. Mohrholz, and J.R.E. Lutjeharms

Meridionals transect off Angola along 08 E surveyed hydrography and the ichthyoplankton community structure. It started near the equator during a Benguela Nino situation and ended off northern Namibia at a time when strong winds from Southeast had brought the Angola-Benguela Frontal Zone (ABFZ) closer to its normal position at 16 S. The meridional gradient of the ABFZ is much stronger inshore than farther offshore. Changing wind situations caused changes in hydrographical surface morphology and gradients, as well as in the distributional limits of surface living tropical, respectively subtropical species. In contrast to this the faunistic boundaries of mid-water species and water masses at depth remained more persistent in location. North of the ABFZ average fish larval abundances were six times higher than south of it. The centre of vertical distribution of both chlorophyllum and fish larvae coincided generally with the pycnocline and deepened with it at the front. The species richness declined from 6 S towards the south by about one species per degree of latitude, but did not reveal any distinct signal at the ABFZ. However, the community structure changed drastically across the front. The faunal structures north and south of the ABFZ had only a similarity of 22%. The diversity indices reached maxima, percentage similarity between stations minima at the boundary. Off Angola, larvae of mesopelagic fish species apparently adapted to oxygen deficits dominated. Off northern Namibia the ichthyoplankton was composed by widely distributed high oceanic species, central water species, and some temperate elements.

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ICES CM 2000/L:22 (Poster)

Space-time behaviour of the Angola-Benguela frontal zone during the Benguela Nino of April 1999

V. Mohrholz, M. Schmidt, J.R.E. Lutjeharms, and H.-Ch. John

During April 1999, a multidisciplinary survey off Angola - Northern Namibia crossed the Angola-Benguela Frontal Zone (ABFZ). Meteorological and hydrographical data obtained were momentaneous, but not entirely synoptical. A sequence of SST satellite images provided intermittent synoptical information, whilst biological data integrated preceding longer time scales. All sets of information matched each other. Along the continental slope the Angola Current advected less saline surface waters from the great rivers to 13 S, and waters with tropical temperatures to 19 S. Waters off northern Namibia were warmer than 20 C nearshore (>23 C offshore), with a weak meridional thermal gradient and an unusually southern position of the ABFZ. Geostrophic analysis shows the Angola Current as a continuation of the South Equatorial Countercurrent. The sub-thermoclinal Angola Dome was centered at 8.5 S, 8 E. With increasing equatorward winds from 10 April onwards, strong coastal upwelling developed. Ekman transport shifted this upwelled water offshore and detached the surface part of the Angola Current westwards. The ABFZ became more pronounced and moved equatorwards closer to its normal surface position at 16 S, but farther to the south at depth. The SST images show that the ABFZ remained interrupted zonally by the Angola Current as far south as 20 S for the whole of April. SST images indicate the rapid dynamic response of the ABFZ to atmospheric forcing near the coast, whereas the conditions offshore were more persistent. Mesoscale eddies in the ABFZ may be of considerable importance for the mixing of tropical surface water from the Angola Current with Benguela upwelling water.

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THEME SESSION

on

Environment – Plankton – Fish Linkages (M)

ICES CM 2000/M:01

***Prorocentrum lima* (*Microalgae: Dinoflagellata*): killer food for zooplankton**

C.C. Ajuzie and G.T. Houvenaghel

The toxicity of the microalga *Prorocentrum lima* and its probable toxic effects on zooplankton were tested using actively growing cells of *P. lima* and filtered culture medium of *P. lima* on *Artemia nauplii*. Filtered *P. lima* culture medium at concentrations ≥ 50 % killed the brine shrimps within 24 hours. Three days old brine shrimps consumed *P. lima* cells within 30 minutes following the introduction of the latter into wells holding the animals. Death of brine shrimps occurred from around 90 minutes onwards, following the introduction and consumption of the toxic cells. Older nauplii (3 days old) reacted readily and showed early responses from intoxications than younger *nauplii* (1 day old). A single *P. lima* cell in the gut of brine shrimp is enough to kill the animal. The probable cause of death in intoxicated brine shrimp is discussed.

Keywords: *Artemia* (brine shrimp), behaviour, culture medium, dehydration, gut contraction, microalga, *Prorocentrum lima*, zooplankton.

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ICES CM 2000/M:03

Patterns in growth, ingestion and survival probability of Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*) larvae on Georges Bank

L.J. Buckley, E.C. Caldarone, R.G. Lough, and T.L. Ong

The amount of RNA and DNA in individual larvae was used to estimate the condition, recent growth and survival probability of Atlantic cod and haddock larvae on Georges Bank. Sampling between 1992 and 1999 was concentrated in the months of April and May when larvae were most abundant on the southern flank, with more limited sampling in March. Distinct patterns in RNA-DNA ratios and growth were seen with larval size or age and water temperature. Recent growth increased with larval size after first feeding and approached an asymptotic level later in the larval period. Maximum variability in growth occurred within a size range corresponding to a brief period after yolk-sac absorption and feeding initiation. Growth increased with water temperature reaching maximum values of 0.15/d in May at about 7°C. Ingestion rates estimated using a bioenergetic model increased with temperature, however above 7°C the rate of increase was insufficient to meet the increasing metabolic costs and maintain rapid growth. These data suggest that growth was temperature limited below 7°C and food limited at higher temperatures. Survival probability was related to larval size and water temperature.

Keywords: cod, growth, haddock, ingestion, larvae, survival, temperature.

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ICES CM 2000/M:04

***Calanus finmarchicus* in Icelandic waters: population genetics and ecology at the Norwegian Sea/N. Atlantic Ocean boundary**

A. Bucklin, O.S. Astthorsson, A. Gislason, and P.H. Wiebe

Large-scale circulation patterns in the N. Atlantic may partition the ocean basin into three semi-distinct gyre systems: the Norwegian Sea, the northern N. Atlantic, and the western N. Atlantic. Zooplankton entrained in these gyres may be ecologically, reproductively, and (perhaps) genetically distinct due to geographic isolation in different circulation systems and/or to isolation by distance. Ocean basin-scale genetic structuring of *C. finmarchicus*, and especially the boundary between the N. Atlantic and the Norwegian Sea, was a focus of our efforts during the Spring Surveys of the Marine Research Institute (Reykjavik, Iceland) in May/June, 1999 and 2000. Population genetic analysis demonstrated the differentiation of populations of *Calanus finmarchicus* in different water

masses surrounding Iceland. DNA sequence variation of mitochondrial cytochrome oxidase I (mtCOI) and the nuclear gene encoding phosphoglucose isomerase (PGI) was evaluated using a suite of population genetic and statistical tests to quantify the genetic distinctiveness of populations and characterize population genetic structuring at the targeted scales. The distribution, abundance, and genetic variation of *C. finmarchicus* was placed in a realistic ocean setting, including water mass structure and ocean circulation patterns, in order to understand the interaction between zooplankton stocks and production and physical circulation patterns.

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ICES CM 2000/M:05

Long term changes in the North Sea – A two-model system?

R. Clark and C. Frid

We present data on long term trends from climatic, oceanographic and biotic time series for the North Sea area. Long term changes in the ecosystem appear to be forced by one of two models. In those areas of the North Sea which are predominantly influenced by Atlantic inflow (northern, central and western areas) long term changes in biological systems are primarily governed by changes in climate, while in the south eastern areas of the North Sea (the bights and the Danish coast) long term changes in the ecosystem are driven by changes in nutrient concentrations. Specifically, in the majority of the open North Sea area, climatic effects dominate and override the influence of nutrients, whereas in the southeastern North Sea, changes in nutrients have been of sufficient magnitude to control most aspects the ecosystem.

Secondary productivity (zooplankton, benthos, fish and bird communities) are, over the long term, mainly forced by changes in food supply, although there are exceptions. Consequently, secondary productivity is ultimately driven by one of these two models.

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ICES CM 2000/M:06

Are the macrozooplankton populations in the Barents Sea controlled by predation?

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There appear to be strong predator-prey interrelationships between macrozooplankton (krill and amphipods) and their main predators (capelin and cod) in the Barents Sea. Some of the evidence for is already published, and some is intended for publication in the near future. The results show an inverse relationship between the krill and amphipod biomass and the stock size of capelin in the Barents Sea. In the mid 80s and 90s, when capelin stock was at extremely low levels, cod switched from capelin to alternative prey such as amphipods and krill. Cod growth was slower at time periods with low capelin abundance. In the present ICES paper these zooplankton data are supplemented with the data from recent years. We intend to synthesize these results and discuss these in relation to physical parameters such as advection and temperature. Our aim is to improve the understanding of zooplankton-fish interactions in the Barents Sea Ecosystem.

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ICES CM 2000/M:07

The effects of Calanus on the recruitment, survival and condition of cod and haddock on the Scotian Shelf

K.F. Drinkwater, K.T. Frank, and B. Petrie

An exploratory correlation analysis between zooplankton abundance and cod and haddock recruitment, survival and growth are presented. The zooplankton data were collected by the continuous plankton recorder (CPR), which is towed at approximately 7-m depth from commercial ships at regular monthly intervals along fixed routes. Data are

averaged over the northeastern and southwestern portions of the Shelf. The CPR data were collected during 1961–75 and from 1991 to present. The zooplankton indices included the abundance of *Calanus finmarchicus* (averaged over stages 1–4 and over stages 5-6), *Paracalanus* and *Psuedocalanus*. The abundance of cod and haddock in the southwestern and northeastern Scotian Shelf were obtained from the virtual population analysis estimates. Results indicate a statistically significant negative relationship between the early stages (1–4) of *Calanus finmarchicus* and the recruitment and survival of cod and haddock on the northeastern Scotian Shelf. In addition, residuals from a Ricker stock and recruitment relationship were negatively correlated with *Calanus finmarchicus* stages 1–4. The larger *Calanus* were only significantly correlated with condition of haddock on the southwestern Scotian Shelf. The only statistically significant correlation with *Paracalanus* was with haddock recruitment in the northeastern shelf region. The possible mechanisms behind the negative correlations between zooplankton and fish are explored.

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ICES CM 2000/M:08

Measurements and modelling of ocean climate and zooplankton in the Barents Sea

A. Edvardsen, D. Slagstad, K.S. Tande, and P. Jaccard

The coastal shelf of northern Norway and the Barents Sea is a highly productive area, with a food chain in which phytoplankton and zooplankton supports the recruitment of major fish stocks such as herring, capelin and cod. This area is a highly advective one, mainly perturbed by the North Atlantic Current and the Norwegian Coastal Current, which is an important factor for spatial and temporal distribution of zooplankton. This work was conducted along the western border of the Barents Sea repeatedly during 1998 and 1999. We implemented a new approach to study the interaction between zooplankton; vertical migration and advection using technology like Scanfish-OPC-ADCP-MOCNESS and hydrodynamical models. Zooplankton community structure was monitored by net tows and zooplankton abundance fields were mapped using an Optical Plankton Counter (OPC) counting copepodide life stages CIII-CV of *Calanus finmarchicus*, which is the major contributors to the dietary input of planktivorous fish in this region. Current fields were measured by a ship mounted ADCP and the residual current fields were calculated by subtracting the tidal component obtained from a hydrodynamical model. The flux of zooplankton during each cruise was calculated by combining the zooplankton- and residual current fields.

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ICES CM 2000/M:09

On the food of herring in the western part of the Norwegian Sea

A. Gislason and O. S. Astthorsson

The food of herring (*Clupea harengus*) was studied in the western part of the Norwegian Sea, where the Norwegian spring spawning herring migrate for feeding during summer. The material was collected on 3 cruises in 1995 (April, May, June) and 2 cruises in 1996 (May, June). A total of 653 stomachs of herring ranging in length from 24.0 to 39.0 cm were examined. Of these 622 or 95% were found to contain food. The proportion of stomachs with food was lowest in April, and highest in May and June, indicating that the main food intake took place during May and June. As judged from the mean stomach fullness the herring fed mainly during the night. Copepods (mainly *Calanus finmarchicus*, *C. hyperboreus* and *Metridia longa*) were most important prey of herring, both in terms of weight and biomass. In June Amphipods (mainly Themisto abyssorum) were also important in the diet. The relations between herring migrations and the distribution and seasonal abundance of zooplankton are discussed. The food of herring was found to be largely similar to the composition of zooplankton in the sea.

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ICES CM 2000/M:10

Interannual variations in hydrography and spring bloom dynamics, and their effect on *Calanus finmarchicus* distribution and reproduction on the Scotian Shelf in the late '90s and 2000

E. Head

The eastern Scotian Shelf (SS) has as its upstream source the Gulf of St. Lawrence, (GSL), whereas the mid-central and western SS are influenced by the Nova Scotia Current and by springtime intrusions of water from offshore. Both the GSL and offshore are springtime sources of overwintered *Calanus finmarchicus* and for the latter, the degree of penetration on to the shelf appears to be linked to the position of the Gulf Stream in a given year. Reproduction always starts later for the population on the eastern SS than for the one in the west, which may be due to temperature differences or to the earlier arousal of the offshore population. In 1999, an unusually early occurrence of the spring bloom on the eastern SS apparently led to an early onset of reproduction in *C. finmarchicus*. In 2000, water temperatures were generally warmer than those seen in the 90s: the effect on the *C. finmarchicus* populations is being examined.

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ICES CM 2000/M:12

The role of plankton fluctuations in the production of pelagic fishes in a sensitive ecosystem

A.E. Kideys

Since the last few decades, striking changes have been occurring in the pelagic ecosystem of the Black Sea. These changes which are mainly induced by man are particularly striking at the planktonic level. The overall impact is the fluctuations seen in the catches of this commercially important pelagic fishery. Here I present what the main changes in plankton are and how these affect the commercially important pelagic fishery in the Black Sea.

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ICES CM 2000/M:13

Seasonal variation of plankton dynamics in the Kuroshio extension region based on a 3-D ecosystem model

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An ecosystem model was developed to be incorporated biological processes of lower trophic level into a three-dimensional physical primitive model, and applied to the Kuroshio extension region in the northwest Pacific where most of winter-spawned larvae of Pacific saury (*Cololabis saira*) are distributed.

Mesoscale eddies and meander around the extension were appropriately reproduced, and biological results responded to the temporal change of physical field and indicated strong sensitivity to wavelength of the meander and depth of the mixed layer. In comparison of model estimates with observed values by research vessels in meridional cross sections across the extension, the supply of nutrient from lower layer was richer especially in the north-side of the ridge of meander, and the model showed chlorophyll maximum at surface in spring and at sub-surface in summer as well as observations. The model also simulated the almost similar seasonal variation and spatial distribution of zooplankton biomass, which is one of important factors responsible for growth and mortality of saury larvae.

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ICES CM 2000/M:14

Plankton size distribution and predator-prey relationship in the Belgian coastal zone

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Distribution of phytoplankton around several sandbanks of the Belgian Coast was investigated in February 1995 and 1997. The TWINSPAN dendogram, for the 2 years, shows a clear separation of cluster, corresponding to different sandbanks. The nearshore banks phytoplankton community structure differed significantly in terms of species composition from the offshore Banks.

Canonical Correspondence Analysis (CCA) of the phytoplankton data-set revealed, that beside temperature, salinity and turbidity, the nutrient concentration (NO2-) contributed substantially to explain the variance in phytoplankton species. The observed differences in phytoplankton species distribution could be explained by the position of the sandbanks.

Westhinder, OostDyck and Oosthinder are positioned further from the coast than Kwintebank, Middelkerke, and Stroombank, and the plankton community over Westhinder, Oostdyck, and Oosthinder are clearly influenced by the Atlantic current penetrating the southern North Sea from the English Channel.

The sub-areas, which were separated based on phytoplankton species composition, also displayed a different situation with regard to the biomass size

spectra and the potential trophic transfer between phytoplankton and zooplankton.

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ICES CM 2000/M:15

Environmental forcing of zooplankton variability on Georges Bank

D. Mountain, J. Kane, and J. Green

Plankton and hydrographic measurements from Georges Bank over the last 25 years indicate a close relationship between salinity and the abundance of zooplankton during the spring. Both time series also exhibit significant relationships with the North Atlantic Oscillation (NAO). The salinity may be a proxy for physical processes or conditions that influence the zooplankton abundance. Analysis of the salinity data indicates that the variability is associated with different physical processes at different times. Finding a consistent mechanistic connection between NAO variability and physical processes that would control salinity and have a realistic linkage to zooplankton variability is difficult. Identifying which parts of the apparent relationships represent true forcing-response connections and which may be simply fortuitous is the subject of the discussion.

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ICES CM 2000/M:16

Interannual variations of the amount of herring in relation to plankton biomass and activity, temperature and cloud coverage in the Baltic Sea

L. Postel

Herring biomass in the ICES Sub-divisions 22, 24–32, compiled by (Thurow 1997), depend on eutrophication of the Baltic Sea during the 20th century. Superimposed, there are interannual variations, which coincide with those of mesoplankton biomass and phytoplankton activity (production index), temperature (SST, air [near bottom]) and cloud coverage. The latter fits with the amount and phase of the galactic cosmic ray flux as described by Svensmark and Friis-Christensen (1997) and Svensmark (1998).

Keywords: activity, Baltic Sea, cloud coverage, galactic cosmic ray flux variations of herring biomass, plankton biomass, temperature, 1972 to 1992.

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ICES CM 2000 M:17

The effect of spatial and temporal variations zooplankton concentrations on larval cod growth and survival on Georges Bank: a sensitivity analysis based on modelling and observations

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The U.S. GLOBEC Georges Bank/NW Atlantic program has generated an unprecedented body of data on vital rates, abundance and distribution of zooplankton and ichthyoplankton on Georges Bank. Concurrent with the data-gathering activity has been the development and refinement of coupled a physical-trophodynamic model describing survival and distribution of larval cod and haddock. Using zooplankton data from the Georges Bank broadscale cruises, we expand the biological model to include a 3-D and time-dependent description of the zooplankton prey field to address hypotheses linking interannual variations in copepod production on the Bank to growth of cod larvae. Prey concentrations are interpolated between monthly broadscale cruises applying species specific rates of reproduction, growth and mortality obtained from process cruise measurements and literature values. We determine when and where prey concentrations were limiting larval fish growth and we examine the sensitivity of modelled growth rates to realistic variations in egg production and naupliar concentrations of dominant copepod species, including *Calanus finmarchicus* and *Pseudocalanus* spp.

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ICES CM 2000/M:18

Decadal plankton changes on the eastern Nova Scotian Shelf and western North Atlantic

D. Sameoto

A comparison study of the phytoplankton colour index, selected phytoplankton and zooplankton taxa from the eastern Scotian Shelf (CPR E-line) and from the Northwest Atlantic (CPR Z-line) showed a significant similarity in yearly abundance changes. It is suggested that environmental changes, influencing both regions, are causing the organisms to respond in a quasi-synchronous manner. Changes in abundance of the population of *C. finmarchicus* in the Northwest Atlantic were correlated with the abundance of *C. finmarchicus* on the Scotian Shelf. This correlation could be explained if the populations of *C. finmarchicus* from the Northwest Atlantic contribute to the reproducing population of *C. finmarchicus* on the eastern Scotian Shelf. The period between 1991 and 1998 was a period of high levels of phytoplankton colour index and low levels of *C. finmarchicus* and euphausiids on both CPR lines.

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ICES CM 2000/M:19

Zooplankton as an ecological indicator in a fish stock recovery assessment

K. Sherman, J. Kane, S. Murawski, W. Overholtz, and A. Solow

Spatial and temporal biomass and species diversity time-series of zooplankton have been examined in a continental shelf ecosystem for indications of variability in abundance levels associated with effort reduction management actions for the recovery of depleted bottom fish stocks. Analyses were conducted on 15,000 zooplankton samples collected seasonally over two decades from the U.S. Northeast Shelf ecosystem (1970s to 1999). Fish stock results were obtained from the Northeast Fisheries Science Center's bottom trawl survey indices of spawning biomass of selected demersal (cod, haddock, yellowtail flounder) and pelagic (herring and mackerel) fish species. Following a decline in the late 1970s, the emerging pattern of the zooplankton component of the ecosystem showed a robust upward trend with the capacity to support recovery of early life and adult stages of herring and mackerel in the mid-1980s and the early life stages of cod, haddock, and yellowtail in the late 1990s.

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ICES CM 2000/M:20

Regional dynamics of *Calanus* in the Norwegian Sea in response to ocean climate in 1997

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A coupled 3D hydrodynamic and ecological model has been set up for the Norwegian Sea (i.e. SINMOD). The hydrodynamic model uses the z-coordinates in the vertical direction. The horizontal grid point distance is 6.67 km and covers the northern North Sea, Mid Norwegian Shelf, Lofoten Basin, and Faroes Shelf. The western limit is just at the eastern boarder of the Icelandic Shelf. The open boundaries are taken from a regional model using 20-km grid resolution. The models have been forced with atmospheric input from 6 hourly wind and pressure fields. The ecological model has eight state variables in addition to a structured model of *Calanus finmarchicus*. The state variables are nitrate, ammonium, silicate, diatoms, flagellates, microzooplankton, and slow and fast sinking detritus. The *Calanus* model uses developmental structure for the nauplii and weight structure for the copepodites. Data from Station M (66°N, 2°E) has been used to adjust the mortality rates of *Calanus*. 10% of the CV's are allowed to develop into females and start a new generation and the remaining 90% is transferred into an overwintering

stage having a depth distribution between 500 and 1500m. The overwintering stock of *Calanus* at Station M below 600m was taken as an initial distribution for the whole model domain (north of the Scotland-Iceland ridge). The model simulates the pattern of phytoplankton growth, which is in accordance with observational data from several cruises in the region during the year of *Calanus*. An early start (March/April) in the Coastal Norwegian waters and at the front between the coastal water and the Atlantic waters was found. The spring bloom starts gradually later West and North in the Norwegian Sea. The earliest spawning took place near the shelf break off Norway where ascending *Calanus* met the spring bloom in surface waters. At Station M the timing of the spring bloom and the successive copepodite stages are simulated correctly. The simulated second generation is two weeks earlier than observed in field data. However, there is a large heterogeneity around this position in the Norwegian Sea on the southwestern slope of the Vøring Plateau. Coastal water and perhaps water from the East Iceland Current may change the property (vertical mixing and nutrient supply) and the history of the *Calanus* stock entering this geographical region. Two generations are of *Calanus* simulated in the southeastern part of the Norwegian Sea. Along the shelf break the second generation is advected as far north as the entrance to the Barents Sea. In the Northern North Sea the temperature and the supply of food is sufficient for the model to produce three generations.

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ICES CM 2000/M:21

How to get more fish: ecosystem and environmental options

J. H. Steele

Linear network analysis of a simple (10 box) food web is used to explore options for increasing biomass of fish stocks corresponding to past pristine, or future well-managed ecosystems. The options include; older fish; no "jellies"; minimal benthic invertebrate predators; increased primary production; decreased microbial loop (detritus). The general conclusion is that no single option gives much more than a doubling of fish biomass, and a concatenation of options seems unlikely.

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ICES CM 2000/M:23

Geographical variation of Chl-a seasonality, and its interannual variation in the subarctic North Pacific Ocean

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To make understood clearly the geographical variability of Chl-a seasonality in the subarctic North Pacific Ocean, we compared the seasonal variation of biological and physical conditions among waters. The spring blooming appeared in the Oyashio, sea of Okhotsk, Bering shelf water. On the other hand, western, central, eastern pacific, and Bering basin water did not have spring blooming. MLD (mixed layer depth) of the Oyashio and sea of Okhotsk was reached at 40m depth at April due to decrease salinity. However, the MLD of western, central, eastern pacific, and Bering basin still existed below 100m depth at April. The timing of the seasonal pycnocline formation may play important role for the Chl-a seasonality in the subarctic North Pacific. The climatic regime shift occurred during mid 1970s and subarctic circulation accelerated in the North Pacific Ocean. Consequently advection from the Okhotsk Sea to the Oyashio water enhanced. In the Oyashio water, sea surface salinity decreased, and Chl-a concentration of April increased from mid 1970s. There is possibility that the low saline water advected from the Okhotsk Sea acts the development of seasonal pycnocline formation, and causes high Chl-a concentration from mid 1970s in the Oyashio water.

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ICES CM 2000/M:24

Modelling growth and advection of larval cod and haddock on Georges Bank in evolving flow and prey fields: a synthesis of observations and model results for spring 1995

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Surveys conducted as part of the U.S. GLOBEC/NW Atlantic program from March-June 1995, encountered a large number of cod and haddock eggs and larvae on the Northeast Peak of Georges Bank. These cohorts were sampled for three months as they were transported along the Southern Flank of the Bank. Detailed information was obtained on larval abundance and growth, and the space-time structure of the zooplankton prey field and hydrography. These data are being synthesized and interpreted using spatially explicit physical and biological numerical models. We present the results of our efforts examining the growth and survivorship of the larval fish cohorts using individual-based models (IBM) embedded in realistic, dynamic copepod prey and hydrodynamic flow fields. Our larval fish IBM includes considerations of turbulence, light, prey choice and behaviour. Our copepod prey field includes naupliar and copepodite stages of major species of copepods on the Bank (including Pseudocalanus, Calanus, Centropages and Oithona).

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ICES CM 2000/M:25 (Poster)

Sound scattering from macrozooplankton aggregations off Patagonia at 38 kHz

G.L.A. Colombo and A.O. Madirolas

During a series of routine annual surveys for fish abundance estimation off the South Patagonian Shelf (Argentina), additional acoustic and plankton sampling was performed every year along a transect established at the 51°LS. The spatial distribution and aggregation pattern of macrozooplanktonic concentrations was studied utilising 38 kHz acoustic data. Large plankton scattering layers were detected and its species composition identified. The scattering layers occupied mainly the 25–50 m depth range during night hours, ascending rapidly to the surface at dawn and vanishing at the beginning of the day. No scattering layers were detected during daytime. Correspondence between plankton samples and echorecordings revealed hyperiid amphipods as the main scattering source at the working frequency. The results obtained in this work point out the potential of fish assessment surveys databases as a source of information for the study of the abundance of macrozooplankton in the Argentine shelf.

Keywords: Acoustics, euphausiids, *Euphausia lucens*, *Euphausia vallentini*, hyperiid amphipods, macrozooplankton, Southwest Atlantic, spatial distribution, *Themisto gaudichaudii*, vertical migration, 38 kHz.

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ICES CM 2000/M:26 (Poster)

Carrying capacity of apex predators and the frequency and cadence of physical forcing in marine food webs

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Carrying Capacity has been defined as the maximum biomass "supportable" for a given level of primary productivity. For apex predators, this supportable biomass is also a function of the food web's structure. Current discussions emphasize that carrying capacity may change as part of a "regime shift." In this frame of reference, a shift in primary productivity may be considered to be an alternation between two carrying capacities. However, if the change represents an oscillation, changes in the food web structure or an apex predator's long-term carrying capacity will depend not only on the amplitude of the oscillation, but on its frequency and cadence, where cadence is defined as the sequencing of the extremes of productivity. In this paper, we examine quantitative models of several North Pacific marine food webs. The ecosystems range from the Bering Sea to subarctic and subtropical gyres to the Eastern

Tropical Pacific. Each ecosystem has been hypothesized to respond differently to ENSO and decadal scales of physical variation. For each model, we determine a "static" carrying capacity for apex predators or the

biomass supportable if primary productivity remained constant. Then, we manipulate each system by varying the frequency and amplitude of primary production to ask, "on what scale of variation does each ecosystem maximize production?" The results are compared to changes in frequency, amplitude and cadence of forcing that may be expected under scenarios of long-term climate change, and under fishing pressure, which may not have evolved to take advantage of the natural variation within the system.

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ICES CM 2000/M:27 (Poster)

The seasonal cycle of nitrate supply and potential new production in the Gulf of Maine and Georges Bank regions

J. J. Bisagni

Total primary production in the World Ocean may be divided into "new" and "regenerated" based upon the source of nitrogen. Allocthonous nitrogen (NO3) input into the Gulf of Maine and Georges Bank regions results from horizontal and/or vertical transport of NO3 into the euphotic zone, river input, atmospheric deposition and nitrification. Autocthonous nitrogen (NH4) input results from recycling by biota within the water column and sediments. In the absence of allocthonous nitrogen, any marine ecosystem will eventually become non-sustainable due to export of nitrogen through sinking of biogenic material, harvesting activities, and predation from migratory pelagic species. The Gulf of Maine and Georges Bank are regarded as highly productive from the standpoint of primary production and fisheries. However, despite high levels of primary productivity and fish production on Georges Bank, rates of secondary production are lower than expected based on values from other productive seas. Hypotheses put forth to explain observed lower secondary production on Georges Bank are 1) advective losses of zooplankton, and 2) nitrogen limitation. In an effort to detect the presence of nitrogen limitation and to better understand apparent lower secondary production over Georges Bank, amounts of new and regenerated primary production are estimated using a quantity which has been termed "potential new production" (PNP). PNP can be estimated through vertical integration of NO3 from the surface to the maximum depth of the euphotic zone (Ze), usually taken as the depth of the 1% PAR light level, assuming that all NO3 is eventually used by the phytoplankton. This paper reports on work to determine the seasonal cycle of new primary production over the Gulf of Maine and Georges Bank using PNP as a proxy for new primary production.

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ICES CM 2000/M:28 (Poster)

Large scale interaction between sea ice dynamics and zooplankton community off east Antarctica

S. Chiba, T. Ishimaru, G.W. Hosie, and M. Fukuchi

Yearly interaction between zooplankton community structure and environmental change off east Antarctica (90–160 BE) was studied, using zooplankton net samples taken in March during 1988–1996 by Japanese Antarctic Research Expeditions (JARE). Copepods-based community dominated, accounting for more than 80 % to total numerical abundance. Annual mean abundance of most of zooplankton species varied in a same manner. The abundance, except of salps, increased in years when distance of sea ice retreat during spring-summer was large, but markedly dropped in years of the least sea ice retreat. As minimum sea ice retreat during spring-summer indicates an ice-edge bloom of limited scale, it is indicated that production of copepod-based zooplankton community but salp-based one depended on rich phytoplankton resources derived on ice-edge bloom. Since negative correlation between yearly variability of Antarctic krill recruitment and salp biomass has been reported in relation to the seaice dynamics around the Antarctic Peninsula/Weddell Sea Region, effects of sea ice decrease due to global warming on krill-based Antarctic marine ecosystem is attracting scientific attentions. This study demonstrated that the similar interaction might exist between salps and copepods off east Antarctica where krill biomass was scarce. Pattern of yearly sea ice dynamics and Antarctic Curcumpolar Wave (ACW) will also be discussed in the presentation.

Keywords: Antarctic Ocean, JARE, salps, sea ice, zooplankton community.

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ICES CM 2000/M:29 (Poster)

Reasons of plankton biomass dynamics in the southern Barents Sea

S.S. Drobysheva and V.N. Nesterova

Based on regular plankton and hydrographic investigations having been conducted in the Barents Sea since 1959 we described the dynamics of prevailed species *Calanus finmarchicus* biomass against long-term fluctuations in the Barents Sea hydrological regime and stock variations of abundant fish consumers - cod and capelin.

Stable and unstable periods of plankton biomass variations with different mean annual value and range of interannual fluctuations have been revealed. The cold period of 1967–1981 was characterized by low mean annual level of biomass amounting to 150 mg/m^3 and its interannual variations not more than in 2-3 times; in relatively warm periods of 1952–1965 and 1982–1988 the increase in mean biomass up to 300 mg/m^3 and significant inerannual fluctuations (to 6 times), that was indicative of instability of the biomass level, were typical.

Obviously, periodical variations of trends are caused by variation in the conditions of forming plankton production - the condition of water masses and intensity of their consumption by fish. The extent of each factor effect and their priority periodically varied. It is evidenced by the synchronism of the fluctuations of water temperature and *C. finmarchicus* biomass in the stable period and its disturbance in the unstable one. The latter was depressive for the main consumers of plankton.

The specific relationship of *C. finmarchicus* biomass with the temperature of Atlantic waters and fish abundance in different periods of interannual variations were considered on the basis of correlation analysis. The analysis showed that the advection of Atlantic waters determined constant recruitment of stock and, hence, boreal status of plankton in the southern Barents Sea, but the biomass level was regulated by biotic factor.

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ICES CM 2000/M:30 (Poster)

Phytoplankton biomass across and along the Angola-Benguela Frontal Zone in April 1999

D.S. Neto, B.B. Sangolay, C.A. Ruby, M.L. Silva, and H.S. Marques

Environmental changes affecting distribution and dynamic of phytoplankton biomass exert an important influence on fish stocks. This study intends to contribute to the knowledge of phytoplankton distribution across and along the Angola-Benguela Frontal Zone (9.00S, 23.10S). Samples were collected (on board of German R/V 'Poseidon', April 1999), at three depths in each CTD station, at the maximum (at 20–50 m) and near the two extreme values (at 5–20, and 50–90 m) of the range of the fluorescence curve of chlorophyll-a (chl-a). Nutrients and oxygen, chl-a, phaeopigments (phaeo) concentrations and phytoplankton were determined. At low irradiance, phytoplanktonic organisms were found between 5–10 m in the water column and at high irradiance, or during the night, they were found deeper (40–50 m).

Chl-a concentrations suggest that phytoplankton biomass was more concentrated on the Angola Dome region (8.50 S, 8.00 E.) and on the upwelling zone (15.00 S-17.00 S). Generally, a higher concentration of chl-a was found at 20–50 m however, the highest value was recorded during the day at 50–90 m (11.59 S, 12.10 E). Generally, pheo were significantly higher than chl-a. The high quantity of detritus in the Angola waters could explain the high concentration of phaeo, as a result of chl-a deterioration. Flagellates and dinoflagellates dominated in Open Ocean and along the Angolan coast, and diatoms in the Namibian waters. The high quantity of dinoflagellates and flagellates observed in Angolan waters suggest a high probability of blooms.

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ICES CM 2000/M:31 (Poster)

Peculiarities of feeding behaviour in Arcto-Norwegian cod when major food objects are in deficiency

E. Orlova, A. Dolgov, V. Nesterova, M. Antsiferov, and L. Konstantinova

Materials on feeding, distribution and fatness of cod systemized for the period 1980–1990 (data from literature and the authors' data) have reflected a wide range of conditions for its foraging and feeding adaptation. Types of cod foraging are distinguished depending on supply with the main food object - capelin. Peculiarities are revealed in its feeding when capelin are in deficiency (1986–1988, 1995, 1997–

1998) which are accompanied with a low fatness of cod. Under these conditions an increased accessibility of capelin during specific years was a compensatory factor that has contributed to maintaining of a high level of fat content in fish liver (to 53 %), being close to that during an intensive feeding on capelin.

Variation in role of other food objects, caused by an overlapping of their areas with cod, is shown for some years with different temperature regimes. Due to intensive transition of predators to other food objects (redfish, non-target species, macroplankton and benthos) there were seasonal variations in periods and extension of feeding migration of cod related to biological peculiarities and behaviour of food objects.

Higher importance of macroplanktonic crustaceans (Euphausiidae, Gyperiidae) in feeding of cod, usual at a low abundance of capelin, has been established to increase even more during the moderate and cold years owing to a retarded development of crustaceans, successive formation of near-bottom concentrations in the direction from the west to the east. The most favourable conditions of cod feeding during autumn are formed at a high accessibility of polar cod; its seasonal consumption during a fall in water temperature, when linear and weight growth of fish terminates, is usually accompanied with a sharp increase in cod fatness.

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ICES CM 2000/M:32 (Poster)

Some features of distribution and feeding of the Atlantic herring (*Clupea harengus harengus*) in the Barents Sea

E. Orlova, E. Seliverstova, and V. Nesterova

Based on the long-term data on local concentrations of immature Atlantic herring in the Barents Sea (1985–1996) peculiarities of their vertical and horizontal distribution depending on the temperature conditions are shown. A clear connection of herring distribution with food supply status (Copepoda, Euphausiidae) in the main areas of their habitation has been revealed. The dependence of herring vertical distribution and their feeding activity on the fatness and food supply has been established. The conclusions concerning the variability of copepod plankton role in herring feeding due to the differences of temperature conditions in the period of herring wintering and copepod accessibility because of seasonal variations in their development, another food availability, possible herring competition with capelin have been drawn.

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ICES CM 2000/M:33 (Poster)

Rapid variations of the Norwegian Sea water heat content during 1995–1999 and their influence on condition of the feeding plankton

E. Sentyabov and N. Plekhanova

Temperature condition dynamics in the Norwegian Sea Atlantic waters in late 90s was characterized by the transition from cooling in 1995–1997 to significant warming in 1998–1999. That occurred against a temperature rise having been in progress since early 90s and reaching its maximum in 1997–1998 in the NorthEast Atlantic. This paper considers the main reasons of these variations connected with the atmospheric processes and their influence on seasonal development and the distribution of important food object - *Calanus finmarchicus.*

In cold 1995–1997 the spawning of Calanus was delayed, in June naupliuses were only registered in the Faeroes area. Water warming in the two following years was accompanied by earlier biological spring and the wider distribution of juvenile *C. finmarchicus* to the open sea. In these warm years east distribution of plankton elder age groups, the main component in pelagic fish feeding, was recorded, that also stipulated blue whiting and mackerel migration tracks becoming displaced. In 1996–1997 the redistribution of heat advection along the Norwegian Current branches alongside with the decrease in Atlantic water temperature was observed. The east branch was colder, and the west one – warmer, than usually. The situation turned out resulted in main *C. finmarchicus* concentrations shifting to the central Norwegian Sea.

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THEME SESSION

on

Spatial and Temporal Patterns in Recruitment Processes (N)

ICES CM 2000/N:01

Incorporating spawning origins of pelagic juvenile cod and environmental variation in the stock-recruitment relationship

G.A. Begg, G. Marteinsdottir, and S. Jónsson

Recent studies modeling back-calculated birth date distributions of pelagic juvenile (0-group) cod (*Gadus morhua*) have indicated differential regional spawning components in waters off the west, north and east coasts of Iceland, in contrast to traditional paradigms of stock structure. The relative proportions of pelagic juvenile cod that were estimated to originate from these regional spawning components were hypothesized to vary in response to the inflow of Atlantic water from the main spawning grounds in the south to the North Icelandic shelf. We examine this hypothesis by analyzing annual current flow rate data (1985–1998) in relation to the proportions of pelagic juvenile cod that were estimated to originate from regional spawning components in waters around Iceland. Additional variation in stock and environmental conditions were also examined in relation to the estimated spawning origins of pelagic juvenile cod to enable a detailed analysis of the stock-recruitment relationship. Results from our study will be placed in the context of spawning stock structure and recruitment prediction, and will provide an understanding of the effects of stock and environmental conditions on variable recruitment levels in the Icelandic cod stock.

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C. M. 2000/N:02

Reproduction areas of the cod stock in the western Baltic Sea

M. Bleil and R. Oeberst

Analyses of the previous years showed that the reproduction of the Belt Sea cod stock (*Gadus morhua morhua*) is also very important for the cod stock of the central Baltic Sea *(Gadus morhua calarias*). Oeberst (1999, 2000) proved that between 20% and 50% of cod caught in the Bornholm Sea aged 2 or 3 years between 1994 and 1998 were spawned in the Belt Sea. On account of this large significance of the Belt Sea cod stock information regarding the reproduction process are important.

In the last years the Institute of Baltic Fishery, Rostock, carried out extensive investigations concerning different aspects of the reproduction process of the Belt Sea cod. In addition to analyses to the maturity development, to the timing of spawning and to the quality of the cod eggs it was proved that the strength of a new year class is determined essentially by the portion of the active female spawners in the dominant length range of the spawning stock.

The goal of the article presented is the description of the actual spawning areas of the Belt Sea cod stock by means of the spatial distribution of the spawners based on characteristic parameters as the maturity stages and the proportion of the sexes. The inclusion of hydrographic parameters makes it possible to describe the conditions for the spawning activities. The calculation of the gonadosomatic index as well as the density distribution of spent females were used in order to compare the actual situation with the observations from the fifties, sixties and eighties (Berner 1960, 1985, Berner *et al.* 1973, Thurow, 1970)

Additional information is given regarding the smallest length of maturity for both sexes and the maturity ogive. The basis for these analyses are data sampled between 1992 and 2000. During the time period from November to June, the period of the reproduction activities of the Belt Sea cod stock, altogether 46 800 individuals were caught and analyzed. The comparison of the results of the different years is used to describe variations of the spawning areas and to discuss possible causes for these changes.

Keywords: Baltic Sea, Belt Sea, cod, gonadosomatic index, reproduction, spawning area.

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ICES CM 2000/N:03

Nursery grounds for the West Nordic Greenland halibut stock - where are they?

J. Boje and E. Hjörleifsson

Icelandic 0-group surveys suggest that Greenland halibut eggs and larvae drift from spawning grounds west of Iceland (West Nordic stock) mainly towards East Greenland. Nursery grounds are therefore traditionally believed to be located off East Greenland or north of Iceland. Examination of bottom trawl surveys and of by-catches of Greenland halibut in the shrimp fishery exclude any widespread nursery grounds in the area from East Greenland to eastern Iceland. Comparing the examined area with known nursery grounds in West Greenland clearly denotes the sparse abundance of juveniles in East Greenland – Iceland. A drift of larvae from the West Nordic stock to southwest Greenland are known to occur, and southern parts of the nursery grounds in West Greenland may therefore act as nursery grounds for Greenland halibut deriving from the West Nordic stock. The location of main nursery grounds for the West Nordic stock, however, still remains unknown, unless the nature of habitat and/or the distribution pattern of juveniles is different from what is observed in other nursery grounds. A total recruitment failure for the stock may also be a reason for the sparse abundance of juveniles as supported by analytical assessments.

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ICES CM 2000/N:04

Long distance dispersal versus local retention as a means of replenishing Caribbean marine fish populations

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Early models and evidence from genetics suggested that long distance dispersal of larvae is likely a common event leading to considerable population connectivity among distant populations. However, recent evidence strongly suggests that local retention is more the rule, and that long distance transport is likely insufficient to sustain ecologically marine populations. We build on earlier larval transport model results to examine the probability of larval dispersal to downstream islands within different regions of the Caribbean at varying distances from source populations. Through repeated runs of an 3-D ocean circulation model (MICOM), coupled with a random flight model estimating larval subgrid turbulent motion, we estimate the likelihood of particular circulation events transporting large numbers of larvae to within a 5 and 10 km radii of downstream populations, as well as account for total accumulations of larvae over each year. We then examine the hypothesis that larvae of coral reef fishes capitalise on flow structures to be retained in the proximity of their native island. Here, high-resolution biological and physical surveys of the pelagic processes affecting the larval phase of coral reef fishes were conducted on the western shore of Barbados. An integrated view of the 3-D flow field is given by multivariate objective analysis of CTD and ADCP data. We provide information on the formation, maintenance, and advection of larval patches by comparing, at different levels of behaviour, predicted and observed larval distributions. Percentage of larvae retained in the Barbados near field is also estimated.

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ICES CM 2000/N:05

Spatial modelling of spawning habitat suitability for the sole (*Solea solea* (L.)) in the eastern English Channel and southern North Sea

P.D. Eastwood and G.J. Meaden

The availability of suitable spawning grounds and nursery areas is thought to represent one link in the chain of physical and biological factors that control annual levels of recruitment. However, despite the growing body of literature describing fish-habitat relationships and variations in habitat quality, there are limited examples where the results are subsequently used to describe and map spatial variations in both habitat quality and quantity. Here we outline an approach to developing models of spawning habitat suitability for sole (*Solea solea* (L.)) in the eastern English Channel and southern North Sea, using data on the distribution of sole eggs in relation to temperature, salinity, depth and sediment type. Raster maps of the environmental variables, developed within a Geographical Information System (GIS), form the basis of the habitat models. Monthly spatial variations in sole egg abundance are modelled using regression quantiles, a non-parametric regression technique that provides linear model estimates for any part of the biological response variable, and therefore affords greater flexibility to modelling species-habitat relationships. The regression quantile estimates are then used to re-code the environmental raster maps to produce maps of habitat suitability. The final habitat models depict both temporal and spatial variations in spawning habitat suitability for a single spawning season.

Keywords: eastern English Channel, Geographical Information Systems (GIS), habitat suitability models, regression quantiles, *Solea solea*, southern North Sea

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ICES CM 2000/N:06

Causes of spawning pattern variability of anchovy and hake on the Patagonian shelf

M.D. Ehrlich, P. Martos, and R. P. Sánchez

Hake and anchovy are the most important demersal and pelagic resources on the Argentine shelf. Both species have a common geographical range, as they are trophically linked: the anchovy is one of the main food items of the hake during their adult stages. While the hake is heavily exploited, with clear signs of overfishing, including a seriously reduced spawning biomass, the anchovy is relatively unexploited. Traditionally both species shared the same reproductive scenarios off Patagonia characterized of tidal mixing fronts acting as larval retention areas. This paper reviews the spawning and nursery ground of both species since early 1970's. The most striking result is the gradual disconnection of the hake from the traditional spawning grounds, which still occupied by the anchovy. The typical hake spawning concentrations are now dispersed and located offshore, while the anchovy maintains the classical pattern in close association with the frontal system. An analysis of the hydrographical conditions prevailing in the spawning grounds shows no significant changes that could account for this anomalous hake behaviour. The implications of these changes on recruitment and population dynamics of both species are discussed.

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ICES CM 2000 /N:07

Inter- and intra-annual variability in meso- and large-scale horizontal distribution, abundance and population structure of Baltic sprat

V.N. Feldman and T.G. Vasilieva

On the basis of dis-aggregated data from hydroacoustic surveys conducted by AtlantNIRO in May–June and October 1992–1999 the distribution patterns of young-of-the-years/recruits and adult sprat in ICES Sub--divisions 26, 28 of the Baltic Sea are shown. The analysis of age-specific abundance data from hydroacoustic surveys revealed intra-annual meso-scale (between statistical rectangles and depth strata) and inter-annual large-scale (between subdivisions and basins) variability of horizontal distribution of sprat. The inter-annual variability in abundance of sprat between Sub-divisions 26,28 is related to basin specific hydrographic, while intra-annual variability in meso-scale horizontal distribution of abundance (within Sub-division 26) is related to seasonal spawning and feeding migration, that influenced by the depth-specific hydrography.

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ICES CM 2000/N:08

Recruitment variability in Norwegian spring-spawning herring (*Clupea harengus* L.): the effect of temperature in larval drift trajectories

Ø. Fiksen and A. Slotte

The Norwegian spring-spawning herring is one of the largest fish stocks in the North Atlantic. The traditional spawning grounds are found along the Norwegian coast from Lofoten in the north (69°N) to Lista in the south (57°N), but the spatial distribution of spawners differ between years and periods. The recruitment to the stock is also quite variable. In this paper we attempt to model the recruitment variability from temporal (annual) and spatial variations in temperature and distribution of spawning herring. The growth of herring larvae (until metamorphosis) is assumed to be temperature limited, while mortality rate is a function of size. The larvae drift northwards from their spawning area and eventually ends up in the nursery area, the Barents Sea. Temperature at various stations along the Norwegian coast has been recorded since the 1930s. These data will be used as input to the model, together with data on spawning stock sizes, stock structure (length and condition) and distributions. The predicted variations in larval survival are furthermore compared with observed variations in recruitment.

Keywords: larval survival, model, recruitment, spawning stock size, spawning stock distribution, temperature.

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CM 2000/N:09

Horizontal and vertical distribution of sprat in the Southern Baltic Sea during spawning time. First results of the 1999 German June acoustic survey

T. Gröhsler, U. Böttcher, and E. Götze

This paper describes the results of an acoustic survey carried out with R/V 'Walther Herwig III' in May/June 1999 in the Baltic Sea, Sub-divisions 24-28. The survey was conducted within the framework of the EU project 'Environmental and fisheries influence on fish stock recruitment in the Baltic Sea (STORE)'. The main objective was to describe the spatial distribution of sprat stocks and to estimate their abundance by means of acoustic methods. The horizontal and vertical distribution was analysed in relation to hydrographic conditions. The latter were characterised by a typical spring situation. Due to the spring warming of the surface layer a thermocline was observed at 15 to 20 m. The permanent halocline, which was connected to a temperature discontinuity, was located between 55 to 65 m. Both clines clearly affected the vertical distribution of sprat. In deeper basin areas where both layers occurred, sprat was mainly concentrated in a small layer below the permanent halocline. In shallow water, which was characterised by a missing permanent halocline, sprat was predominantly allocated below the thermocline. For the main investigated area in Sub-division 25 the sprat and herring stock size was estimated to be about 40.8 x 10^9 individuals or 355.5 x 10^3 t, and about 1.0 x 10^9 individuals or 41.5 x 10^3 t, respectively. As it is known that sprat is feeding on cod eggs, it is discussed that the distribution of sprat is connected to the occurrence of cod egg layers.

Keywords: abundance, biomass, herring, hydroacoustic, hydrographic conditions, horizontal and vertical distribution, Southern Baltic, sprat, 1999.

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ICES CM 2000/N:10

On the relation between larval growth and recruitment: a comparison between larval and juvenile otolith growths

G. Allain, P. Petitgas, P. Grellier, and P. Lazure

Dial increments in the otolith of larvae and juveniles enable to reconstruct individual growth trajectories. Larval growth is one of the major indicators in the field that can be coupled with physical and food chain characteristics in order to understand larval survival and recruitment processes. Anchovy in the Bay of Biscay has shown in the ten past years major variations in recruitment level varying from 20 000 to 100 000 metric tonnes. In 1999, repeated ichtyoplankton surveys were performed on a major spawning ground of anchovy in front of Gironde estuary, which enabled anchovy eggs and larvae to be sampled through the entire season together with parameters of the pelagic ecosystem (production by size classes). In autumn, a juvenile survey was undertaken in the area where young juveniles recruit which originate from the Gironde estuary spawning ground. The spatial origin of the juveniles in the surveyed area is controlled using a hydrodynamic model. Birth dates of the sampled juveniles are estimated from otolith microstructure analysis. Growth curves of recruited juveniles, which were larvae during the ichtyoplankton surveys, are compared to the growth curves of the larvae. Are the survivors the faster growing larvae?

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ICES CM 2000/N:11

Modelling the spatial and temporal structure of survivorship to settlement in North Sea and west of Scotland haddock

M. Heath and A. Gallego

Haddock spawn over a wide area of the northern North Sea and west of Scotland and the eggs and larvae experience a range of oceanographic environments during their pelagic phase. These have the potential to generate both spatial and temporal patterns in pelagic survivorship. In addition, the patterns of spawning intensity and dispersal act to precondition the population surviving to the end of the pelagic phase for competition during settlement. Settlement appears to be the main density dependent stage during the recruitment of haddock. These processes have been incorporated into a spatially resolved, individual based model of haddock early life history. Here, we present analysis of results from the model, showing the effects of spawning stock size and structure on the spatial and temporal

patterns in survivorship to various developmental stages.

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ICES CM 2000/N:12

An evaluation of the utility of spatially-explicit biophysical models in recruitment studies

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We have developed a suite of coupled, spatially explicit biophysical models of the recruitment process for walleye pollock in Alaskan waters as part of the Fisheries Oceanography Coordinated Investigations (FOCI) program. These models include a three-dimensional circulation model, a bioenergetically based individual-based model which tracks early life stages of pollock through space and time, and a nutrient-phytoplankton-zooplankton model which provides a spatially and temporally varying food source for young pollock. We have performed model experiments, sensitivity analyses and hindcasts with these models in an attempt to learn how physical and biological factors influence the recruitment of this species. We will review and evaluate the present status of the use of spatially explicit biophysical models in recruitment studies, with emphasis on the work done in FOCI. What have we learned from these models? What are advantages of their use? What are some of the difficulties and pitfalls? What can they tell us about spatial and temporal patterns in the environment of the early life stages of marine fish, and the implications of these patterns for recruitment? How have model experiments and sensitivity analyses, as well as model hindcasts of particular years added to our understanding of pollock recruitment? What further extensions and refinements would be useful? We hope that this review will be useful to others engaged in modelling recruitment processes.

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ICES CM 2000/N:13

Scale and pattern in recruitment processes of bay anchovy in Chesapeake Bay

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Recruitment of bay anchovy (*Anchoa mitchilli*) varies annually in Chesapeake Bay, and levels and patterns are related to variability in hydrological conditions and the spatial distribution of spawning stock biomass. Midwater-trawl surveys, conducted three times annually from 1995–1999, over the entire 320-km length of the Bay, provided information on annual and regional patterns of recruitment, and their relationships to variability in the estuarine environment. Adult biomass of anchovy within the Bay at the beginning of spawning seasons in 1995–1999 varied six-fold, but it alone was not directly related to the young-of-the-year (YOY) recruitment level. Levels of recruitment in October were low in 1995 and 1996 (6 to 7 X 10^9) but higher in 1997-1999 (19 to 52 X 10^9). An important feature of the recruitment process is an ontogenetic migration in which YOY bay anchovy tended to move upbay until they are approximately 45 mm TL, after which they begin to move downbay. The strong salinity gradient may act as a partial barrier to upbay or downbay migration, the effect being more pronounced for small (<60 mm TL) anchovy. However, seasonal water temperature was more important in determining the latitudinal distribution of spawning stock biomass. Late-summer recruitment of YOY anchovy was high when water temperature was low in April–May, inhibiting upbay migration of adults at the onset of the spawning season, and insuring that most spawning occurred in the lower and middle region of the Bay. A modified Ricker stock-recruitment model that included the latitudinal range of adult migration between April and July, explained 98% of recruitment variability.

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Migration/dispersal patterns of YOY bay anchovy *Anchoa mitchilli* in the Chesapeake Bay: Sr:Ca analysis on a ubiquitous species

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Bay anchovy *Anchoa mitchilli* is a ubiquitous, abundant pelagic species in the Chesapeake Bay, and does not exhibit discrete modes of habitat use related to different life-history stages. Subtler ontogenetic habitat shifts by estuarine fishes may occur across salinity regimes, but these have been difficult to document and investigate

using traditional sampling/tagging approaches. Here we test whether young-of-the-year (YOY) of bay anchovy to different parts of the Chesapeake Bay results from differential dispersal rates. Electron microprobe analysis of otolith strontium was used to hind-cast patterns and rates of movement across salinity zones. Individual chronologies of strontium were constructed for 55 bay anchovy aged 43–103 d collected at five Chesapeake Bay mainstream sites representing upper, middle, and lower regions of the Bay during September 1998. Most YOY anchovy were estimated to have originated from the lower bay. Those collected in 5 and 11psu sites exhibited the highest past dispersal rates, all in an up-estuary direction. No significant net dispersal up- or down-estuary occurred for recruits captured at the polyhaline (> = 18 psu) site. Initiation of ingress to lower salinity waters (< 15 psu) was estimated to occur near metamorphosis at sizes > 25 mm SL and 50 d.

Keywords: bay anchovy, Chesapeake Bay, dispersal rate, otolith, Sr:Ca, YOY.

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ICES CM 2000/N:15

Abundance and distribution of larvae of commercially important fish species in the western Baltic Sea during the period 1993–1998

B. Klenz

The distribution and abundance of larvae and juveniles of the western Baltic Sea fish species of commercial importance are described. The results are based on five ichthyoplankton surveys carried out in May/June on a standard station grid in ICES Sub-divisions 22 and 24 during the period 1993–1998. The number of larvae caught varied throughout the time series. In 1994 the largest mean abundance [larvae/m^2] was estimated.

The time series derived from the Bongo-Net samples shows a very slight increase in larval abundances of the western Baltic cod stock. But the values are below the mean abundance of cod larvae in the Bornholm Basin.

The influence of the varying plankton survey time and the direct wind-induced drift of cod early life stages from the main area of investigation towards the east are discussed.

An increasing trend in herring larvae abundances was observed during the period 1993–1998. In three years regional spawning activities along the German coast were ascertained in accordance with previous results from literature – especially on stations in the Kiel Fjord, in the Eckernförde Bight, and in the north of the River Schlei.

Species assemblage correlations are investigated for the larvae sampled during the period 1993–1998. The statistical analysis of the data shows no general relationship between the larvae of the commercially important western Baltic Sea fish species. The species assemblage varies through the years investigated.

Keywords: abundance, distribution, fish larvae, species assemblage correlations, western Baltic Sea.

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Recruitment of Baltic cod and sprat stocks: Identification of critical life stages and incorporation of environmental variability and spatial heterogeneity into stock-recruitment relationships

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For the recruitment process of Baltic cod and sprat, critical periods have been identified by comparing abundance estimates obtained for successive early life history stages: i.e. for potential egg production by the spawning stock, realized and surviving egg production, larval and 0-group abundance. Based on an exploratory statistical analysis, environmental variables showing significant relations to survival rates of critical life stages are incorporated into modified stock-recruitment models. The models have been set up for individual ICES sub-divisions, containing spawning areas with distinct hydrographic regimes and recruitment success, and secondly, combined for the central Baltic in total.

For cod, recruitment depends critically on egg survival, with oxygen concentration in dwelling depths and predation by clupoids being major causes of egg mortality. Independent of the spawning area investigated, the surviving egg production of cod is hardly correlated to larval abundance, however, larval abundance is significantly related to year class strength. This indicates that factors acting either on hatching

success and/or during the early larval stage are of major importance for cod recruitment in the Baltic.

For sprat, the egg stage does not appear to be critical for recruitment success, although sprat eggs are vulnerable to low temperature and cannibalism. Also, the production of late egg stages is significantly related to larval abundance. Year class strength, however, is largely independent of larval abundance, which indicates the main critical period in sprat recruitment to be the late larval and/or early juvenile stage in this area.

The statistical model obtained for prediction of cod recruitment at age 0 in Sub-division 25, containing the major spawning area of the Bornholm Basin, explained 69% of the variance if based on the potential egg production by the spawning stock, corrected for egg predation by clupoids, and considering the oxygen condition in the reproductive volume as well as a larval transport index as abiotic variables. In the more eastern spawning areas, the hydrographic regime did in general not allow successful egg development in the period 1981–1992. Thus, only relative simple models based on the egg production by the spawning stock and the reproductive volume are required to achieve a reasonable explanation of recruitment variability. Contrary to cod, sprat reproduces successfully in all major Baltic basins and if major processes affecting the larval and early juvenile stage can be identified, relatively simple stock recruitment relationships may be sufficient.

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ICES CM 2000/N:17

Influence of the surface circulation on the spawning strategy of the Sicilian Channel anchovy

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Several interdisciplinary surveys carried out in the Sicily Channel within the European Union projects MED96-052 and MED98-070 have evidenced the coupling between the hydrography and the spawning strategy of the Sicilian channel anchovy. The surface circulation is determined by the Atlantic Ionian Stream (AIS), the jet of modified Atlantic water entering the eastern Mediterranean basin. It describes a large cyclonic meander around the prominent topographic feature of Adventure Bank (off the western part of the island), then it impinges the shore accumulating warm water in the neighborhood of Sciacca and it acts as a concentration mechanism. The anchovy egg distribution found during 1997, 1998 and 1999 indicate that this is the preferred site for anchovy to spawn. The anchovy larvae distribution is different, with the highest larval concentration located off Cape Passero, 200 km downstream of the main spawning ground. The estimated averaged age of this population, based on the length of the larvae, is 8 to 10 days, which matches the time it takes a larvae that has hatched from an egg spawned off Sciacca to get Cape Passero while advected by the AIS. This area appears to be the main nursery ground, a fact supported by the cyclonic circulation induced by the general circulation of the AIS, which provides enrichment mechanisms for larvae growth and feeding.

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Oceanic factors in cod and haddock egg and larval distributions on Georges Bank (1977–87) and processes, which may govern interannual variability in recruitment

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The MARMAP 11-year time series (1977–1987) of cod and haddock egg/larval distributions was analyzed to estimate the average seasonal loss rates compared with known environmental events and size of the recruited year class. Indices for hydrographic and baroclinic circulation variability on Georges Bank during 1977–1987 springs were being developed to interpret gadoid early life stage variability. Hydrographic structure and geostrophic flow have been estimated for March-April and May-June on sections across the Northeast Peak spawning ground and southern flanks spawning route. The largest hydrographic anomaly was an increased extent of cool shelf water in 1978, while the largest transport anomalies were increased southwestward flow in 1983 and 1987 and reduced flow in 1985. Analysis of abundance of Georges Bank cod eggs and larvae, and age-1 recruitment estimates from VPA, showed highest correlations between adjacent life-history stages. The best predictor of abundance at age 1 was the abundance of recently hatched 3–5 mm larvae. For haddock, however, the best predictor of year class size was the abundance of 12–15 mm larvae. Weekly flow fields were created and particles were released from historical spawning areas to assess the relative retention of larvae within the 70-m isobath.

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Stochastic (Markov) modelling of larval survival condition along tracks of particles in a hydrodynamic model

S. Mahévas, P. Petitgas, and P. Lazure

Coupling of biology to physics in recruitment studies is generally performed in two ways: (i) regression analysis of a meteorological index with an abundance index of fish, (ii) an individual based approach where partial differential equations are used to model food availability, growth and mortality of larvae along tracks of particles in a hydrodynamic model. Here we analyze the interest of an intermediate approach to the coupling. It is based on the statistical characteristics of the spatio-temporal process of larval environmental events along tracks of particles in a hydrodynamic model. Passive particles are released simultaneously on a grid in the hydrodynamic model on an important spawning ground of anchovy in Biscay (in front of the Gironde estuary). This sampling of space is repeated at regular intervals during the spawning season. Once released, a particle is tracked. Along its trajectory, physical parameters such as temperature, vertical turbulence, advection, stratification are estimated with the physical model. This enables to construct a spatio-temporal series of categorical states (say, good or bad) for the larval environment that is experienced by the particle. Markov models are then fitted to the series along the trajectories. The interest in the modelling is in the estimation of different types of statistics related to the time duration in the different states. The series of physical events along the trajectories are then coupled to a stochastic model for larval survival potential. The model is a random walk where an index representing larval survival potential is increased or decreased depending on the physical events encountered and on time. Two years are compared where high and low recruitment occurred.

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ICES CM 2000/N:20

The temporal and spatial changes in the observed size of cod eggs in the Eastern Baltic

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The data base of Latvian Fisheries Research Institute on ichthyoplankton in the period of 1973–1999 was analysed separately for the 4 regions of the Baltic Proper (Bornholm Basin, Gdansk Deep and 2 parts of the Gotland Basin: southern and central). The different patterns of changes of size of cod eggs between the regions, during the spawning season and from year to year have been investigated. All significant correlations of diameters of cod eggs with the year-class strength of cod were negative. We also analysed the alterations of size of cod eggs with the depth and depending on stage of development in the Bornholm Basin and the Gdansk Deep in the second half of the 90s. In the Bornholm Basin cod eggs did not altered significantly with the stages of development, but in the Gdansk Deep they were increasing in size significantly. This difference was attributed to the unfavourable hydrological conditions in the latter basin resulting in the increased mortality in the group of smaller eggs.

Keywords: changes, cod eggs, size.

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The abundance, growth rate and mortality of the early life stages of herring (*Clupea harengus*) and smelt (*Osmerus eperlanus*) in the Vistila Lagoon (southern Baltic Sea) during 1998-1999

P. Margoński

The abundance, growth rates and mortality of early life stages of two pelagic fishes (herring and smelt) has been compared. Young smelt were found among collected samples during each cruise (with the exception of the very first cruise each year). Since herring larvae were hatching earlier than smelt larvae, they were found also in the samples during the first cruise of each year. Herring juveniles emigrated from the Polish part of the Vistula Lagoon at the end of June. Comparing the highest values of larvae abundance from 1999 to 1998, the increase of about 70% in smelt and even 300% in herring has been observed. Despite of this increase, the proportion of herring to smelt abundance was similar comparing both sampling seasons. In 1999, because of

warmer winter and spring, larvae of both species appeared about 2 weeks earlier than in 1998.

Herring in the Vistula Lagoon has at least three cohorts each year, but growth rate analysis seemed to be reasonable only for the first and the most abundant one. The 1999 herring larvae and juveniles had slower growth rate (0.504 mm/day) comparing with those of 1998 (0.569 mm/day) in the same time period of the year. Smelt larvae came from a single cohort and their growth rate may be divided into three periods:

- up to mid-June (the highest growth): 0.432 mm/day and 0.374 mm/day,
- from mid-June up to the beginning of the autumn: 0.243 mm/day and 0.325 mm/day,
- in the autumn: 0.101 mm/day and 0.098 mm/day,

(the data for 1998 and 1999 respectively). The change between the first and the second period depends very much on the dramatic decrease of food organisms abundance observed at the beginning of the summer. The change between the second and the third one depends on a rapid decrease of water temperature.

Herring instant mortality (between particular cruises) ranged between 0.008 and 0.306 in 1998 and between 0.006 and 0.141 in 1999. The highest values were caused rather by emigration of juveniles from the study area than by natural mortality. Smelt mortality differed significantly between both sampling seasons (0.018 in 1998 and 0.034 in 1999).

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ICES CM 2000/N:22

Spatial patterns in growth rate variability of Arctic cod in Disko Bay, West Greenland

P. Munk

The Disko Bay at West Greenland is a highly productive area of great fishery importance. The hydrography is of marked temporal and spatial variability, and investigations have shown characteristic patterns in hydrography and plankton dynamics. In June 1997 we carried out field study across the bay focusing on frontal characteristics of the hydrography and their potential influence on the life traits of fish larvae distributed in the Bay. Larvae of Arctic cod (*Boreogadus saida*) were widely distributed in the Bay, while larvae were not found south of this area. We estimated larval growth rates in the order of 10% (SGR in weight), but growth rates varied significantly within relatively short distances along our transects of sampling. Attainable growth rates were apparently linked to frontal hydrography and the productivity at lower trophic levels, and findings emphasise a conspicuous environmental influence on fish recruitment processes in the Bay.

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ICES CM 2000/N:23

Time, space, physics and food: the temporal and spatial distribution of anadromous fish larvae in an Estuarine Turbidity Maximum (ETM)

E.W. North and E.D. Houde

Variability in freshwater flow may govern survival and recruitment of white perch (*Morone americana*) and striped bass (*M. saxatilis*) larvae by controlling retention of early-life stages and by insuring overlap of preferred larval temperature/salinity zones with prey distributions in the Estuarine Turbidity Maximum (ETM) region. This hypothesis was evaluated in spatially explicit surveys of the physical and biological properties of the upper Chesapeake Bay estuary. Five cruises, three in May 1998 and two in May 1999 were conducted. Gradients in depth-specific abundances of striped bass and white perch larvae and their zooplankton prey were determined in conjunction with measurements of salinity, turbidity and temperature. Although physical conditions in the upper estuary differed between cruises and years, the spatial patterns in distributions of larvae were consistent. Most striped bass eggs (96%) and white perch yolk-sac larvae (59%) were located upstream of the salt front (1 PSU isohaline). Virtually all striped bass (94%) and most white perch (82%) postlarvae were located within 10 km of the maximum turbidity zone. Size- and depth-specific relationships between larvae, their zooplankton prey and estuarine physics are being evaluated, especially with respect to variability in freshwater flow and to larval ontogeny and behavior. It is apparent that the ETM region is an important nursery area for anadromous fish larvae. Life-history strategies ensure that adults spawn at appropriate times to promote retention of larvae in a region of abundant prey, thus improving probability of recruitment success.

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ICES CM 2000/N:24

A dynamic spatially-explicit analysis of growth and mortality in larval radiated shanny (*Ulavria subbifurcata*)

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We apply a coupled biophysical model of transport to reconstruct the environmental history of larval radiated shanny in Conception Bay, Newfoundland. A circulation model is coupled with a description of the patterns of growth rates derived using non-parametric local density estimators. The model is applied to data collected during a two-week period during which larvae, their food (copepod nauplii) and their predators (capelin) were monitored in three intensive surveys. Our goal is to determine whether environmentally explicit information can be used to infer the characteristics of individual larvae, which are most likely to survive. Backward reconstruction is used to assess the influence of variations in the feeding environment on changes in the growth rates of individual larvae. Forward projections are used to assess the impact of predators on the cumulative density distribution of growth rates on the population of larvae in different areas of the bay.

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ICES CM 2000/N:25

Examining the potential effects of vertebrate predation on Georges Bank larval cod: A modeling study for the 1995 field season

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The influence of predation on the dynamics of larval fish is difficult to estimate and may have a considerable impact on the recruitment process. During March–June 1995, the NOAA Coastal Ocean Program (COP)/U.S. GLOBEC NW Atlantic program had the opportunity to measure the abundance of both larval cod and some of their predators on Georges Bank. Here, we explore the potential influence of spatially explicit, size-dependent predation by herring and mackerel on a cohort of larval cod during transport along the Southern Flank of Georges Bank. Larval cod are modeled using an individual-based model supported by a size-structured zooplankton prey field and a realistic hydrodynamic flow field. The dynamic predator field is based upon field observations of herring/mackerel abundance.

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ICES CM 2000/N:26

Spatial and temporal patterns in age and size at maturity and spawning stock biomass of North Sea gadoids

M.-J. Rochet

Demographic traits like growth, maturity or fecundity are plastic in fish. The question is how their variability affects recruitment and population dynamics, and whether it should be taken into account in stock assessments.

This paper focuses on variations in time and space in age and size at maturity of four gadoid species in the North Sea: cod, whiting, haddock and Norway pout. Data from the International Bottom Trawl Survey (IBTS) in the nine standard roundfish areas of the North Sea for the 1983–1999 period are used. It is shown that there is significant spatial variation in age and size at maturity for cod, haddock and whiting. An index of spawning stock biomass (SSB) is estimated, taking into account this variability along with the spatial and temporal variations of fish abundance (also provided by IBTS data). These estimates of SSB are much more variable than those obtained through VPA by assessment working groups. In addition, for haddock the decreasing trend in SSB is much steeper when account is taken of spatial variations. The performance of survey-based SSB estimates in predicting recruitment is compared to the performance of VPA-based indices.

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ICES CM 2000/N:27

Baltic cod: Resolving processes determining spatial and temporal windows of survival

M.A. St. John, H. Mosegaard, H.-H. Hinrichsen, P. Grønkjær, F. Köster, K. Hüssy, and R. Neilsen

The linking of environmental processes to variations in recruitment success of fish stocks, the Holy Grail of fisheries oceanographers, has proved difficult. Typically research has followed two approaches. First is the linking of enhanced condition, growth or feeding success of a specific stage relative to a specific environmental condition. Secondly, a correlative approach has been employed relating the duration or intensity of a process to recruitment success. The former approach gives little information about the survival success of individuals to later stages, while the latter does not identify processes influencing the survival of the recruits, which are invariably a small component of the potential survivors. What is required is the identification of specific processes occurring during the early life history stages leading to increased survival success. Hence, we have chosen to look at the characteristics of survivors to elucidate the processes occurring during the pelagic stages of cod, which result in survivor success. Baltic cod spawn over a prolonged period (March to September) and hence experience highly variable survival rates due to seasonal variations in oxygen conditions at the depth of incubation, food availability, transport and predation. Furthermore, eggs and larvae are of varying in size and thus in egg buoyancy and larval growth rates, due to adult contribution. We will through the utilisation of otolith characteristics such as hatch check size (identifying egg size), daily increments (identifying hatching time), increment width (indicative of otolith growth rates) and comparison with an environmentally forced 3-D circulation model of the Baltic Sea, identify environmental windows and processes influencing the survival success of Baltic cod.

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ICES CM 2000/N:28

Migration of juvenile deep-sea redfish (*Sebastes mentella* (Travin)) from the East Greenland shelf into the central Irminger Sea

C. Stransky

This study investigates the stock structure and recruitment of deep-sea redfish *Sebastes mentella* off East Greenland and in the central Irminger Sea and evaluates current migration theories. Analyses of long-term trends in length distributions from survey data and commercial catches on the East Greenland shelf and in the central Irminger Sea are presented to identify strong year-classes and to track their abundance in these areas. Following the length frequency patterns over the past five years, a sharp decrease in abundance of recruiting *S. mentella* on the East Greenland shelf and a subsequent "ingrowth" of this length class into the oceanic stock in the Irminger Sea becomes evident. This observation, made for the first time since the regular groundfish surveys off Greenland started in 1982, suggests a migration of juvenile fish from East Greenland into the central Irminger Sea and indicates that the East Greenland shelf could be an important nursery area for oceanic redfish. The phenomenon of large-scale migration and its effect on the management of these stocks is discussed with respect to controversy on stock separation of redfish in the North Atlantic. A short overview on future research needs and objectives of current investigations on the stock structure of *S. mentella* in the Irminger Sea and adjacent areas are given.

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ICES CM 2000/N:29

Cod larval patches in Icelandic waters in 1998

K. Thorisson and Th. H. Asgeirsson

A large area southwest and west of Iceland was sampled twice during June 1998. Two cod larval patches were found and studied. The patch off the West Coast had become too dispersed at the last sampling for valuable comparison with the first cruise. The patch off the southwest coast, however, was retained in the same area during the whole three weeks between sampling cruises and was well suited for comparisons such as survival calculations. At the start of the experiment, in early June the estimated number of cod larvae in this latter patch was $5*10^9$ and the average length was 7.5 mm. The growth of the cod larvae in the patch was slow during the period (0.16 mm d^{-1}), and the mortality was very high, about 15 % d^{-1} on the average.

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ICES CM 2000/N:30 (Poster)

Distribution of larvae and juveniles of small pelagic fishes in the northwest Pacific off east Japan

H. Kubota, Y. Oozeki, and R. Kimura

Distributions of larvae and juveniles (20–50 mm SL) of the pelagic fishes, Japanese sardine (*Sardinops melanostictus*), Japanese anchovy (*Engraulis japonicus*), and mackerels (*Scomber japonicus and S. australasicus*), were surveyed using a Methot-Isaacs-Kidd midwater trawl (MIKT, 2.24 x 2.24 mouth opening and 1.64x1.75mm mesh size) in the northwest Pacific from May to June 1997. MIKT was obliquely towed 35 times from 60 m depth at night. Size distributions of three generic groups were compared between a near coast area (144E) and an offshore area (147–148E), and also compared among three latitudinal divided areas in the offshore area. Average lengths of sardine, anchovy and mackerels at the offshore area were significantly larger than the near coast area, suggesting an advection mechanism occurs due to the constant offshore-ward current. Further, average lengths of sardine and anchovy were larger at the southern stations than the northern stations in the offshore area.

The latitudinal difference of the length distribution of Japanese sardine did not agree with the large-scale distribution reported by larger mid-water trawl surveys. This indicates the necessity for small-scale surveys using quantitative sampling gears for the precise understanding of larval ecology.

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ICES CM 2000/N:31 (Poster)

Factors affecting the distribution of wrasses (Pisces: Labridae) in a fjord system: analysis by generalised linear models

T. Thangstad, J.H. Fosså, A. Fernö, and A. Johannesen

GLMs are a flexible way of analysing data from ecological surveys, because they allow for the fitting of skewed catch distributions, e.g. by using the negative binomial approximation. GLMs were here used to analyse spatial and temporal associations of three common and currently exploited cleaner-wrasse species with environmental and habitat-related variables. Monthly beach seine and net samples of goldsinny (*Ctenolabrus rupestris* L.), rock cook (*Centrolabrus exoletus* L.) and corkwing wrasse (*Symphodus melops* L.) were to this end collected over a five year period (1986–1990) on four typical habitat types in Masfjord (western Norway). The wrasses exhibited a great deal of distribution overlap, both in time and space. Occurrence and abundance was highly dependent on season and temperature, all species being active and available to capture during summer, while assuming a torpid state at lower winter temperatures. An ontogenetic shift in spatial use was apparent for goldsinny, with 0-group being most common in the outer fjord parts, and adults increasingly common towards the head of the fjord. All species appeared more associated with rocky and weedy habitats over non-sheltered and sparsely vegetated mudflats. The only indication of a differential preference was found in the stronger association of corkwing with the algal belt. The others appeared more influenced by the degree of substratum rockiness. Reasons for the high level of coexistence are discussed.

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ICES CM 2000/N:32

Spatial and temporal patterns in recruitment of shrimp *Pandalus borealis* in the Barents Sea

M. Aschan, B. Ådlansvik, and S. Tjelmeland

The shrimp spawn in autumn and the eggs are carried as out roe by the females until spring when the larvae hatch. Within a period of 2–3 months the shrimp larvae settle to the bottom. Today's assessment and forecast of the shrimp stock productivity and potential-fishing yields is weak. This is partly due to poor knowledge on population dynamics from hatching and until the shrimp are caught in the fishery at the age of three or four years. Since 1995, juvenile shrimp have been caught by a net attached to the underbelly of the survey trawl in the annual cruise in the Barents Sea. The abundance of settled shrimp larvae varies in time and space. The recruitment to the fishery has been quite stable with the exception of the 1996 year class that was observed as 1+ but has not been registered since. We study the annual settlement and survivor of juveniles until recruiting to the fishery. The spatial and temporal distribution as well as density of the four youngest year classes is studied in relation to temperature, depth, shrimp stock abundance and presence of predating cod in the Barents Sea.

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THEME SESSION

on

Sustainable Aquaculture Development (O)

ICES CM 2000/O:01

Waste production in salmon farming

I.M Davies

The production of dissolved nutrients and particulate organic waste by fish farming, in particular salmon farming, has long been seen as a significant environmental constraint on the development of the industry. The discharge of nutrients to the surrounding sea water my increase the potential for enhanced algal production, and the release and settlement onto the seabed of particulate waste can lead to organic enrichment of the sediment and changes in the character of the benthic fauna. Regulatory structures applying to the industry often take account of waste discharges in determining the appropriate levels of production at individual sites or in particular bodies of water. In order to fully inform these decisions, it is necessary have up-to-date estimates of the likely production of waste from the cultivation units. The environmental significance of the waste released is to some degree dependent on the seasonal pattern of nutrient release and of nutrient availability in the water column. Changes in feed formulation, husbandry practices and feed conversion efficiency in recent years have greatly altered the rate of waste production. This paper presents modelled estimates of waste production from typical modern salmon farms in Scotland. The estimates are resolved by month through the complete marine phase of the growing cycle. The influence of likely future changes in stocking strategies and feed utilisation on waste production is discussed.

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ICES CM 2000/O:02

Release of reared turbot in Belgian coastal waters as a tool for stock enhancement

D. Delbare and R. De Clerck

The main objective of this project was to investigate the potential of stock enhancement of turbot within a national context. Therefore 3000 juveniles were cultured until they reached a size which was supposed to be suitable for adaptation to the conditions in the wild. After conditioning to natural prey organisms (shrimp and gobies), approximately 1900 juveniles were tagged with a Petersen disk and released in June 1998 in a closed area near the Belgian coast. After one and half year the total capture rate exceeded 15%. During this period specific biological aspects related to migration, survival, and growth were evaluated by means of captured turbot. Spatial distribution showed that most individuals remained in Belgian coastal waters until October of the year of release. During winter, the turbot migrated to deeper waters (Central North Sea). In spring, the migration pattern showed a return to more coastal waters (The Netherlands, France, Belgium, and the United Kingdom). In addition, data from stomach analysis and growth showed that the released turbot adapted very well to the natural conditions, with a similar growth and feeding pattern as the wild population. This experiment demonstrates clearly the potential of restocking as regards turbot.

Keywords: restocking, tagging, turbot.

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ICES CM 2000/O:03

Geographic information systems (GIS) are tools for better integrated coastal zone planning and management (ICZP/M)

I. Døskeland

The most powerful characteristic of GIS is their unique ability to combine several types of data from different sectors, based on geographic location as the common parameter. One example is the identification of potential areas for the expansion of salmon farming on the basis of physical and social or demographic criteria. Such analyses need to include e.g. distances from sewage outlets, recreational areas, other fish farms, public transport networks and nature conservation areas, in addition to depths, currents and recipient status.

In order to make GIS a reliable decision support tool (both for political and scientific decision-making), the user must bear in mind the following considerations:

- Some relevant themes may be impossible to map (e.g. the value of a wilderness landscape or the value of a species). To what extent does available information fit the questions asked?
- We have no consistent standard for the registration, quality and exchange of information.

- Poor-quality data, arbitrary combinations of topics in analyses, and misleading use of symbols for map presentations, may give less reliable results.

The EU Interreg IIC project "Seagis" is attempting to solve some of these issues on the basis of exchanges of best practice among regions around the North Sea (lead partner Hordaland County Council, http://www.hordaland-f.kommune.no/seagis/default.htm).

One deliverable of the project is a method for visualising the individual steps in an analysis by means of flowcharts. This concept will improve the description of input data, clarify the criteria for combining them and provide transparent documentation of results.

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ICES CM 2000/O:04

Monitoring programmes - a vital part of mariculture regulation

A. Ervik

Establishing new mariculture activities is difficult in many industrialised countries. There are several reasons for this, though lack of understanding of the actual environmental impact and of a consensus regarding what is a tolerable impact, together with the need for reliable methods of assessing and monitoring it, are amongst the most important. This in turn impairs the inclusion of mariculture in ICZM, which is a prerequisite for expansion in the ICES countries.

In order to overcome these obstacles, it is essential to develop adequate regulatory frameworks that include well-defined environmental quality objectives (EQO) for the industry, as well as control mechanisms to ensure that these objectives are fulfilled. Furthermore, both environmental impact assessments and efficient monitoring programmes with associated environmental quality standards (EQS) must be employed, together with feedback mechanisms that will trigger adequate action if the EQOs are breached. In order to make the industry trustworthy, it is important that the regulatory framework should be transparent and open to inspection.

Monitoring programmes are vital components of such regulatory frameworks, and can only be used in this context. A monitoring programme on its own is thus of little value. The regulatory system for the Norwegian mariculture industry is discussed as an example of integrated monitoring.

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ICES CM 2000/O:05

Prospects for selective breeding for stress tolerance in aquacultured fish

Sv.-E. Fevolden

Given what is known about the adverse effects of stress, an enhanced tolerance of stressful procedures has been thought to improve e.g. food conversion and growth, and reduce the incidence of diseases under aquaculture conditions. Better tolerance of stress may also lead to improved fecundity, egg quality, post-spawning survival, and flesh quality.

The goal of breeding for a low stress-responsive strain of fish, therefore, embraces several traits identified by the aquaculture industry as key candidates for improvement.

Cortisol is highly acknowledged as a stress indicator of fish. Lysozyme has also been shown to alter blood concentrations of fish following stressful stimuli. Results from a closing EU-project "Selective breeding for stress tolerance in aquacultured fish" in which both cortisol and lysozyme were used as selection criteria, will be presented. The study has been aimed at i) comparing heritabilities of cortisol and lysozyme and estimate phenotypic and genetic correlations between them; ii) producing selection lines based on high or low responsiveness for cortisol and lysozyme; iii) assessing the consistency of altered stress response in the progeny; and iv) testing progeny groups for various performance traits.

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ICES CM 2000/O:06

Changes of digestive enzymes during growth of cultured juvenile cuttlefish *Sepia officinalis* L. (Mollusca Cephalopoda). Effect of enriched diet and ration

N. Koueta, A. Le Calvé, B. Noël, and E. Boucaud-Camou

The culture of cephalopods is becoming an interesting area due to their fast growth and their scientific importance, and to their commercial value. Juvenile as well as mature cuttlefish are characterised by a predatory diet, but only subadults and adults can be

reared on artificial diet. Actually, relatively grown up animals (up to 15 days old) can be successfully reared on artificial diet, but it is not the case for early juvenile and this is the main constraint for the development of profitable cephalopod aquaculture. In order to formulate an artificial diet well accepted by juveniles, their digestive capability was studied. Biochemical estimation of temporal development of digestive enzymes in juvenile cuttlefish *Sepia officinalis* shows a correlation between growth and proteolytic activities from hatching to 30 days old. However, trypsin activity increases during the first 15 days then greatly decreases, while chymotrypsin activity increases constantly along the first month of the post-larval life.

From hatching, the group of juvenile cuttlefish fed on natural live prey shows a higher level of trypsin activity than the group fed on enriched PUFA (polyunsaturated fatty acids) live prey, but the level of chymotrypsin activity does not depend on food quality. Digestive enzymes were recorded at different levels depending on the rations used.

Keywords: diet, digestive, enzymes, growth, juvenile cuttlefish, rearing.

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ICES CM 2000/O:07 (Poster)

Satellite observations and forecasting can mitigate effects of toxic algae blooms

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Concern for harmful algae blooms (HABs) has grown with increased awareness of the impact of HABs on the aquaculture industry and tourism. After the severe HABs off southern Norway in 1988, a monitoring program was established to provide information on HABs. Today the program includes an in situ observation network and weekly bulletin at a public IMR website - ALGEINFO.

In the European Space Agency project - "DeciDe for near real-time use of ocean colour data in management of toxic algae blooms"- headed by NERSC with partners at IMR and PML, satellite observations of ocean colour and 3D numerical modelling complement the algae monitoring service. Together, the information from these projects permits the synergetic use of in situ, satellite and modelling data for better prediction of bloom development and transport.

The rapidity of information dissemination is vital, since early warning of HAB conditions can allow fish farmers to take actions to mitigate harmful effects. A summary of information adapted for the public is made available as quickly as possible via ALGEINFO and the "DeciDe" website. In addition, fisheries authorities responsible for organising the operational response to HABs are notified immediately of potentially harmful situations.

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ICES CM 2000/O:08 (Poster)

Some growth data of cold shock triploids in turbot (*Scophthalmus maximus*)

E. Vázquez, C. Fernández-Pato, C. Martínez-Tapia, G. Blanco, and J.A. Sanchez

Turbot (*Scophthalmus maximus*) appears to be an important commercial fish species. Over the last two decades great improvements have been achieved in aspects such as monitoring, feeding, and illness control that have lead to improve the conditions for turbot aquaculture. Nevertheless, some genetic methodology application such as chromosome manipulation to obtain triploids can also provide efficacious tools to get over some disadvantages related to maturity and reproduction. The triploid individual are steriles, and sterility in commercial fish stocks has the potential to increase production yields since metabolic energy would be used for somatic growth instead of gonadal development. Moreover, restocking natural waters with triploid fish would prevent the disruption of genetic adaptations of indigenous gene pools of local populations. Finally, triploids are useful to avoid natural reproduction as in the case of GMOs. Results of an experiment drawn to get turbot triploids applying cold shocks are presented. Triploid growth data obtained during a period of two years are compared to diploid that belong to the same cohort as triploids.

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THEME SESSION

on

Efficiency, Selectivity, and Impacts of Passive Fishing Gears (P)

ICES CM 2000/P:01

Fish meal/fish oil replacement in practical diets for European sea bass *Dicentrarchus labrax* and gilthead seabream *Sparus aurata*

P. Coutteau, S. Ceulemans, R. Robles, A. Oliva-Teles, S. Chatzifotis, A. Van Halteren, and P. Verstraete

The substitution of fishmeal and fish oil as the major protein and fat source in aquafeeds remains an important issue due to the unpredictable and limited supply of these raw materials. The potential of alternate protein sources originating from gluten, soybean, and terrestrial animal by-products has been well demonstrated for various fish species in laboratory studies. Nevertheless, formulators of practical feeds for marine fish often lack critical information. The partial replacement of fishmeal and fish oil was evaluated in practical feeds for the two dominant aquaculture species of marine fish in Europe, i.e. European seabass *Dicentrarchus labrax* and gilthead seabream, *Sparus aurata*. The proportion of fish meal protein in nutritionally balanced feeds could be reduced from 66% (of total dietary protein) to 25% by the use of either pure vegetal protein sources (soybean, corn) or a mixture of vegetal (soybean, wheat) and animal meals (poultry meal, haemoglobin). The proportion of fish oil/meal fat could be reduced from 81% (of total dietary fat) to 33% by the use of a mixture of predominantly vegetal (soybean) and animal fat (poultry meal). This replacement did not affect growth performance, food conversion and total carcass proximate analysis in laboratory trials. The cost-efficiency of fish meal/oil replacement in practical diets as a function of fish meal/oil price will be illustrated in a simulation using least-cost formulation.

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ICES CM 2000/P:02

'By-catch and offal' feed from the herring industry - performance of Atlantic salmon as concerns growth, feed utilisation and fillét quality

G.-I. Hemre and K. Sandnes

Aiming to increase utilisation of raw material from the herring industry, fish-feed made directly from the by-products gained after filleting, was made by means of microwave coagulation. The herring by-products excerted 100% of the protein and lipid in the diets. Several feeding experiments have been conducted to optimise feed quality, fish growth and protein retention. As control commercial fish-meal based diets have been used. Main conclusions are that the offal can be stabilised to obtain high protein and lipid quality (without rancidity) and that the feed fulfils the salmon's requirement for high growth and feed utilisation. When using special designed vitamin and mineral mixtures high fillet quality is found. The concept is concluded to be environmental "healthy" both because of increased utilisation of by-catch / by-products, and because of high digestibility coefficients obtained and thereby low environmental impact when using this feed.

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ICES CM 2000/P:03

Documenting seafood safety: contaminant concentrations in Norwegian fish feeds and mariculture products.

A.-K. Lundebye, B. Bøe, and K. Julshamn

The dioxin scandal in Belgium in 1999 heightened public concern regarding food safety. In order to protect consumer safety, surveillance programmes on fish feed and seafood exist in Norway. In order to protect fish- and human health, and to minimise the environmental impact of fish farming, regulations exist for the maximum level of contaminants that may be present in fish feed. Fish feed manufacturers are responsible for ensuring that their products comply with these regulations, in addition the Directorate of Fisheries randomly takes 1000 fish feed samples annually which are analysed for various contaminants to ensure that concentrations are below the maximum permitted limits. Data will be presented on the levels of organic and inorganic compounds present in Norwegian fish feed. A range of potential contaminants in Norwegian fish and shellfish of commercial importance, are currently monitored by the Directorate of Fisheries' environmental programme "Miljødatabasen". The aim of the programme is to: Provide data on marine resources living in unpolluted waters, meet the demand, from distributors and consumers, for information

concerning levels of potential contaminants in seafood, and to provide historical data and monitor contaminant levels in fish and shellfish. Results from this programme will be given. In addition to the above mentioned surveillance programmes, the Directorate of Fisheries' Institute of Nutrition conducts research on health and safety aspects of seafood, relevant results will also be presented.

Keywords: fish, metals, organic compounds, seafood safety.

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ICES CM 2000/P:04

The role of technology transfer in the development of new fish species for aquaculture

C. Talbot and A. García-Gómez

Aquaculture has a long history however, the intensive, market-driven production of fish, exemplified by the salmon farming industry, is relatively recent. On a global basis, the vast majority of fish farming uses extensive or semi-intensive production methods and, compared to salmonids, relatively little is known about the biology, husbandry methods, and nutritional requirements of these fish species. Lack of species-specific knowledge related to farming is one factor which limits the development of aquaculture. However, many of the principles of production optimisation and the development of feeds which applies for the well studied species are applicable also to the less well studied species. There is a large farmed production of *Seriola* species *(S. quinqueradiata* and *S. dumerili*) in Asia, and *Seriola dumerili* cultivation is also proposed for the Mediterranean. This industry predominantly uses moist feeds made from raw fish and generally, there is little focus on technologies and techniques, principally related to health and feeding management, which enable the fish to be grown with maximum efficiency. The salmonids are exclusively grown using dry feeds, employing relatively sophisticated technologies and production methods, and with considerably higher efficiency of production. This paper will draw upon developments in nutrition and farming methods in salmonids, and in the two *Seriola spp* to examine some key issues related to improving the efficiency of production in aquaculture.

Keywords: feed management, nutrition, salmonids, technology, transfer, yellowtails.

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ICES CM 2000/P:05 (Poster)

Screening of immunostimulants for the gilthead seabream *Sparus aurata*

L. Tort, J. Rotllant, S. Ceulemans, and P. Coutteau

The increasing production rates of gilthead seabream (*Sparus aurata*) in the Mediterranean area and the occurrence of a pathological syndrome (the winter syndrome) related to immunosuppression make this species a suitable model for testing the action of immunostimulants delivered in the diet. The action of two immunostimulant premixes, based either on purified glucans (PG, commercial source) or on modified yeast (MY, INVE *Aquastim*) were evaluated in a standard commercial feed for sea bream with a negative control without immunostimulants. The respective activities were compared in a laboratory simulated winter-temperature ramp including an acclimation period at 18°C (4 weeks), decrease to 11°C in one week, maintenance for 2 weeks at 11°C and recovery to 18°C in one week. The results clearly show that non-specific immune indicators (phagocytic index, complement and lysozyme activity) were enhanced after the acclimation period in the MY group and less (increased lysozyme activity) in the PG group. After the decrease, the levels of these indicators are similar for both MY and PG, but after maintenance at 11°C all three indicators showed better performance in the MY than the PG group. After temperature recovery (18°C) levels are similar for complement and lysozyme and better in the phagocytic index for MY. These results show that immunostimulants improve immunocompetence of seabream fed standard commercial diets and may help in the resistance of seabream to low temperature-induced alterations.

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THEME SESSION

on

Trophic Dynamics of Top Predators: Foraging Strategies and Requirements, and Consumption Models (Q)

ICES CM 2000/Q:01

Harbour seal *Phoca vitulina* habitat use and interaction with fisheries as explored by a combined GIS and population energetic model

A. Bjørge, T. Bekkby, V. Bakkestuen and E. Framstad

A 1600 square kilometre coastal archipelago in Norway (62N, 6E) housing a population of harbour seals was modelled using a Geographic Information System (GIS). Proportions of different habitat types available to harbour seals for haul-out and foraging were estimated. The movements and foraging activities of harbour seals were monitored with VHF radio telemetry and two automated, directional radio receiving stations. Data on harbour seal habitat use were analysed using a fixed kernel home range distribution in ArcView. A population energetic model based on activity; body size and composition simulated the harbour seal energy requirement from mid June to mid August. The diet of seals in the area was established from otoliths in faecal samples collected at haul-out sites. Activity patterns and animal locations of radio-tagged seals were used to combine the GIS and energetic models. The combined model revealed preference for two habitat types for foraging. Two prey species associated to these habitats contributed most to the energy consumption of the seal population. The most important habitat was 100–200 m deep basins with soft substrate where the main food species was Norway pout *Trisopterus esmarkii*. The other preferred foraging habitat was tidal currents and eddies created at shallow rocks cowered by kelp, *Laminaria hyperborea*, where young saithe *Pollachius virens* was the main food. The distribution of fishing operations (bottom set nets, trawls and kelp harvesting) was modelled in ArcView. The co-occurrence of fishing operations and seals were analysed, and the predation on commercial fish species at the fishing grounds was estimated.

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ICES CM 2000/Q:02

Feeding and food consumption by the Barents Sea predatory fishes in the 1980–90s

A.V. Dolgov

Data from the Russian-Norwegian database were used to study food composition of the most numerous Barents Sea fishes (cod, haddock, Greenland halibut, long rough dab, spiny and other skates, saithe) in the 1980–90s. Length composition of commercial prey species and changes in predator diet depending on their length are analysed. Possible values of total food consumption by these species are estimated and the impact of these predators on the stock status of commercial species is described. Biomass of food consumed by fish is compared to that consumed by other high-order predators (sea mammals and birds).

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ICES CM 2000/Q:03

Impacts of fisheries on seabird community stability

R.W. Furness

Fisheries can change the structure of seabird communities. Fisheries may decrease numbers of some seabird species by reducing abundance of small prey-fish. They may increase numbers of others, by increasing prey-fish abundance through depletion of predatory fish stocks, or by provision of offal and discards. Fisheries can also change or trigger interactions between seabird species. Many impacts of fisheries on seabirds are difficult to measure against a background of many varied environmental and human influences. Some impacts of fisheries are clearly evident. A few may have drastic effects on seabird community stability. I focus on examples of this last group. Long-line by-catch of albatrosses and petrels may soon lead to species extinctions if current trends are allowed to persist. Set-net by-catch has caused major reductions in certain seabird populations. Depletion of stocks of small lipid-rich fish can reduce food supply, and hence numbers, of seabirds, as documented in Peru, Norwegian Sea, and Barents Sea. Less widely appreciated is the influence of discards and offal discharged at sea. With dramatic increases in numbers of large, aggressive, scavenging seabirds, desirable changes in fisheries management to conserve stocks or reduce discarding can trigger diet-switching so that scavenging seabirds turn to killing smaller seabirds, with drastic consequences for community structure. Management of fisheries to reduce impacts on the wider environment needs to take this into account. The longer

scavenging seabird populations are encouraged to increase as a result of discard provision, the more severe the impact on other seabirds is likely to be.

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ICES CM 2000/Q:04

Foraging strategies of seabirds: the Northern Gannet (*Sula bassana*) as a model

S. Garthe and W.A. Montevecchi

Seabirds are important consumers of fish throughout the world's oceans. We have selected the largest seabird of the North Atlantic, the Northern Gannet (*Sula bassana*), as a model species for studying their foraging strategies. Fieldwork was conducted in Shetland, U.K., and Newfoundland, eastern Canada. The use of different types of microelectronic devices attached to chick-rearing adult Gannets proved to be extremely promising for this study, allowing new parameters to be measured. These devices store e.g., data on flight direction, activity (swimming vs. flying), dive depth and duration, underwater movements, prey ingestion and water temperature.

Gannets feed predominantly on shoaling pelagic fish such as mackerel, herring, capelin and sandeels. This diet varies within and between seasons, strongly related to prey availability. Prey-capture techniques are flexible and obviously related to different prey fish. In some areas supporting large commercial fishing fleets, gannets are important consumers of discards. From dietary data, population estimates and literature on energy requirements, total food consumption of gannets is modelled. Furthermore, data logged by the microelectronic devices allow to calculate statistics on catch per unit effort and foraging efficiency, values which may be used successfully as indicators of the productivity of different hydrographic regions.

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ICES CM 2000/Q:05

A comparison of the Eastern and Western Bering Seas as seen through predation-based food web modelling

V. Lapko, K. Aydin, V. Radchenko, and P. Livingston

We present a comparison of two quantitative food web models of the Eastern and Western Bering Seas. Food webs were created from independent estimates of production, consumption, biomass and diet from each region for multiple predator and prey species. The results highlight the differences in the trophic structure of the two food webs from the top predators' point of view, and also provide substantial insights into the relative strengths of different methods for measuring predator-prey linkages. Furthermore, dynamic modelling and sensitivity experiments indicate differences in the potential for top-down and bottom-up control in the two ecosystems. In addition, the results indicate important links between the per-biomass rates of fish population growth (P/B) and the amount of variance found in the predator-prey linkages. Finally, we discuss the high sensitivity of the model to assumed rates of predation on juvenile life stages of fishes, an element of the models, which is difficult to measure in many marine ecosystems.

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ICES CM 2000/Q:07

Foraging behaviour of minke whales (*Balaenoptera acutorostrata*) in the southern Barents Sea

U. Lindstrøm, A. Harbitz, T. Haug, and T. Pedersen

Stomach content samples from 27 minke whales, caught during the Norwegian commercial whaling in the period May-June 1999, were collected in three sub areas in the southern Barents Sea. Simultaneously, a comprehensive resource survey was conducted in order to identify and estimate the abundance of potential prey items for the whales in the same sub-areas. The small-scale resource surveys revealed significant variations in absolute and relative prey abundance both between sub areas and, temporally, within sub areas.

This was, to some extent, also reflected in the whale diets, which was dominated by herring and capelin. The aim of this study is to use the obtained data on diet and prey abundance to assess quantitatively both the feeding strategy and prey selectivity of the minke whales in the area.

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ICES CM 2000/Q:08

Prey selectivity, capelin and inter-annual variation in the diets of common murre chicks in the Northwest Atlantic

W.A. Montevecchi and G.K. Davoren

Central Place Foraging Theory predicts that single-prey-loading parents should be highly selective in the prey that they capture for delivery to offspring. Common murres breeding on Funk Island, the largest colony in the Northwest Atlantic, are extremely consistent in the prey that they feed to their chicks both within and between seasons. Throughout the1990s, chick diets were dominated by female capelin, primarily gravid females that have higher energy densities than males or spent and immature female capelin. At the same colony, multi-prey loading Northern Gannets foraging in similar areas takes much higher proportions of male capelin. Gannets do not dive as deeply as murres, suggesting that murres have access to male capelin but select gravid female capelin for chicks. However, female capelin also exhibits slower burst speeds and is hence easier to capture than male capelin. Underwater video shows that when foraging murres encounter large inshore schools of capelin, predation success is virtually ensured and that the birds spend considerable time swimming near the school before capturing (or selecting?) a fish. Inter-annual variation in capelin length, mass and condition (mass/length) are related to 1) changing oceanographic conditions, 2) the abundances, spawning dates and spatial and temporal distributions of capelin, and to 3) similar independent measures of spawning capelin collected during beach surveys and commercial harvests. We assess whether seabird harvests of capelin reflect changes in the abundance, behaviour and distribution of capelin in the 1990s and, thus, whether seabird diets can be used as reliable indicators of changes in local fish stocks. Finally, the trophic implications of sex- (female) and condition- (gravid) biased predation by Common murres, the dominant seabird consumer of capelin in the Northwest Atlantic, are considered.

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ICES CM 2000/Q:09

Behavioural switching in North Sea cod: implications for foraging strategy?

D. Righton, K. Turner, and J.D. Metcalfe

Data Storage Tags (DSTs) which record depth, temperature and light were used to monitor vertical movements and horizontal migrations of adult cod in the North Sea. Fifty-eight cod were tagged off Lowestoft in late March 1999; twenty-two of which were returned by March 2000 after up to 225 days at liberty. Four behavioural phases were discernible from the combined results. Cod were most active as they moved north during April and May, remaining in mid-water and making only brief excursions to the seabed. During June and July, activity fell, and cod spent most of their time on the seabed, exhibiting little vertical movement. During August and September, cod typically left the seabed at nightfall and returned to it before dawn. Throughout October, activity increased as vertical movement patterns returned to those previously exhibited in April. The results suggest that cod may enter into a rest period following their post-spawning migration from the southern North Sea, and increase their activity before their pre-spawning migration. Although we did not measure feeding directly, the lack of activity during summer months indicates that feeding may have taken place only rarely. Such behavioural switching may have implications for fisheries models that assume constancy in feeding behaviour.

Keywords: activity, Data Storage Tags, migration, vertical movement,

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ICES CM 2000/Q:10

Variation in environmental conditions, feeding and growth of cod in the Eastern Baltic

D. Uzars, T. Baranova, and E. Yula

During the three previous decades (1960–1990) there has been a major change in biomass of cod and their prey organisms fishes and invertebrate. During the years of different environment the changes in food composition, feeding intensity and growth of cod was observed. Variation in growth of the eastern Baltic cod is related to the cod stock size and food availability. The influence of cod abundance and environment factors, including temperature and feeding conditions on the interannual variation in length and weight at age of cod is discussed.

Keywords: Baltic Sea, biomass, cod, diet, observed weight at age, temperature.

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ICES CM 2000/Q:11

Hake food consumption in the southern Bay of Biscay estimated from a gastric evacuation model

F. Velasco and I. Olaso

Hake, *Merluccius merluccius (L. 1758)* food consumption per quarter and age class is estimated using the results of the analysis of 11 504 hake stomach contents. Samples were collected and analysed on board in two quarterly samplings carried out in the Cantabrian Sea and off Galician north coast during 1994 and 1997. Food consumption is estimated through a general gastric evacuation model for gadoids including as variables: water temperature, predator size, stomach content weight and prey energy density. According to our results, hake quarterly food consumption varies from 29 g for an age 0 class hake to 1513 g for an age 6+ class hake. Compared with the other quarters, consumption in quarter 2 is lower for hake of age classes 1 and 2, and generally higher for older hake. Quarterly rations are allocated into the main commercial species and other prey groups using hake diet composition in volume by age class and quarter. Results show blue whiting is the most important prey for hake and makes up more than half of the consumption from age class 2–3 upwards. In its lifetime from age class 0 to class 5 one hake consumes 11.6 kg, and almost 8 kg of them are of blue whiting. Crustaceans are only important for younger hakes but are almost negligible from age class 2 up. The importance of the rest of the fish species varies between ages and quarters. Using blue whiting, horse mackerel and hake length distributions in stomachs, the number of blue whiting, horse mackerel and hake of each length range consumed per quarter by one hake of each age class and quarter is estimated.

Key words: Ration estimate; gastric evacuation: consumption rates; *Merluccius merluccius*

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ICES CM 2000/Q:12

Food consumption of European hake (*Merluccius merluccius*) estimated by application of a bioenergetics model: Is the growth of hake underestimated?

J. Riis-Vestergaard, F. Velasco, L. Hill, and I. Olaso

The food consumption rate of European hake was estimated by a bioenergetics model and compared to hake consumption rates from the literature, estimated by the gastric evacuation method. The bioenergetics model needs field data on the predator's growth rate, temperature regime, and gonadal production and uses laboratory based submodels on the predator's net food conversion efficiency, standard metabolism, and activity metabolism, all of which were derived from results for other gadoids. Rations estimated by the bioenergetics model were substantially lower than those from the gastric evacuation method for the same subset of data were. Possible reasons for the lower consumption estimated by bioenergetics were evaluated by varying the growth rate and parameters of the submodels. Underestimation of the growth rate appeared to be the more likely explanation.

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ICES CM 2000/Q:13 (Poster)

A comparison of the seasonal abundance of hake (*Merluccius merluccius*) and its main prey species off the Portuguese coast

L. Hill and M.F. Borges

Hake is an important predator in the Atlantic off the Portuguese coast. Its diet has been studied between 1997 and 1999 and the main fish species it preys on have been identified. This poster compares the seasonal abundance of hake and its main prey species in three physically distinct regions of the continental Portuguese shelf and slope using commercial landings (for all gears except the purse seine, which targets sardine only). The main prey species, which vary in order of importance according to season, are blue whiting (*Micromesistius poutassou*), mackerel (*Scomber scombrus*) and chub mackerel (*Scomber japonicus*), anchovy (*Engraulis encrasicholus*) and sardine (*Sardina pilchardus*). It is shown that the seasonal and spatial variation in abundance of preys in the ecosystem corresponds to the proportions of prey in the diet, which confirms that hake is an opportunistic feeder. Hake and these species are all commercially important, so these interactions are important for an ecosystem approach to their management.

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ICES CM 2000/Q:14 (Poster)

Geographical and seasonal changes of prey species and prey consumption in the western North Pacific minke whales

T. Tamura and Y. Fujise

The forestomach contents of 498 minke whales *Balaenoptera acutorostrata* sampled in the western North Pacific from May to September during 1994 - 1999 JARPN (the Japanese Whale Research Program under Special Permit in the Western North Pacific) surveys, were analysed. Sixteen prey species consisting of 1 copepod, 4 euphausiids, 1 squid and 10 fishes, were identified. Minke whales in this region pursue single prey species aggregations. Results showed geographical and seasonal changes of prey species. In the western North Pacific, Japanese anchovy was the most important prey species in May and June, while Pacific saury was the most important one in July and August. Pacific saury and krill were the important prey species in September. In the southern Okhotsk Sea, krill was the most important prey species in July and August. Estimates of the daily prey consumption rate were 1.8 - 5.7% of body weight by two methods. The total prey consumption by minke whales in the western North Pacific in August was estimated at 36 - 60 thousand tons, including 30 - 42 thousand tons of Pacific saury (70 - 83% of total). Total consumption of krill by minke whales in southern Okhotsk Sea in August was 7 - 11 thousand tons.

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ICES CM 2000 /Q:15 (Poster)

Diet composition, feeding rhythms and daily rations of the Baltic herring in the Gdansk Basin

V.N. Feldman, F.A. Patokina, and N.A. Kalinina

Diet composition, diurnal feeding rhythms and individual daily food intake of the Baltic herring in the Gdansk Basin are studied on the basis of 4 daily (28-h fishing) stations conducted in July-August 1998 and May 1999. A diet composition analysis of herring stomachs revealed a substantial share of 1-group sprat of high abundant 1997 year class in the diet of larger herring. Occasionally clupoid larvae and 0-group sprat of very poor 1998 year class was observed in herring diet. The significance of high magnitude of herring predation on sprat described before (Patokina, Feldman, 1998) is confirmed. It is argued in favour of consideration of herring predation on juvenile sprat as of medium importance.

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ICES CM 2000/Q:16 (Poster)

Geographical distribution versus feeding habits of large-eye Dentex *(Dentex macrophathalmus)* off Namibia and Angola

K. Kilongo

The distribution area of large-eye Dentex (*Dentex macrophathaimus*) in its main extension off Angola and Namibia was surveyed and 613 stomachs sampled from the South of Congo River (7°08'S) to the north of Namibia (20°33'S). The highest catch. per unit of effort was observed between 14° and 17°S, with a peak between 15° and 160° S. An inverse correlation between the area of highest abundance and the size *of D. macrophathalmus* indicates the highest concentration of small fish in the area. The analysis of the stomach contents showed that large-eye Dentex feeds on fish, shrimp, euphausiidae, polychaels, and cephalopods in order of importance. Fish and shrimp occurred in all the extension of the area, while Euphausjidae and polychaets between 13° and 20°S, mainly in the stomachs of small fish. The catch per unit of effort of shrimp and fish of less than l0 g was higher between 7° and 14°S. and decreased southward, while of fish with the weight equal or more than 400 g had an opposite trend. This may suggest the high consumption of small fish by big fish in the area of highest concentration of *D. macrophathalmus.*

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THEME SESSION

on

The Application of Experimental Laboratory Studies to Fisheries Science (R)

ICES CM 2000/R:01

Estimating natural mortality of wild cod from controlled feeding and starvation experiments conducted in the laboratory

J.-D. Dutil, Y. Lambert, and D. Chabot

The contribution of individual factors to the rate of natural mortality is usually unknown because it can hardly be measured in the wild, particularly in large ecosystems. Atlantic cod experienced a decline of their nutritional condition in the early 1990s in the Gulf of St. Lawrence. Whether natural mortality increased, as a result of that decline was determined from controlled experiments conducted in the laboratory. The maximum range of several variables reflecting the nutritional condition of fed- and un-fed cod > 30 cm was determined. By comparing values observed in the wild and in the laboratory, we concluded that wild cod might die of inanition during the spring period. The decline in the nutritional condition of wild cod from January to April was slower than observed in food deprived cod in laboratory experiments. This indicates that cod feed but do not meet their energy requirements in winter prior to spawning. In contrast, the decline in condition from April to May matched the rate observed in the laboratory experiments. Survival probability should be assessed in May during the spawning period and is unlikely to be overestimated as the rate of energy mobilisation observed in the laboratory never exceeded the rate observed in the field.

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ICES CM 2000/R:02

Experiments and models as reciprocal tools to understand environmental links in recruitment dynamics

Ø. Fiksen, E. Otterlei, and A. Folkvord

Recently a number of rearing experiments has established firm relations for the maximum average growth rates of cod and herring larvae at several temperatures. Larval fish in their natural habitat may reach these growth rates if food and other environmental factors are optimal. However, the realised feeding- and growth rates under food limiting conditions are more difficult to measure experimentally. Food limited ingestion rates may be modelled using empirically derived parameters for processes such as prey detection distance, turbulence-mediated encounter rates, and attack- and capture success. These processes change as the larva grow and develop, and should be formulated as functions of the relative size between the prey and larvae. From the predicted ingestion rate, the realised growth rate can be calculated by use of standard bioenergetic models. Here, we summarise some of our experiences on developing a mixture of theoretically and experimentally based models and demonstrate the ability of such models to assess how environmental factors such as prey availability, predation risk, temperature, turbulence, turbidity (e.g. primary production) affect larval growth and survival.

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ICES CM 2000/R:04

A multivariate analysis of condition of herring larvae from different environmental regimes

H. Høie, A. Folkvord, and A. Johannessen

Herring larvae were reared in laboratory at different temperatures (6 and 10°C) and different feeding levels from hatching and until eight weeks after hatching. Each larva was measured for developmental stage, standard length (SL), dry weight, RNA, DNA and protein content. High survival, up to 92% after eight weeks, was obtained. Larvae given high feeding levels (1200 prey per l) had exponential growth of dry weight, DNA and protein throughout the experiment. Almost no growth was observed in larvae given low feeding levels (40 prey per l) in the first half of the experiment, while an increase in the second half was seen. The RNA content of larvae given high feeding levels was not different at the two temperatures in spite of differences in somatic growth rates, which indicates lower RNA activity at lower temperatures. We found higher DNA concentrations in larvae reared at higher temperatures, which probably reflects temperature induces differences in growth through hyperplasia and hypertrophy. The measured variables of the larvae were used as input variables in a stepwise discriminate function analysis. The resulting classification functions were used to characterise the larvae from the different feeding regimes. The possibility of using differences in larval nucleic acid contents as a tool for discrimination of larval condition and regional origin is discussed.

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ICES CM 2000/R:05

Spawning success in relation to salinity of three flatfish species, dab (*Pleuronectes limanda*), plaice (*Pleuronectes platessa*) and flounder (*Pleuronectes flesus*), in the brackish water Baltic Sea; implications for distribution of spawning areas and stock discrimination

A. Nissling and L. Westin

The spawning success and thus abundance and distribution of dab, plaice and flounder in the Baltic Sea, a large brackish water area, is restricted by salinity. By assessment of spermatozoa mobility and fertilisation at different salinities and determination of salinity of neutral egg buoyancy (egg specific gravity) from stripped fishes, salinity requirements for egg development was evaluated. The results were used for evaluation of potential spawning areas and further for stock discrimination by analyses of differences in salinity requirements for fish from different areas (SD 23-28). The results suggest that two stocks of dab exist and that successful spawning may occur in the Sound (SD 23), the Arkona basin (SD 24) and rarely in the Bornholm basin (SD 25). Opportunities for successful spawning of plaice exist regularly in the Arkona- and the Bornholm basin and occasionally in the Gdansk- and Gotland basin (SD 26 and 28). No differences in salinity requirements for fish from SD 24-28 suggest one stock in the Baltic proper. Two different types of Flounder occur, demersal and pelagic spawning. The former, constituting of one distinct stock, may spawn successfully as far north as in the Åland Sea and the Gulf of Finland (SD 29 and 32) with the 5.5-6 isohaline as lower limit. For pelagic spawning flounder, salinity of neutral egg buoyancy suggests that successful spawning may occur regularly in the Sound, the Arkona- and Bornholm basin as well as in the eastern deep areas, the Gdansk- and Gotland basin, and that three stocks exist.

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ICES CM 2000/R:07

The implementation of laboratory studies to shrimp recruitment modelling - a brief review of experimental procedures

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Shrimp has pelagic larvae and the time and location of larval settling are critical components for a successful recruitment to the population. Shrimp larvae occur in the surface layers after hatching and are then found in deeper waters until they finally settle. It is, therefore, essential for recruitment modelling to include robust data concerning the duration of the pelagic stages and the environmental factors that govern the vertical distribution of larvae. Laboratory experiments have given complementary in-sights to the growth performance and duration of the various pelagic stages of shrimp larvae. Furthermore, preferences of specific larval stages to given temperatures, salinities and light regimes have been successfully studied in addition to feeding behaviour and responses to predators. Here we present some designs and techniques that have been employed for the study of shrimp larvae in the laboratory.

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ICES CM 2000/R:08

Demonstration of maternal effects of Atlantic cod: Combining the use of unique mesocosm and novel molecular techniques - A new EU-project

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One of the effects of fishing is a reduction in average age and size in exploited fish stocks, leading to an increasing proportion of recruit spawners in the stock. Current management practice assumes equal viability of offspring from first time spawners and from repeats spawners, despite the fact that that first time spawners often produce smaller eggs than older spawners do. The aim of this EU-project is to follow offspring from families of first time spawning and older cod, reared under identical and semi-natural conditions in marine enclosures (mesocosms). The parental origin of the larvae is identified using microsatellite DNA methodology. The advantage of this approach, compared to traditional laboratory rearing, is that

rearing conditions are close to natural conditions, and all larvae are reared in the same environment. This eliminates the tank-to-tank variability often observed in traditional rearing experiments. The fish are reared from hatching, through the larval and juvenile stages, until sexual maturity. Growth rates, survival and nutritional condition will be measured using methods such as RNA/DNA ratio and otolith micro increment analysis. The results will be related to parental origin and quality measures of the eggs. It is intended to incorporate the results into management models for improvement of fishery management strategies. In this paper we will focus on a description of the project.

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ICES CM 2000/R:09

The application of tank experiments to the study of reproductive potential in teleosts using *Gadus morhua* as a test model

P.R. Witthames, T.E. Andersen, and O.S. Kjesbu

Age-based population assessments (VPA) have often failed to show a clear relationship between spawning stock biomass and either recruitment or biomass estimated from annual egg production. Recent work has shown that the inclusion of reproductive potential (a measurement of both the quality and quantity of eggs produced in relation to female size and age) helps to explain some of the variation in the stock and recruitment curve. Tank experiments will make it possible to develop tools to measure reproductive potential either directly from fecundity or indirectly from maternal reserves. This paper describes such experiments involving first year maturing cod (*Gadus morhua)*, in which egg production has been studied in relation to maternal reserves. Ovary biopsy samples were taken from the start until the end of spawning when the fish were killed in order to study the persistence of post-ovulatory and atretic follicles (the latter are oocytes that are resorbed during the vitellogenic phase) using histological methods. These results were examined to suggest ways to improve the detection of post spawning females, (which is essential when making field assessments of maturity). Using this data it was also possible to quantify atresia in relation to the egg production cycle.

Keywords: cod, fecundity, reproductive potential, tank experiments.

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ICES CM 2000/R:10 (Poster)

The use of known ageing techniques to enhance growth bands on the second dorsal spine of the gulper shark (*Centrophorus granulosus* Schneider, 1801) and the Portuguese dogfish (*Centroscymnus coelolepis* Bocage and Capello, 1864)

A. Moreira, P.B. Machado, and I. Figueiredo

Deep-water sharks comprehend an important fraction of the black scabbard fish fishery located in the village of Sesimbra at the Southwest of Portugal's mainland. However, little is known about is biological aspects, namely age and growth. The present work shows the preliminary results obtained by the assaying of documented ageing techniques to the second dorsal spine of two deep-water squaloid sharks commonly caught along the Portuguese continental slope, gulper shark (*Centrophorus granulosus*) and Portuguese dogfish (*Centroscymnus coelolepis*). The application of a decalcification and staining technique proved useful for enhancing growth bands on dorsal spines. The use of these structures in future ageing studies is emphasised.

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ICES CM 2000/R:11 (Poster)

Maternal effects on egg size and egg buoyancy of Baltic cod, *Gadus morhua*- implications for stock structure effects on recruitment

L. Vallin and A. Nissling

Successful spawning of cod in the Baltic Sea is restricted to the deep basins; the Bornholm basin, the Gdansk Deep and the Gotland basin, at salinities varying between 11-20 psu. Due to oxygen-depletion

commonly prevailing in these areas, neutral egg buoyancy above oxygen-critical levels is of substantial importance for egg survival. Measurements of egg size and egg specific gravity revealed a significant relationship between egg size and salinity of neutral egg buoyancy. Large females were found to produce larger more buoyant eggs, implying egg development at more favourable oxygen conditions. The significance of egg production by old females for recruitment of cod in the Baltic Sea was tested for two different periods displaying different hydrographic conditions, 1967–1980 and 1981–1994, respectively. The number of recruited cod (age 2) was positively related to the fraction of eggs produced by old females (5 years). Accordingly, stock age structure should be considered in stock-recruitment relationships and in the management of the Baltic cod stock.

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ICES CM 2000/R:12

Modeling the population dynamics of cod along the Norwegian Skagerrak coast: what we need to understand better before we have a reliable population model

N.Chr. Stenseth, J. Gjøsæter, K. Lekve, and A. Frigessi

Cod population along the Norwegian Skagerrak Coast have been model using different modelling approaches. Currently the fjord is used as the population unit. In this paper we describe and discuss a model based on Bayesian statistical inference. Data are available on the 0-group and the 1-group but not on the mature stock. Through an age-structured model, we aim through the model to predict the population size of the mature stock. The basic model will be summarised.

On the basis of the obtained modelling results, we will in this paper discuss where we need to focus our future research in order to obtain better parameter estimates as well as better assessments of the mature stock. This will include:

- A better understanding of the various components of the biological population (e.g., between the 0- and 1-groups).
- A better assessment of the age of maturation is needed as well as a better understanding of the relation between age/size of fish and quality of spawning products.
- We would also need a better understanding of the effect on the vital rates of the population of the production of plankton and the timing of reproduction of plankton relative to hatching of the larvae (with such knowledge, much of the stochasticity in larval survival would probably be removed, and the accuracy of our models would increase).
- A better understanding of the sampling process and how that links to the true population is also needed; indeed, sensitivities to parameters in the current sampling model is extensive.

The paper will be concluded by an overall discussion of approaches to modelling marine fish populations and how experimental data might help us develop better models.

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THEME SESSION

on

Temporal and Spatial Trends in the Distribution of Contaminants and their Biological Effects in the ICES Area (S)

ICES CM 2000/S:01

Temporal trends in malformations of pelagic fish embryos from the southern North Sea in relation to anthropogenic xenobiotics

V. Dethlefsen and H. v. Westernhagen

We present a method of biological effects monitoring in the marine environment to detect changes in ecosystem health. The method uses the prevalence of malformations in pelagic fish embryos as indicator, and is based on a proven relationship between developmental defects in embryos and tissue contaminant levels of parent fish. Any significant increase of embryo abnormalities indicates the existence of an impact on the system. This impact may be caused by natural factors, but also by anthropogenic xenobiotics. A time series from 1984 until 2000 is available for the southern North Sea. The history of malformation prevalence in the area after the year 1990 mirrored the decline in major pollutants which is consistent with the development of sediment and river input data as well as contamination levels in the target species, i.e. dab *Limanda limanda*. With the described method we were able to identify an otherwise unnoticed pollution event in winter 1995/1996 in the southern North Sea. Most recent data from spring 2000 indicate a stabilisation of malformation rates at a rather low (2%) level, which is considered the natural background.

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ICES CM 2000/S:02

Contemporary patterns and historical rates of increase of mercury contamination in different marine food chains

S. Fleming, R.W. Furness, and I.M. Davies

We present measured trends in mercury contamination over the past 100 years in epipelagic, mesopelagic and deep-sea marine food webs, showing 3-10 fold increases in mercury concentrations. The most rapid increases, and highest contemporary levels, occur in mesopelagic food chains in southern ICES areas. Congruent patterns are evident in fish and in seabirds, but the latter permit ready analysis of long term trends because of the availability of museum study-skin collections. Laboratory and field studies fully validate the use of seabird feathers as a reliable monitor of mercury contamination in their food. Although local mercury contamination 'hot-spots' can be identified within the North Sea, most of the North Sea food chains can be considered 'mercury-depleted' relative to those in North Atlantic environments. This pattern supports the view that point source and riverborne mercury is of minor importance relative to inputs from atmospheric deposition. The latter suggests that jet stream transport of mercury pollution from North America is the primary cause of mercury contamination in European waters. Methylation of inorganic mercury deposited from the atmosphere is thought to occur especially in low oxygen environments such as the deep sea. This is important because fish and seabirds assimilate a very high proportion of ingested organic mercury but only a small fraction of ingested inorganic mercury. High accumulation of mercury in mesopelagic and deep sea fish and in predators on mesopelagic animals suggests that methylation is a key process determining mercury accumulation in marine animals. We will discuss the importance of vertical migrations of marine animals as a factor influencing mercury contamination in different marine fish stocks and environments, and consider the toxicological implications of the measured levels and trends.

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ICES CM 2000/S:03

Is there a relationship between accumulated contaminants and biomarker responses in Atlantic cod, *Gadus morhua*?

K. Hylland, B. Bjerkeng, and N. Green

There are basically two general mechanisms by which organisms are affected by most contaminants: either more or less directly, an acute effect, or following long-term (chronic) exposure. Acute effects are generally quantified using standardised tests with selected test-organisms, but there exist no widely accepted methods

to quantify chronic effects. For one, such effects are envisaged as being most relevant to long-lived, metabolically active organisms, thereby excluding most of the favourite acute-test organisms. In addition, the exposure periods generally need to be prohibitively long. Chronic effects may be caused both by accumulation of damage or as accumulation of contaminants up to and above some threshold of damage.

The objective of the present study was to investigate relationships between tissue contaminants and some measures of the well-being of Atlantic cod collected at both contaminated and clean sites along the Norwegian coast. The datasets used were part of the Norwegian JAMP and consisted of data on 450 individual cod from 6 sites and 3 years (1997–1999).

A relationship was observed between tissue levels of contaminants and some biochemical or physiological responses in cod. Some responses were in accordance with expectations, such as ALA-D inhibition in fish with high metal (Pb) levels in tissues. Other responses, e.g. metallothionein in liver, had a weak and opposite relationship to the expected (increase at high metal levels). Although the sites provided a reasonable range of exposures from near pristine to moderately contaminated, station-effects were obvious for some responses. In conclusion, accumulated contaminants did affect putative health effects in Atlantic cod, although more information is needed on other parameters that may also be station-specific and could affect responses.

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ICES CM 2000/S:04

Strategies to investigate links between community response and individual response to environmental contaminants

K. Hylland

Environmental contaminants have had and still have serious impacts in marine ecosystems. There has been an increasing demand for methods to detect and quantify effects. There has been three main approaches: (i) the detection of effects on communities and/or populations, (ii) the quantification of effects on laboratory-held species (bioassays) and (iii) a diagnosis of changes in cellular, physiological or morphological status of an organism (biomarkers). The latter type of methods have come into increasing use over the past two decades and appear to carry the potential for a more focused effect-based and contaminant-specific monitoring in the future. The objective of this paper is to present current status and to indicate what may be needed to link biomarker responses in organisms to changes in populations or communities.

No method is perfect. It is rarely possible to link community level effects to contaminant inputs, bioassays are generally not very sensitive and biomarker responses may be linked to contaminant inputs, but are poor predictors of ecological effects. There are at least two approaches to improve on current strategies: one is to use knowledge of community structure to identify possibly sensitive species for subsequent biomarker analyses. A second approach is to combine a suite of selected chemical, biochemical and physiological responses to obtain a satisfactory estimate for the health of a target organism. Such an estimate may then be used to model risks to the relevant population (and community). The former strategy could be implemented using available techniques, but there may be a lack of sufficient basic knowledge to implement the second strategy.

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ICES CM 2000/S:05

Biological effects of contaminants in pelagic marine ecosystems - a practical workshop

K. Hylland

There is a lack of agreed methods to assess the impact of contaminants in pelagic ecosystems. Earlier workshops arranged under the auspices of ICES and IOC have successfully stimulated research into the use of biological effect methods to monitor contaminant impacts in benthic ecosystems. Many of the techniques developed have now been incorporated in national and international monitoring programmes. Since benthos constitutes only a part of the marine ecosystem potentially exposed to contaminants, however, there has been increasing interest throughout the past years to commence co-ordinated studies on effects in organisms representing pelagic ecosystems as a basis for future monitoring programmes.

The objective of the workshop is to bring together scientists involved in relevant work in a practical workshop in order to assess the ability of selected methods to detect biological effects of contaminants in pelagic ecosystems under uniform and standardised conditions. The methods will be assessed for their applicability in future monitoring programmes.

During February–September 2001, research vessels from England, Germany, Norway and Scotland will collect water samples and selected pelagic organisms at seven sampling stations in three areas of the North Sea. Samples will be obtained on a contaminant gradient in the German Bight (at three stations of the 1991 IOC/ICES

Bremerhaven Workshop on Biological Effects of Contaminants) and at three stations in the vicinity of an

oil field in the central/northern North Sea plus a reference area. In addition, cages with fish and mussels will be positioned in each of the three areas for 4ÿweeks. Facilities will be made available following some of the cruises to perform exposure and challenge studies under controlled conditions at shore laboratories.

The entire programme for the workshop will be presented including the selection of biological effect methods and the range of chemical analyses that will be performed.

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ICES CM 2000/S:06

EROD and ChE measurements in flounder (*Platichthys flesus*) as monitoring tools in English estuaries

M.F. Kirby, M.R. Hurst, C.A. Kelly, S.J. Kirby, P. Neall, T.A. Tylor, S. Morris, and P. Matthiessen

Recent studies have made it clear that fish populations in UK estuaries are being exposed to an extensive mixture of contaminants at the sub-lethal level. Amongst the tools used by CEFAS to investigate the extent of these effects are a range of enzyme biomarkers. This paper outlines measurements of ethoxyresorufin O-deethylase (EROD) activity, a marker of induction of the mixed function oxygenase (MFO) detoxication system, and cholinesterase (ChE) inhibition, a marker of neurotoxicity, in tissues of the flounder (*Platichthys flesus*) from a number of key estuaries.

Hepatic EROD activities were found to be significantly ($p<0.05$) induced at 8 out of 15 sites whilst muscle ChE activities were significantly ($p<0.05$) lower in fish from 12 of 15 sites when compared to specimens from a reference site. Specimens from industrialised estuaries such as the Mersey, Tyne and Tees routinely showing the greatest effects in both assays.

It is clear that flounder populations in certain English estuaries are experiencing sub-lethal effects, probably as a result of exposure to a number of contaminant classes. Potential consequences of these and other, non-contaminant, influences are also discussed. Chemical analytical data are presented that provides partial evidence that polycyclic aromatic hydrocarbons (PAH)/ poly chlorinated biphenyls (PCB) and organophosphate/ carbamate pesticides are contributors to the observed EROD and ChE effects respectively.

Keywords: biomarker, cholinesterase, EROD, estuary, flounder (*Platichthys flesus*), pollution monitoring.

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ICES CM 2000/S:07

QPID: an innovative instrument for identification and verification of environmental toxicity

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In an ongoing research effort concerning the actual harmful effects of "unknown" compounds in the marine and estuarine environment, RIKZ is involved in the development and validation of an instrument for integrated biological and chemical assessment of ecological risks of sediment, water and biota samples. The instrument consists of three building blocks: in vivo bioassays, in vitro screenings assays and a TIE (Toxicity Identification and Evaluation) tool. The in vitro screening assays concern either broad spectrum or so called "toxic mechanism based" assays. Examples are Microtox (broad-spectrum toxicity), Mutatox (genotoxicity) and for instance ER-CALUX (estrogenic toxicity). These assays have in common that they require the use of organic solvent extracts. Research activities involve the analytical, chemical and ecological validation of the assays; the achievement of controlled chemical exposure, and standardisation and protocolisation. The TIE tool under development constitutes of a package of fractionation techniques combined with a Quality Peak Identification and Database system (QPID). QPID aims at the identification of organic compound(s) responsible for effects in screening assays and features a database that integrates GC-MS fragmentation characteristics with physico-chemical and toxicological data for an extended range of environmental chemicals. The performance of the integrated biological and chemical system is currently evaluated in a case study on Dutch harbour sediment toxicity. Results of this study will be presented, with emphasis on both laboratory methods and database development.

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ICES CM 2000/S:08

Studies of endocrine disruption in marine fish - progress with the EDMAR programme

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Earlier work at CEFAS and elsewhere has established that several UK estuaries contain male flounder *Platichthys flesus* experiencing vitellogenesis and intersex, indicating that these water bodies are heavily contaminated with oestrogenic substances. The UK EDMAR programme has confirmed that these effects are still occurring, and has been investigating whether other fish populations are affected. The work has followed up the observations in flounder by exposing them in cages in contaminated industrial estuaries. This failed to demonstrate vitellogenin (VTG) induction, leading to the hypothesis that the majority of exposure may be from sediment via the food. This has led on to experiments in which flounder have been fed with invertebrates from the Tees estuary. Another part of the field programme has focused on the sand gobies *Pomatoschistus minutus* and *P. lozanoi* and the viviparous blenny *Zoarces viviparus*. Studies of reproductive success, intersex and VTG induction have revealed sexual abnormalities in these species as well. Finally, CEFAS has developed an assay for androgen exposure in sticklebacks *Gasterosteus aculeatus*, based on induction of the glue protein spiggin in females. Initial results from a programme of caging are presented. Another paper in this session (Thomas *et al.*, CM 2000/S:11) will discuss some of the causes of these effects. The EDMAR programme has also looked at some invertebrates but these results are not reported here.

Keywords: endocrine disruption, estuarine fish, intersex, male vitellogenesis, spiggin induction.

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ICES CM 2000/S:09

Baltic cod reproductive impairment: ovarian organochlorine levels, hepatic EROD activity, developmental success of eggs and larvae, challenge tests

R. Schneider, D. Schiedek, and G.I. Petersen

During the past two decades, different types of reproductive disturbances, including inadequate ovary maturation, low fecundity and early life stage mortality, have been demonstrated for a number of fish species in the Baltic. Suggestions have been made that larval deformities and increased mortality in pelagic eggs of plaice, flounder, whiting, and demersal eggs of herring, are caused by chloroorganics like DDTs, PCBs, and other persistent bioaccumulative compounds. The present study aimed at assessing links between the viability of eggs and larvae from Baltic cod and the concentration of organochlorines analysed in the ovaries of the females. Eggs from 32 running ripe female cod from the Bornholm Basin were stripped, artificially inseminated and incubated in Baltic seawater. Hepatic enzymatic activity of EROD was used as a biomarker of a biochemical effect of contaminants apt to result in decreased viable hatching, larval survival and larval growth rates. If fish, or their eggs, are pre-exposed to toxicants, only a low extra dose is likely to induce a toxic effect. This approach, known as a "challenge test", was used as a tool for examining whether the individual fertilised cod larvae from the Bornholm Basin have different intrinsic sensitivities towards a single extra toxicant. A higher intrinsic sensitivity in the different larvae batches may be a result of the mother-to-egg transfer of toxicants causing elevated burdens of toxicants in the eggs and larvae.

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CM 2000/S:10

The use of sediment bioassays in monitoring and surveillance programs in the UK: A preliminary assessment

J.E. Thain, Y. Allen, S. Kirby, and J. Reed

Sediment bioassays are now recommended in the OSPAR Joint Assessment Monitoring Programme (JAMP) suite of techniques and have been incorporated into the UK National Marine Monitoring Programme. Results from field surveys in the UK are described and include whole sediment tests with *Arenicola marina* and *Corophium volutator*. In addition, these two bioassays have been used in a research programme for screening dredged material prior to disposal at sea. Forty-one dredged material samples were bioassayed. Sediment elutriate bioassays were carried out also on the same samples using the *Tisbe battagliai* bioassay. The results show that for the purposes of assessing the quality of sediment samples a battery of techniques should be used including the use of whole sediment bioassays and elutriate tests.

Keywords: *Arenicola marina, Corophium volutator*, dredge spoil, monitoring, sediment bioassay, *Tisbe battagliai.*

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ICES CM 2000/S:11

Characterising hazardous substances in the UK marine environment

K.V. Thomas, M.R. Hurst, J. Lavender, P. Matthiessen, J.E. Thain, and M.J. Waldock

In order to assess the risk posed by hazardous substances present in the marine environment, investigations are required to characterise the most toxicologically significant substances present. This task can represent finding the proverbial needle in a haystack, since, in many industrially impacted areas, estuarine sediments and surface waters contain a complex mixture of natural and synthetic substances. To help the process, toxicity identification evaluation (TIE) procedures have been developed to isolate and characterise the biologically active compounds present. The TIE procedures have been combined with an acute bioassay using a marine copepod (*Tisbe battagliai*), mutagenic assay (Mutatox™) and an *in vitro* yeast-based screen for oestrogenic activity. A wide range of compounds, including pesticides, surfactant metabolites, natural steroids and industrial chemicals, have been identified and used to inform monitoring programmes and risk assessments.

Keywords: estuaries, toxicant characterisation, toxicity identification evaluation (TIE), sediments, surface waters, UK.

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ICES CM 2000/S:12

Analysis of ICES long-term data on diseases of North Sea dab (*Limanda limanda*) in relation to contaminants and other environmental factors

W. Wosniok, T. Lang, V. Dethlefsen, S.W. Feist, A.H. McVicar, S. Mellergaard, and A.D. Vethaak

ICES data on the prevalence of grossly visible diseases (lymphocystis, epidermal hyperplasia/papilloma, acute/healing skin ulcerations) of dab (*Limanda limanda*) submitted by Member Countries were statistically analysed with respect to potential relations with contaminants in water, sediments and biota as well as nutrients, water temperature, salinity, oxygen content and catch per unit effort (CPUE). Data were extracted from the ICES Environmental Data Centre, ICES Oceanography Data Centre and the ICES Fishery Databanks. The analysis was carried out for three regions located in the south-eastern, central and north-western North Sea which were selected on the basis of the availability of disease data. The time span considered partly covered almost two decades.

Non-parametric interpolation techniques were used to obtain the necessary uniform time pattern for all time series. To account for the use of interpolated values, parameter estimates and significances within a logistic model for the disease prevalences were calculated by means of a bootstrap procedure. A variety of factors, including contaminants, were identified as being significantly related to the disease prevalence. However, depending on the area and time range, different sets of factors were identified. This reflects the multifactorial aetiology of the diseases covered, but can also be attributed to some high correlations among the explaining quantities.

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ICES CM 2000/S:13 (Poster)

Temporal trend observations in fish and sediments in the Clyde estuary

A.D. McIntosh, L. Webster, and D. Richardson

The Clyde estuary receives a wide range of chemical inputs. Some of these, including polycyclic aromatic hydrocarbons and chlorinated bi-phenols, have been

monitored in sediments and fish species. More recently this programme has been extended to include biological effects indicators including P4501A mixed function oxidase by ethoxyresorufin O-deethylase (EROD) estimation and bile metabolite measurements. The scope of work has also been extended to include investigations into the presence of oestrogen mimicking chemicals.

A summary of the work carried out to date is presented.

Keywords: bile metabolites, fish, PAH, P4501A.

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ICES CM 2000/S:14 (Poster)

Biomarkers and PAH concentrations of the common mussel, *Mytilus edulis*, in an industrially polluted sea loch.

A.D. McIntosh, L. Webster, and B. Gowland

Loch Leven is a sea loch situated on the West Coast of Scotland. The loch contains an aluminium smelting works that discharges polycyclic aromatic hydrocarbons (PAHs) into the loch. Data is presented here on a range of biological effects measurements along with tissue PAH concentrations of common mussels (farmed and wild) found in Loch Leven.

This site is compared to a non-industrial waste receiving sea loch, Loch Etive, where mussels have been transplanted between the two lochs to look at uptake and depuration of PAHs. Comparisons are drawn between the different biomarkers used and correlations made to the PAH concentrations in the tissues.

Keywords: biomarkers, mussels, PAH.

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ICES CM 2000/S:15 (Poster)

PAH concentrations and bile metabolite measurements in plaice and flounder from the Firth of Forth

A.D. McIntosh, L. Webster, and D. Richardson

The river Forth receives a wide range of chemical inputs from shipping and onshore industrial activities. Some of these, including polycyclic aromatic hydrocarbons and chlorinated bi-phenols, have been monitored in sediments and fish species. Biological effects measurements including P4501A mixed function oxidase, by ethoxyresorufin O-deethylase (EROD) estimation and bile metabolites are presented. A summary of the work carried out to date is presented.

Keywords: fish, PAH, biomarkers

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THEME SESSION

on

Classification and Mapping of Marine Habitats (T)

ICES CM 2000/T:01

A proposed ecosystem and habitat classification system for United States marine and estuarine waters

R.J. Allee

The Ecological Society of America and the United States National Oceanic and Atmospheric Administration's Offices of Habitat Conservation and Protected Resources sponsored a workshop to develop a national marine and estuarine ecosystem classification system. Among the participants were scientists who had developed various regional classification systems and federal managers who might ultimately use this system for conservation and management. The objectives were to: 1) review existing global and regional systems; 2) develop the framework of a national classification system; and 3) propose a plan to expand the framework into a comprehensive classification system. A consensus developed during the workshop that a classification system would provide a useful common language for description of habitat and a framework for interpretation of ecological function. However, all agreed that a system currently did not exist that was both broad enough in scope and fine enough in detail to be useful at the national level. Participants developed a classification framework that blended global scale systems with regional systems to provide a prototype classification system. The prototype system provides a descriptive approach, using a combination of physical and biological information, to classify "ecological units" that ultimately represent the biological community or assemblage within a given habitat.

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ICES CM 2000/T:02

An assessment of two acoustic survey techniques as a means of mapping seabed assemblages in the Eastern English Channel

C.J. Brown, K.M. Cooper, W.J. Meadows, D.S. Limpenny, and H.L. Rees

A survey was carried out in the Eastern English Channel to investigate the use of acoustic survey techniques, used in conjunction with traditional biological sampling methods, to map the variety and distribution of benthic habitats and their associated biological assemblages. Two acoustic techniques, digital sidescan sonar and an acoustic ground discrimination system, were used to classify and map the distribution of acoustically different substrata within the survey area. Benthic communities and sediment types within each of these regions were sampled using grab and underwater video/photographic techniques. Substrates within each acoustic region were generally homogeneous in distribution, and sediment types ranged across the survey area from cobbles and coarse gravel through to muddy sands. Analysis of the faunal data revealed the presence of statistically distinct biological assemblages within most of the acoustic regions, although species similarity between samples collected from within each acoustic area was often low. The application of acoustic techniques, used in conjunction with biological sampling techniques, to map the distribution of seabed habitats and associated benthic communities is discussed.

Keywords: benthic community, biotope, habitat, mapping, sidescan sonar.

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ICES CM 2000/T:03

The BioMar marine habitat classification - its application in mapping, sensitivity and management

D.W. Connor

A marine habitat classification has been developed for intertidal and nearshore subtidal waters of Britain and Ireland as part of the EC Life-funded BioMar project (1992–97). The classification system was developed to aid the management and conservation of marine habitats, and is now well established as a management tool in UK nature conservation, particularly in the implementation of the EC Habitats Directive.

The BioMar classification has been applied, through a national mapping system, to habitat mapping at broad and fine levels of detail. It is being used to systematically assess seabed sensitivity to a wide range of human activities. Through consistent characterisation of seabed communities, it facilitates monitoring of both spatial and temporal trends in communities as well as inter-site evaluation of aspects of biodiversity and rarity.

This paper will examine a variety of practical applications of the classification, thereby illustrating the potential benefits of broader classifications, such as the European EUNIS classification and that being developed for the OSPAR/ICES areas.

Keywords: conservation, habitat classification, management, mapping, sensitivity.

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ICES CM 2000/T:04

The EUNIS habitat classification

C.E. Davies and D. Moss

The EUNIS habitat classification has been developed on behalf of the European Environment Agency to facilitate description of marine and terrestrial European habitats through the use of criteria for habitat identification. It is a broadly based hierarchical classification, which provides an easily understood common language for habitats. It builds on earlier initiatives (CORINE and Palaearctic habitat classifications) and incorporates existing classifications used by European marine Conventions and the EU-funded BioMar project with cross-references to these and other systems. It is recognised that detailed biotopes from some marine regions are poorly represented and that EUNIS will need to be expanded to cover this wider geographic area. Most of the additions will probably be made at hierarchical level 5 (where the distinct BioMar and Mediterranean units are now held). Changes and additions to the classification will only be made following detailed consultation with experts. A key to the habitat units at each of the first three levels is incorporated and the classification is linked to a parameter-based database to describe specific habitats. The present draft of the EUNIS habitat classification was completed in November 1999 and is expected to remain stable for a time to allow validation and testing through field trials and descriptive parameters to be compiled.

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ICES CM 2000/T:05

Ecotopes in the Dutch marine tidal waters

D.J. de Jong

In order to predict the effects of intended steps and measures on aquatic ecosystems, the use of ecotope maps and habitat maps has increased in the past decade. Recently, in the Netherlands, a GIS-method has been developed for the marine tidal waters to define the ecotopes and habitats that occur there and to depict them in maps. This method, HABIMAP, uses the relations between communities or species and their abiotic environment. These relations are determined and they are mapped, using an 'accumulation' of the various parameter maps leading to the eventual ecotope and habitat maps. Apart from the rendering of current ecotopes and habitats the HABIMAP-method makes it possible to test the effects on ecotopes and habitats (situation, extent) of measures taken by man and to work retrospectively as well. The HABIMAP-method, in fact, can be viewed as a spatial model, that can be a part of a larger Decision Support System, if desired.

In this lecture workable definitions are given for the ecotope and habitat concepts and the method used to create the maps in question is illustrated and discussed. Consequently a proposal is presented for an ecotope classification of the North Sea-Dutch Continental Shelf) and for the marine coastal tidal waters, respectively, illustrated by maps.

The relations with the ecotope classification made up within the frame work of the European Union (EUNIS) is discussed.

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ICES CM 2000/T:06

Intensive evaluation of the evolution of a protected benthic habitat: HABITAT

S. Degraer, V. Van Lancker, G. Moerkerke, M. Vincx, P. Jacobs, and J.P. Henriet

The western Belgian Coastal Banks is an area of internationally ecological importance. Because of its diversity and the presence of several shallow sites (up to 0-m MLLWS), the area has been proposed as a special area within the EC-Habitat Directive and 3400 ha is proposed as the first Belgian marine protected area. To develop a management plan, based on scientific data, a standardized biological-geological research strategy was set up. The macrobenthos was selected as key component, because of its important place in the ecosystem and its clear relation with the physico-chemical environment. In order to describe the T0-situation of the benthic habitat, the research involves a detailed mapping of the biological and physical environment (macrobenthos, bathymetry, sedimentology, geomorphology and hydrodynamics)

based on newly gathered and existing data. Moreover, very-high resolution digital side-scan sonar imagery is used to unravel the relationship between the acoustical characteristics and the sedimentology, geomorphology and eventually the macrobenthos. In this perspective, a standardised macrobenthos side-scan sonar interpretation is aimed at.

Together with a predictive model based on the specific habitat preferences of the different macrobenthic communities, this methodology forms part of quick and low-cost evaluation tools for the follow-up of the evolution of the area.

Keywords: Belgian continental shelf, coastal ecosystem, habitat, macrobenthos, marine nature reserve, monitoring, scientific support plan, side-scan sonar.

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ICES CM 2000/T:07

Canadian imaging and sampling technology for studying marine benthic habitat and biological communities

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The systematic mapping of marine benthic habitat and biological communities requires specialized oceanographic instrumentation. During the past ten years, as part of research programs investigating the effects of mobile fishing gear and offshore hydrocarbon development, Canadian scientists and engineers have developed a suite of tools for imaging and sampling seabed habitats over different spatial scales.

Towcam is a towed vehicle which collects continuous but low-resolution video imagery of the seabed over a large area (i.e., 1–10 km transects).

Campod is an instrumented tripod equipped with a high-resolution video camera and a 35-mm camera with 250-frame capacity. It is deployed while the ship is on station, or slowly drifting, and collects high-resolution imagery from a small area. A hydraulically operated videograb, which uses the same conductor cable and winch as Campod, collects sediment and organisms from an area of 0.5 m2. Video cameras allow the operator to select the exact area of seabed to sample and to ensure that the grab closes properly. These three instruments will be described in detail and examples of their application on the continental shelf off eastern Canada provided. These and comparable tools used by other ICES countries when used in conjunction with acoustic survey tools (multibeam, seismic, sidescan, RoxAnn, Quester Tangent, etc.) make possible the classification and mapping of marine benthic habitat and biological communities over large areas.

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ICES CM 2000/T:08

Mapping and classification of deep seafloor habitats

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The absence of, and the need for, a standard universally accepted deep-water marine benthic habitats classification scheme resulted in our initiative to develop such a scheme. Using geophysical data collected with a variety of remote sensor systems and in situ biological and geological observations, we have constructed a geological/biological-based template to be used in standardizing habitat types in water depths greater than 30 m.

Our scheme has been applied to the characterization of groundfish habitats along the West Coast of the US with specific applications in central California and SW Alaska. We will present results of successful applications of this scheme in characterizing commercially important fisheries habitats and its usefulness in managing significant fisheries.

Illustrations of species specific preferences to distinct and identifiable geologic, morphological and associated biologic character will be presented. We will also show how suites of instruments such as side-scan sonar, multibeam bathymetric, high-resolution seismic reflection, and in situ observational data have been used to construct maps that characterize Mega-, Meso-, Macro- and Microhabitats. In addition, we will illustrate how this scheme can be used within the ICES regions.

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ICES CM 2000/T:09

Marine habitat classification and mapping within ICES: where to go from here?

E. Jagtman

Habitat classification systems and habitat maps integrate physical and biological data, resulting in ready-to-use information at the ecosystem level. This particular feature makes classification systems and habitat maps attractive for a variable group of end-users including scientists, managers and politicians. This paper will, at the end of the session, summarize a variety of initiatives in habitat classification and mapping. It will become clear that there is a fair amount of progress in this field, in particular on basis of technological developments. Though this is promising, a serious drawback of current classification systems and habitat maps is that they define standards for areas of only limited size, or for specific climate zones or biogeographic regions. An important characteristic of the ICES area is that it covers a range of climates and biogeographic units. This means that in order to make applications beneficial to the needs of ICES further developments are needed.

This paper will address technology issues, developments in classification or habitat mapping and will discuss how these issues are interrelated. In addition, subjects like validation of habitat classification, ground truthing of samples and interpolation of data will be briefly touched upon. These considerations will help to get a clear view of the work that needs to be done in future years. Finally, it is discussed how the ICES network of scientists can be involved in the interesting journey that lies ahead.

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ICES CM 2000/T:10

An overview of seabed mapping technologies in the context marine habitat classification

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A 'brain-storming' sub-group of the ICES 'Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem' (WGEXT), was convened in 1999 and 2000 to review a wide-range of seabed mapping technologies for their effectiveness in discriminating benthic habitats (seabed attributes) at different spatial scales. Of the seabed attributes considered important in regulating the biology of marine sands and gravels, sediment grain size, porosity or shear strength, and sediment dynamics were highlighted as the most important. Whilst no one mapping system can quantify all these attributes at the same time, they can often be estimated by skilful interpretation of the remotely sensed data. For example, seabed processes such as bedform migration, scour, slope failure and gas venting are readily detectable by many of the mapping systems and these processes (or features) in turn can be used to assist a habitat classification of the seabed. This paper tabulates the relationship between 'rapid' continental shelf sedimentological processes; the seabed attributes, which tend to give rise to each of these processes, and the most suitable mapping system to employ for their detection at different spatial scales.

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ICES CM 2000/T:11

The mapping of benthic biocenoses in the coastal zone of Latvia

A. Korolev and M. Fetter

The macro benthic communities of blue mussel (*Mytilus edulis)* and marine red algae *(Furcellaria lumbricalis)* are the most frequent biocenoses in the coastal zone of the Eastern Baltic. Blue mussel is a filter feeder, so these biocenoses exhibit high biofiltration and biosedimentation ability and thereby co-operate in the water selfpurification process. The thalli of *Furcellaria* are used by the spawning herring for settling the eggs.

Furthermore, the algae are valuable raw material for agar-agar production. These two species are the species-indicators due to their ecological importance and biogeographic features in the Baltic coastal zone.

In the coastal zone of Latvia the investigations of distribution and abundance of *Furcellaria* were the main part of the benthic biocenoses monitoring which was carried out by the Latvian Fisheries Research Institute in 1980–1990 from Klaipeda to Ventspils. The monitoring was recommenced in1998 and 1999 after interruption in 1991–1997.

According to the previous assessment the total abundance of *Furcellaria* in the Klaipeda - Ventspils region decreased more than 2.5 times from 1980 to 1990 especially after two large oil accidents near the coast. The habitat of *Furcellaria* strongly diminished. The only relatively large stock of *Furcellaria* remains in the section between Pape and Liepaja where the four large herring spawning grounds are situated. This section is the most valuable as a protected marine area (it is included in the HELCOM list).

The results of surveys of 1998 and 1999 showed the restoration of *Furcellaria* stock. In the Pape-Ventspils region the biomass of *Furcellaria* was 3 times higher than it had been in 1990. In this area four large growths of algae were found with density of *Furcellaria* more then 1 kg/m^2.

Blue mussel biomass was also estimated for the Pape-Ventspils region. In comparison with the previous assessment (1982) blue mussel distribution and biomass changed inconsiderably in 1998–1999.

The results of surveys are presented as maps of distribution of *Furcellaria* and blue mussel along the Latvian coast for 1990, 1998 and 1999.

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ICES CM 2000/T:12

The potential of synthetic aperture sonar in seafloor imaging

R. McHugh

Side looking (sidescan) sonar is an established seafloor mapping technique. Recent improvements in sidescan systems include the use of increasingly higher carrier frequencies, wider acoustic bandwidths and even multiple beam forming. These improvements are all designed to enhance range and azimuth resolution. Fine resolution sidescan requires either high frequency operation or very long physical arrays (in terms of wavelength) in order to obtain narrow beamwidths. Physical constraints on practical antenna sizes and operational frequencies ultimately limit system resolution. One fundamental limitation for all sidescan sonar however is their inability to maintain fine along track resolution with increasing range.

In synthetic aperture sonar a small physical aperture is mounted on a platform or towfish. By moving the platform along a linear trajectory a very large synthetic aperture can be created. Moreover, through the processing of the backscattered signals from the created synthetic aperture, the azimuth resolution of such images is independent of range and independent of frequency. Synthetic aperture sonar systems are still under development, however it has been suggested that resolution capabilities will be orders of magnitude superior to any existing sidescan system.

In this paper the concepts that lie behind the fundamental resolutions for both sidescan and synthetic aperture techniques will be presented in a relatively user-friendly way.

The potential of synthetic aperture sonar, and in particular its future use in biotope mapping, will be discussed. Examples of both the latest sidescan and synthetic aperture sonar imagery will be presented.

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ICES CM 2000/T:13

Marine habitat mapping for the Norwegian Sea

T. Noji, T. Thorsnes and J.H. Fosså

An initiative is currently being taken by several Norwegian organisations to obtain funds to intensify ongoing investigations on marine sea floor mapping off Norway. Led by the Geological Survey of Norway and Institute of Marine Research, planning during the last two years has led to the inception of a large-scale mapping project entitled "MAREANO - Marine Areal Database for the Norwegian Sea". The investigation area covers 270 000 km^2 of the shelf and deep sea off western Norway. It is a commercially important region for fisheries and the petroleum industry and includes the world's largest system of cold-water coral reefs.

The aim of MAREANO is to collect new as well as historical data elucidating the physical, chemical and biological characteristics of the seabed along the mid-Norwegian shelf and parts of the deeper Norwegian Sea. The project shall produce maps and/or provide information on seabed bathymetry, marine habitats, biological diversity and resources, mineralogical resources and geological features as well as habitat

contamination. Stored in a GIS database, this information shall be available to environmental managers and interest groups as well as the fisheries, aquaculture and petroleum industries.

A description of the MAREANO project as well as some early results and their consequences for environmental management, e.g., establishing marine protected areas, shall be presented.

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ICES CM 2000/T:14

Mapping fisheries onto marine ecosystems: a proposal for a consensus approach for regional, oceanic and global integrations

D. Pauly, V. Christensen, R. Froese, A. Longhurst, T. Platt, S. Sathyendranath, K. Sherman and R. Watson

Research on ecosystem-based fisheries management, marine biodiversity conservation, and other fields requires appropriate maps of the major natural regions of the oceans, and their ecosystems. It is proposed here that a classification system proposed by T. Platt and S. Sathyendranath and implemented by A.R. Longhurst, defined largely by physical parameters, and which subdivides the oceans into four 'biomes' and 57 'biogeochemical provinces' (BGCPs), could be merged with the system of 50 Large Marine Ecosystems (LMEs) identified by K. Sherman and colleagues, which would represent subunits of the provinces. This arrangement enhances each of the systems, and renders them mutually compatible. For the LMEs, subprovinces are pragmatically defined to serve as a framework for the management of coastal fisheries, and other purposes, while the BGCPs have rigorous physical definitions, including borders defined by natural features.

Moreover, incorporating the 50 defined LMEs into the framework of BGCPs will allow straightforward scaling-up of LME-specific flow estimates (including fisheries catches) up to basin and ocean scales. The combined mapping will allow the computation of GIS-derived properties such as temperature, primary production, etc., and their analysis in relation to fishery catch data for any study area. A further useful aspect of the proposed scheme is that it will enable us to quantify the EEZ of various countries in term of the distribution of marine features (e.g., primary production, coral reef areas) so far not straightforwardly associated with different coastal states.

Applications to shelf, coral reef and oceanic fisheries, and to the mapping of marine biodiversity are briefly discussed.

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ICES CM 2000/T:15

Using autonomous underwater vehicles for seabed habitat mapping

M.J. Rendas, and J. Side

We present work in progress in the EU/IST project SUMARE on the use of autonomous sensors for seabed habitat mapping. Autonomous sensors offer new possibilities for observation of natural environments, due to their ability to react to terrain ground-truth on-line, adapting the survey conditions to the characteristics of the surveyed. Expected increased efficiency, simplicity of use and cost reduction offered by autonomous sensors may have a significant impact on the amount and quality of data that is collected. Our goal is to demonstrate this in two distinct applications: monitoring of sandbanks in the North Sea, and mapping of maerl habitats in Orkney, Scotland.

Here, we focus on the last problem. Field surveys will be conducted using an underwater vehicle equipped of a wide suite of sensors including a profiler sonar and a video camera, with the goal of producing a map of the distribution of areas of living, dead material and mixtures thereof. Existing knowledge about this habitat suggests a patchy spatial pattern, whose frequency of occurrence and characteristic size depends on the physical characteristics of the region. The project's approach is based on the interplay of four components: modelling, signal/image processing, control and statistical inference. Modelling will use the formalism of random closed sets, whose parameters will be tuned using existing a priori data. During the survey, the vehicle uses vision/sonar to incrementally adapt these a priori estimates. This requires the on-line discrimination of the classes of interest. Processed sensor data is used for adaptively guiding the platform, in two major ways. Firstly, it enables direct observation of important shape characteristics of the habitat (e.g., following boundaries of a class): data is directly used to generate the control signals applied to the motor thrusters. Moreover, it enables update of the parameters of the random closed set model which, together with statistical performance analysis methods, enables us to adapt the density of the survey to the actual spatial characteristics of the observed field, defining a trajectory that guarantees a target confidence on the acquired map.

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ICES CM 2000/T:16

New approaches to benthic habitat mapping integrating multibeam bathymetry and backscatter, surficial geology and seafloor photographs: a case study from the Scotian Shelf, Atlantic Canada

B.J. Todd, V.E. Kostylev, G.B.J. Fader, R.C. Courtney, and R.A. Pickrill

The Geological Survey of Canada has undertaken a new approach for sea floor habitat mapping based on an integrated analysis of multibeam bathymetric and backscatter data, associated geoscientific information, and benthos data from Browns Bank on the south-western Scotian Shelf, off the Canadian Atlantic coast. Based on sea floor sediment maps and statistical analysis of megabenthos determined from photographs, six habitats and corresponding associations of benthos were derived and mapped. The habitats are distinguished primarily on the basis of sediment type and thickness and water depth. Secondary controlling factors are sea floor geomorphology, habitat complexity, and relative current strength. A Browns Bank benthic habitat map was developed as a conceptual model summarizing the understanding of the bank ecology. This study highlights the utility of multibeam bathymetric sonar for interpretation of sea floor sediments and for extrapolating benthic habitat characteristics across large areas of sea floor. Based on this pilot project, a national mapping program proposal is being developed as a framework for future ocean management in Canada.

Keywords: backscatter, benthos, habitat mapping, multibeam, Scotian Shelf.

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THEME SESSION

on

Marine Biological Invasions: Retrospectives for the 20th Century—Prospectives for the 21st Century (U)

ICES CM 2000/U:01

Comparing the bioeffectiveness of ballast water treatments

A.A. Cangelosi and I.T. Knight

International guidelines and United States law direct ships to manage ballast water to reduce unintentional organism transfers, but the only method currently available to ships, open ocean ballast water exchange (BWE), has serious limitations. Environmentally sound treatment alternatives that are as or more effective than BWE have been proposed, but the lack of a standard measure of bioeffectiveness and environmental soundness impedes the research and development process. This paper characterises based on field tests the bioeffectiveness of a series of physical separation and biocidal ballast water treatments, and presents an approach to comparing bioeffectiveness of ballast water treatments, generally. Field tests took place on a barge platform at 1500 gpm using identical 175-gallon catchment tanks. Concentrations and viability of zooplankton, phytoplankton, bacteria and viruses with and without treatment at two turbidities and two time intervals were compared. Results are presented in terms of percent kill and/or removal across organisms and, in the case of plankton, taxonomic guilds. The comprehensive testing performed for these tests is appropriate for initial technology screenings, but not for operational assessments of individual installations. A similar standard approach is needed for assessing environmental soundness of proposed ballast water treatments.

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ICES CM 2000/U:03

The nature conservation implications of marine biological introductions

N.C. Eno and J.P. Hamer

The introduction of marine species can be particularly detrimental to nature conservation interests when an introduced species becomes invasive. There are various stages in the process: the introduction, establishment, spread and increasing dominance of the species within biological communities. The rate at which each of these stages occurs differs between species and may depend upon the size of the initial innoculum. The seriousness of the invasion will be site specific and also depend upon the fragility of the marine community affected. In all cases prevention is better than cure, however, this is not always practicable and an approach to minimise the threats on the basis of perceived risk is required. This paper examines the potential threats to marine biodiversity and to areas of marine conservation importance as posed by marine introductions. Reference is made to marine introductions and ballast water management practices in Great Britain as an example of the issues associated with an island within a regional context. The paper details measures which can be taken to minimise the threats, and charts progress to date.

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ICES CM 2000/U:04

Invasion ecology of *Marenzelleria cf. wireni* (Polychaeta; Spionidae) in the Dutch Wadden Sea

K. Essink and R. Dekker

The first record of *Marenzelleria cf. wireni* in estuaries and coastal waters of the European continent was in the Ems Estuary (Eastern Dutch Wadden Sea) in 1983. In the western part of the Dutch Wadden Sea the first specimens were found in 1989.

In the Dollard, a brackish embayment in the inner part of the Ems Estuary with extensive intertidal flats, a significant population developed within a few years time. In 1989–1995 population densities at sandy silt sediments amounted to 2– 3000 *M. cf. wireni*, with a biomass of 8–16 grams ash-free dry weight per m^2. Before the introduction of *M. cf. wireni*, polychaetes made up only 24% of the total biomass, bivalves being dominant with 64%. After the establishment, polychaetes took a 58% share, leaving the bivalves with only 25%. Moreover, the total macrobenthic biomass had increased considerably.

Muddy zones high in the intertidal zone act as a nursery area. Here, 130 000 juveniles were per m2 found. In other, generally more saline parts of the Dutch Wadden Sea, development of *M. cf. wireni* was less successful for many years. At the Balgzand intertidal flats in the

westernmost part of the Dutch Wadden Sea, *M. cf. wireni* was first recorded in 1989. In comparison with the Dollard area it took longer, viz. till 1997, before a population of over 2000-M. *cf. wireni* per m^2 had developed. Locally at Balgzand, the population density showed a sharp increase since then.

The Dollard population of *M. cf. wireni*, however, did strongly decrease after 1995. The remaining population is a few hundreds individuals, or c. 1.5 gram AFDW per m^2.

In this paper we will discuss the concept of an open niche being available for the invading species. There is no clear-cut case of competitive interaction between the newcomer and the autochthonous benthic community (e.g. *Nereis diversicolor*). Finally, the role of the newcomer in the estuarine food chain (juvenile flatfish, waders' birds) will be discussed.

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CM ICES 2000/U:05

Ecological impact of *Marenzelleria viridis* (Polychaeta, Spionidae) in the Vistula lagoon, Baltic Sea

E. Ezhova and L.V. Rudinskaya

North-American spionid worm *Marenzelleria viridis* had entirely established in the brackish Vistula lagoon during a decade after unintentional introduction. The influence of this alien species at the lagoon ecosystem is rather sufficient. Structure of benthic communities, benthos spatial distribution, ratio between main group of macrobenthos and food web was changed due to the invasion *of M. viridis*. Biomass of former dominant species *Chironomus gr.plumosus* was declining during Marenzelleria expansion.

One of the most important impacts of new species was increasing of degree of bottom sediment bioturbation. It is shown that the thickness of oxygenated sediment layer was significantly increased in scale of whole lagoon. It is supposed, consequences can be similar to eutrophication effect due to lagoon is extremely shallow.

Brackish water communities with *M. viridis* show it also, as a dominant species had positive correlation with salinity. Role of North Atlantic oscillation, local condition in the new habitat and set of eco-physiological adaptations for successful establishment of *M. viridis* are discussed.

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ICES CM 2000/U:06

Marine bioinvasions: quantifying the potential of a transfer vector by analysing its relationship with the donor region

O. Floerl and G.J. Inglis

Research on the spread of invasive marine organisms by hull fouling has neglected the potential for transfer of species by recreational boats. In this study, we examine relationships between the fouling assemblages of recreational boats and coastal boat marinas, which may act as potential sources of invasive organisms. Assemblages on vessels, pilings and floating jetties were surveyed in three marinas separated by 300–600 km of coastline in Queensland, Australia. Fouling assemblages varied widely among marinas. Vessels resident in each marina developed fouling assemblages that were characteristic of their homeport. Similarity between the vessel and marina fauna depended upon the age of the antifouling paint on the vessel's hull and how long the boat had been resident in the marina. Biota on the hulls of the vessels variously resembled assemblages on floating jetties or pilings, but the relative importance of each structure as a potential source of propagules varied from marina to marina. Our results show that recreational boat marinas may be an important source for the transfer and spread of hull-fouling organisms. The risk of species transfer depends, in part, on the vessels' antifouling history and on the amount of time they spend in home and destination ports.

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ICES CM 2000/U:08

Marine biological invasions in Australian coastal waters: Current status and future trends

C.L. Hewitt

Surveys for introduced species on a continental scale have been undertaken in International Shipping Ports from around Australia in both temperate and tropical

waters using a consistent methodology. Information from these surveys and from review of the literature and museum collections have identified over 200 introduced species and 100+ cryptogenic species found in all bioregions of Australia. The majority of these species appear to be historic invasions, residing in wholly invaded communities. Evaluation of the sampling efficiency within individual ports using species/area relationships indicate that at the level of the individual berth, three replicate samples does not appear to reach an asymptote indicating that the berth may be undersampled. In contrast at the level of the port, an asymptote is attained after 5 berths (moderate sized ports will have over 30 sampling sites). This indicates that no new species are being detected with additional sampling sites (berths) and the port is being adequately sampled. At the core of the National Port Survey is the use of a single, consistent suite of sampling methods, which allow comparisons between ports, and between berths. Revisitation of survey sites is in development however evaluation of a single large port system (Port Phillip Bay, Victoria) suggests that over the last 150 years invasions appear to be increasing, possibly due an increase in modern shipping traffic and an increase in aquaculture transfers. As expected, the majority of introductions are concentrated around the shipping ports of Geelong and Melbourne. This suggests that invasions will continue in most regions if the transport vectors remain unchecked.

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ICES CM 2000/U:10

Alien wars in the Black Sea

A.E. Kideys, Z. Romanova, G.A. Finenko, and L. Bat

The alien ctenophore, *Mnemiopsis leidyi*, which arrived in the 1980s had an unprecedented impact on the pelagic ecosystem of the Black Sea, when it peaked to enormously high biomass levels at the end of the 1980s and in early the 1990s causing a sharp decrease in this important fishery. Until 1998, in this predator-free environment, competition by planktivorous fishes for the limited food resources was the sole reason for sustaining the biomass of *Mnemiopsis* at moderate levels. However, the arrival of its predator, another ctenophore *Beroe ovata* in 1998 ceased the reign of the first invader in the Black Sea, causing the decrease of its biomass to very low levels. Preliminary experiments show the importance of *Beroe* in controlling the levels of *Mnemiopsis*. Monitoring biomass levels of these two species may give insights leading to the control of alien species in other marine ecosystems.

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ICES CM 2000/U:11

On optimum annual catch of snow crab *Chionoecetes opilio*

V.V. Krylov

To correctly estimate the optimum catch, the value of annual production of marketable specimens is required. Dimensional representation of production includes time. Here a problem, which has not been solved up to now, arises, as the age of the caught crab cannot be determined because of absence of recording structures. Fortunately, time recording takes place in the process of tagging.

Tagging was carried out in 1995 in the Okhotsk Sea. Mean time between tagging and capture (males above the legal size, till remained at the 2nd molt stage) was 26.0 days, so the mean time of crab's stay at the 2nd stage is equal to 26*3 = 78 days. In 1991–1998 the number of males at the 2nd molt stage was about 8% of the total number of males; subsequently, about 3 years pass between two sequential molts. By a molt the mass of a crab becomes about half as much again. This gives the approximate value of the P/B ratio (i.e. the optimum catch): the annual production of crabs of marketable size is equal to 1/10th of the biomass (stock).

The hypothesis that snow crabs at maturity (wide-handed) ends its growth has not an influence on the P/B ratio: increasing of mass by a molt (production) does not depend on future events (whether further molts will occur, or not).

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ICES CM 2000/U:12

Ballast water research in France: current status

D. Masson, O. Courtois, N. Masson, S. Guesdon, and G. Rocher

Due to important economic activities on the French coasts, the introduction of noxious organisms in the coastal waters, particularly by ship's ballasts can have dreadful consequences. After the first studies of the ship's movements in Charente Maritime, several ballast water and sediment sampling have been carried in five main French harbours along the Atlantic, Channel and

Mediterranean coasts. In this first assessment, the research of exotic and possibly noxious phytoplankton was the main task. Nonetheless, Clostridium and Vibrio germs were also searched. The results are presented and discussed, with a prospect on further work.

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ICES CM 2000/U:13

A conceptual approach for management of exotic species: modes of life, time-tunnels and exotic species cells

D. Minchin

Management of exotic species by targeting harmful forms alone will result in apparently benign species being overlooked. Many life forms also have the disadvantage of remaining undescribed and so can not be targeted. Management of most species may be possible by examining the different modes of life (life-history stages) exhibited during their lifetime that will be shared by benign, harmful and undescribed forms. Specific life modes may be shared by several taxa and so may have opportunities of being carried by the same vectors. However, the duration of a life mode may either increase or decrease opportunities for their carriage by a specific vector. Modes of life shared by different species may be targeted in such a way that treatment methodologies employed to reduce overall risk of their transfer could be used in their management. Mid-water ballast exchanges, for example, are most likely to purge organisms with planktonic stages at the time of the exchange leaving those residing in sediment or attached to ballast tank walls. A conceptual approach of a 'time-tunnel', through which carried exotic species must pass, are sequentially exposed to a gauntlet of 'gates' (critical occasions that exotic species must survive) that must be passed before a seminal population can be formed. Secondary introductions are more frequent because a greater number of potential vectors are present, the 'time tunnel' is shorter and there are fewer 'gates'. This concept is applied to some examples of species with different ranges within 'exotic species cells' which mainly happen to be sheltered shipping harbours.

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ICES CM 2000/U:14

New Cladocera species - *Cercopagis pengoi* (Ostroumov, 1891) (Crustacea) in the Vistula Lagoon of the Baltic Sea

E.N. Naumenko and Yu. Yu. Polunina

Cercopagis pengoi is a predatory Cladocera from the Ponto-Caspian basin. Its expansion into the Baltic Sea and the Vistula Lagoon has been started from 1980s. The species penetrated with the ballast waters through the Volgo-Balt channel system. In 1992 it was recorded in the Gulf of Riga, and in 1995, in the Gulf of Finland. In 1999, *C. pengoi* was found in the Gdansk Gulf, and in the early August it was recorded in the Vistula Lagoon. The dynamics of *C. pengoi* distribution in the Vistula Lagoon is considered. The conclusion is made that the species has penetrated into the Vistula Lagoon from the Baltic Sea with the driven sea current. Existence of gamogenesis females with latent eggs shows that *C. pengoi* may naturalise. Biocenosis consequences of such large predator intrusion into the Lagoon may have rather serious effect taking into account the high vulnerability of the community.

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ICES CM 2000/U:15

Distribution and ecosystem impacts of exotic species in the Baltic Sea

H. Ojaveer, S. Gollasch, S. Olenin, V. Panov, and E. Leppäkoski

The Baltic Sea is presently invaded approximately by 100 non- indigenous species, including phytoplankton, zooplankton, fishes and benthic species. Introductions of non-native species to the Baltic Sea begun probably as early as in the 11th or 12th century by the Vikings (soft shell clam *Mya arenaria*). This process of invasions has increased during the last decades, evidenced by the recent appearance of several organisms native to the Ponto-Caspian region (e.g., the round goby *Neogobius melanostomus*, the predatory Cladoceran *Cercopagis pengoi* and most recently, the hydromedusa *Maeotias inexpectata*) and North America (polychaete *Marenzelleria viridis*). All most important invasions are presumably associated with shipping activity and with release of ballast waters, specifically. We review introduction history distribution and invasion pattern of selected alien species in the Baltic Sea. Their impacts on abiotic environment as well as biotic components of the ecosystem (e.g., species diversity and abundance dynamics of native species at different trophic levels) are evaluated. Novel functions, represented by exotic species in the Baltic Sea ecosystems will be discussed.

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ICES CM 2000/U:16

Consequences of invasion of a predatory Cladoceran

H. Ojaveer, M. Simm, and A. Lankov

In 1992, a carnivorous species of the Ponto-Caspian origin, the Cladoceran *Cercopagis (Cercopagis) pengoi* (Ostroumov, 1891), invaded the Baltic Sea. In the area it was originally found, (the NE Gulf of Riga) the abundance of the species has increased linearity in 1992–1999. Dependent upon meteorological conditions, the Cladoceran is present in the pelagic zooplankton community for 7–20 weeks annually by having several peaks of abundance per year. After the invasion of *C. pengoi* the abundance level of its potential prey, *Bosmina coregoni maritima* - have been significantly lower than during the pre- invasion time (t-test, $p<0.01$). Abundance of other native Cladocerans (e.g., *Evadne nordmanni* and *Pleopsis polyphemoides*) or nauplii of copepods did not exhibit any peculiar changes after the invasion. The mean share of *C. pengoi* in the diet of the above listed fish remained below 7% (on wet weight basis) in 1994–1998. As an exception, in the food of bleak (*Alburnus alburnus*) it constituted 83%. The invasion of the alien species to the brackish Baltic Sea ecosystem has increased the functional diversity in several of its sub-systems. This obviously complicates energy flow to higher trophic levels, but probably increases the overall stability of the ecosystem. Direct harm to fisheries (by choking of fishing gears) changes in the diet of several fishes and alterations in mesozooplankton community (mainly in the warm season) are other important consequences of this invasion. As this euryhaline species originates from warmer climate conditions, the global warming should favour the extension of its area in the Baltic Sea region and support further increase in its abundance.

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ICES CM 2000/U:17

Fish population changes following the invasion of the Allochthonous alga *Caulerpa taxifolia* in the Ligurian Sea (NW-Mediterranean)

G. Relini, M. Relini, and G. Torchia

The fish population of a flat marine area (near Imperia in the Ligurian Sea), depths between 4 and 8 m, colonised by the allochthonous alga *Caulerpa taxifolia* (Valhl) *C. Agardh*, was studied during a first series of observations from October 1994 to October 1996. A second set of data was collected from January 1998 to October 1998 in order to compare 4 different environments: *Posidonia oceanica* (P), *Cymodocea nodosa* (CY) and two zones with different coverage of *C. taxifolia* (CSL, CMA). Visual censuses and catches using 200-m trammel nets were carried out. Fifty different fish species were observed during first period, Sparidae and Labridae, with 12 and 10 species respectively, were the two most represented families.

Abundances of *Symphodus tinca* and *Scorpaena porcus* seemed to be a characteristic of this community. A total of 55 different species of fish were either censured or fished during the second study period. The highest levels of species richness were observed at the CSL station (34); 26 species were caught and/or censured on P and CMA, only 14 species on CY. A comparison with fishing data obtained in a control area without *C. taxifolia*, but colonised by the phanerogam *Cymodocea nodosa*, gave a good idea of the qualitative and quantitative changes produced in the fish population as a consequence of the spread of the Allochthonous alga.

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ICES CM 2000/U:18

The invasion of Red-Sea species to the Mediterranean Sea: defining invasion mechanisms by assessment of transport modes and routes

S. Sheffer, E. Geffen, and A. Abelson

During the last 100 years, the marine biota of the Eastern Basin of the Mediterranean Sea has been experiencing dramatic changes which result from the uniquely massive invasion of exotic, mainly Indo-Pacific, species. The vast majority of invasions are believed to be due to human-mediated activities,

notably: ballast-water conveyance and the opening of the Suez Canal. Lessepsian migration is a conspicuous example of a massive invasion of Red Sea species into the Mediterranean, which has induced changes in the Levant-Basin biota. Despite the wide range of studies dealing with Lessepsian migration, very little is known about the routes and modes of dispersal - information that is essential for preventive programs against species invasion. The present study aims at determining species dispersal modes and routes, by using high-resolution molecular methods. As a first step, we used the mitochondrial gene COI, which is polymorphic in *Brachidontes variabilis*, hence, making it an appropriate genetic marker for this philogeographic research. Our preliminary results show that at least 44 genotypes are represented in the 190 individuals sampled from 9 different populations. Cladistic analysis using sequences of all genotypes indicated no geographical subdivision, but two distinctive clusters were apparent. This may show that there are at least two sources to the populations of the Gulf of Suez. It appears that the source of the Mediterranean genotypes is from the populations of the Gulf of Suez, but no founder effect was detected.

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ICES CM 2000/U:19

Introductions of molluscan shellfish - past experience and future considerations

S.D. Utting

For many years, deliberate introductions and transfers of molluscan shellfish have been made usually for fisheries purposes to counteract declining stocks of local species while needing to maintain or increase production for market demand. There have been risks and costs. Many introductions were made without any form of control or regulation. In some cases, the accidental introduction of other species occurred that were pests, predators or disease agents to native species. Legislation was formulated to control further introductions, including controls over the movement into and within the state or country. Further controls were put into place when the hatchery production of bivalve seed became more common practice in the mid -1960s. Guidelines in the ICES Code of Practice have been fundamental in providing advice to support and monitor planned introductions. Inevitably, deliberate introductions of molluscan shellfish will continue to take place around the world to support local fisheries and employment. Current changes in legislation to aid free trade between countries could increase the risks from accidental co-introductions and transfers. Unintentional introductions of molluscan shellfish as foulants on ships, in ballast water and in the aquarium trade should also be realised. Increasing the awareness of the risks involved is paramount.

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ICES CM 2000/U:20

Americans on the wrong side - the lobster *Homarus americanus* captured in Norwegian waters

G.I. van der Meeren, K.O. Ekeli, K.E. Jørstad, and S. Tveite

In November 1999, two female lobsters, one with external egg batch, were captured in the common lobster fishery in the Oslofjord, Norway, and reported as possible American lobsters, *Homarus americanus*, to Bergen Aquarium and the Institute of Marine Research. More, but undersized specimens were said to be present in the fishery.

Closer inspection confirmed that both individuals showed a series of American characteristics, as a ventral tooth on the rostrums, longer and sharper teeth inside the cutter claw and the typical greenish-brown colour common in American lobsters. Tissue sample from one specimen was analysed by starch gel electrophoresis and new alleles, never reported in European lobster before, were found at several allozyme loci. These alleles correspond to common alleles in American lobsters as demonstrated in a reference sample. Origin and time of invasion of the American lobsters are suggested, as well as possible ecological interactions and influence on the original lobster population when invaded by this competitor.

Keywords: ecology, genetics, *Homarus americanus*, *Homarus gammarus*, hybridisation.

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ICES CM 2000/U:21 (Poster)

Distribution of snow crab *Chionoecetes opilio* (Fabricius) in the Barents Sea

S. Kuzmin

Until recently snow crab *Cionoecetes opilio* (Fabricius, 1788) occurred in the north seas of the Pacific Ocean

and the northwestern Atlantic Ocean. In 1996, this species was found in the Barents Sea for the first time (Kuzmin *et al.*, 1999). *C. opilio* was assumed to get there with ballast waters of vessels from the Northwest Atlantic.

Revealing the snow crab in the following years confirms the fact of its invasion to the southern Barents Sea. However, the reproduction of *C. opilio* in the Barents Sea remains to be not corroborated, since the females with external eggs have not been revealed so far.

Crabs were found in the trawl catches at the depths of 100–324 m, they mainly occurred in the north slope of the Goose Bank. At present the snow crab is distributed in the Barents Sea - from 30° 27'E in the West to 47° 20'E in the east; and from 69° 36'N in the south to 72° 39'N in the north.

The carapace width in males was 41–123 mm, that one in females - 42–72 mm. All the females were caught in the northern slope of the Goose Bank. The males found in the Barents Sea were, mainly, mature. There was the noted trend of increase in the male size from the Goose Bank westward and southward.

Obviously, this species is able to form a commercial population in the Barents Sea in future. Snow crab will hardly be a competitor of another one moved into the Barents Sea - the king crab.

Keywords: Barents Sea, distribution, invasion, snow crab.

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ICES CM 2000/U:22 (Poster)

Introduced macrophytes - do they have as large an impact on the ecosystem and fisheries as animals?

I. Wallentinus

During the three last decades increased numbers of introduced seaweeds have established worldwide, but especially along the Atlantic and Mediterranean coasts. Generally, the most important role of macrophytes in temperate waters is through their architectural structure, providing shelter for the mobile fauna and increased surfaces for epibionts. The impact of these introduced seaweeds and higher plants occurs on many levels of the ecosystem, through e.g.: competition with native plants (space, light, and nutrients), competition for space with sessile animals, reduced water movements, accumulation of sedimenting particles, and in a few cases, by being toxic to grazers. On fisheries their impact mainly occurs through: clogging of fish nets and/or by changing the character of the benthic communities; by being a nuisance in aquaculture through fouling on supporting structures, clogging of cages. In extreme cases, by lifting and sailing away with free-living oysters and mussels; but also by fouling on ships. Examples will be given on introduced macrophytes with major or minor effects, including also models. Comparisons are made with some introduced animals. Although nobody can predict future introductions, some common characteristics of the introduced species will be highlighted and the major vectors and hence risks of new introductions emphasised.

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THEME SESSION

on

Medium-Term Forecasts in Decision-Making (V)

ICES CM 2000/V:01

The use of medium-term forecasts in advice and management decisions for the stock of Norwegian spring spawning herring *(Clupea harengus)*

B. Bogstad, I. Røttingen, P. Sandberg, and S. Tjelmeland

The ICES Working Group on Northern Pelagic and Blue Whiting Fisheries has carried out medium-term simulations on the stock-development of Norwegian spring-spawning herring since 1994. The results of the simulations have been used as a basis for advice on the precautionary reference points and on long-time management strategies. The present paper reviews the development of the medium-term simulations where results from the medium-term forecasts carried out in 1995 and 1999 are used as examples. Emphasis is put on the uncertainty on the point estimate of the stock (the starting point of the simulations), and on the stock-recruitment relation. Further, the significance of the medium-term forecast in the decision making process of an international agreed long- time management strategy for this stock is discussed.

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ICES CM 2000/V:02

On the flounder yield and spawning stock medium-term forecasts in Estonian waters

T. Drevs

Estonian flounder catches are strongly correlated with inflows of saline water from the North Sea to the Baltic Sea. In the Gulf of Finland (SD 32) the catches increase 3 years after the strong or moderate inflow, probably because of changes in migration pattern or locomotion activity. Increase of spawning stock biomass and better spawning conditions result the catch maximum 6–7 years after the inflow. In SD 29 the fluctuations of the catches have been smaller than in the SD 32, but the effect of the inflows is clearly expressed. The catches in SD 29 and 28 can be predicted for 5–6 years. According the tagging data, the migrations of flounder do not usually exceed 50-60 miles, but the tagging experiments were performed before the last stagnation period, 1978–1993. The spawning stock number and biomass, estimated by VPA and Separable VPA in Estonian waters of the SD 32, depend also on salinity.

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ICES CM 2000/V:03

Comparison of uncertainty estimates in the short term using real data

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In response to increased interest in the Precautionary Approach, various approaches have been applied to characterize the uncertainty of fisheries assessment projection results. Using three case studies, a comparison of some commonly applied techniques was undertaken to determine if different methods give similar perceptions of uncertainty in the short term, with the same or very closely similar structural models. The techniques for estimating statistical uncertainty included the Delta method, the parametric bootstrap of data, the nonparametric bootstrap of residuals and Bayes. Each method was used to derive cumulative frequency distributions of SSB for 1998 and of change in SSB for 1998 relative to 1992. These comparisons were contrasted against the sensitivity of uncertainty estimates to fundamental structural assumptions such as separability. Results displayed measurable and often repeatable patterns in differences between methods of estimating uncertainty, suggesting that these differences were peculiar to the methodology and assumptions. The Delta method displayed distributions with longer left tails. Results from Bayes and bootstrap percentile methods were similar. Bias adjusted results were more conservative. Often however, differences could be greater when fundamental structural assumptions were altered, indicating that structural relationships must be either clearly established or proper account taken of this model uncertainty.

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ICES CM 2000/V:04

Effects of climate and stocks interactions on the yield of Northeast Arctic cod. Results from multispecies model runs

J. Hamre

A conceptual climate dependent multispecies model for stock interactions and harvesting of herring, capelin and cod in the Norwegian Sea-Barents Sea region has been developed. The concept presupposes that good recruitment of herring and cod is linked to warm ocean climate, which may occur with frequencies of 8 to 10 years. Strong herring year classes overlap the distribution of capelin larvae in 3–4 years causing mass mortality of the capelin fry, and depletion of the capelin stock. At that time the herring is about to leave the Barents Sea, and lack of food in subsequent years reduces the potential yield of cod. Immature cod is the main predator on mature capelin and cannibalism is an important factor in reducing the abundance of juvenile cod when the capelin stock is rebuilding. The model is used in a study of the effects of different fishery management strategies on stocks and yield. Results show that optimum yield of cod is obtained by high fishing mortality on immature cod from the end of a warm period until the spawning stock of capelin is rebuilt In subsequent years the fishing mortality should be reduced until a new warm period occur. This harvesting strategy of cod gives an optimum biomass production of capelin and an optimum potential yield of cod for a spawning stock limit of 200 thousand tonnes. The results are in accordance with the catch history of cod. Prior to the 1970's, the effort of the fishery in the Barents Sea followed to a large extent the abundance of immature cod, resulting in large catches when the stock was abundant. The yearly catches varied from 0.4 to 1.3 mill. tonnes, and the average catches obtained in the two periods 1950–1958 and 1959–1969 are the highest on record. Moreover, the trawlers fished with small meshes in the cod end, discarding considerable quantities of small fish.

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ICES CM 2000/V:05

The use of recruitment time-series structure and environmental information in medium-term stock projections

C.L. Needle, C.M. O'Brien, and C.D. Darby

Foremost amongst the competing aims for fisheries management is the maintenance of fish stocks for the forseeable future. To this end, it is imperative that managers are equipped with indicators of the expected level and variability of future population levels over the medium-term (five- to ten-year) time-scale, and that these indicators are sufficiently reliable, realistic and pertinent to the regulatory framework in which the managers operate. We extend the simulation approach currently employed within ICES stock assessment working groups by including the effect of the imposition of different hypothesised future environmental regimes and characterisations of the time-series structure of residuals to fitted stock-recruitment models. Neglecting either of these two sources of uncertainty can result in a systematic error for prediction. North Sea cod (*Gadus morhua* L.) is presented as a germane and timely case study. We use the probability of the spawning stock biomass falling below the precautionary level of biomass, Bpa, as a diagnostic statistic to monitor projected performance. The relevance and utility of these new models for fisheries management is discussed, together with potential implications.

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ICES CM 2000/ V:06

Validating three methods for making probability statements in fisheries forecasts

K.R. Patterson, C.D. Darby, D.W. Skagen, and M. Smith

We report on a test of three methods that have been used by ICES in making probability statements about fisheries forecasts to management agencies (XSA/ WGMTERM, ICA/ICP, and a stochastic projection method that was first applied to North Sea herring). The principle of the test is to calculate many stock assessments and forecasts using historic data, and to compare probability statements about some quantities (forecast biomass, relative biomass, catch etc.) with the

latest and the most reliable estimates. For most ICES and NAFO stocks where a sufficiently long time-series exists, we calculate retrospective (8 year before present) assessments and then calculate medium term forecasts 5 years forewards. By comparing the frequencies of expected and actual outcomes, we conclude that some methods can be used to make reasonably reliable probability statements about relative biomass (e.g. biomass relative to biomassat some time in the past), but that for most other quantities and most methods the accuracy of probability estimates is very poor. In general, the methods tended to underestimate uncertainty and there was a relatively large proportion of "unexpected" outcomes in the forecasts.

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ICES CM 2000/V:07

Variation in fish condition between Atlantic cod (*Gadus morhua*) stocks and implications for their management

H.-J. Rätz, J. Lloret, J. Casey, A. Aglen, and S.A. Schopka

A comparative analysis of the fish condition (Fulton's K) of 10 cod stocks in the North Atlantic in relation to the temperature of their habitat and their reproductive potential is presented. It is shown that the cod stocks in the North Atlantic display different levels of mean condition, which are partly due to the different temperature regimes of their habitats. Cod stocks living in colder waters, e.g. Southern Gulf of St Lawrence, Greenland and Grand Banks cod stocks, were less conditioned than cod stocks living in warmer waters, e.g. North Sea and Irish Sea. The a-coefficients obtained from Ricker's recruitment-spawning stock biomass (SSB) relationships were defined as an indicator for the recruitment potential of the various stocks and found to be correlated with mean condition factors of the stocks. This indicates that stocks consisting of poor conditioned individuals appear to react very sensitive in recruitment reduction with decreasing SSB while the stocks which consist of well conditioned fish seem to behave more robust with a higher probability of good recruitment at low SSB. The positive effect of the cod condition on their reproductive potential generally implies that the well-conditioned stocks in the Northeast Atlantic can sustain higher exploitation rates than the poor conditioned stocks in the Northwest Atlantic. This is illustrated by a positive relationship between estimated biological management reference points Fmed and the mean cod condition factors by stock.

Keywords: Atlantic cod, biological reference points, Fulton's condition factor, reproductive potential, recruitment-spawning stock biomass relationship, temperature.

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ICES CM 2000/V:08

Do different methods provide accurate probability statements in the short term?

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The performance of uncertainty estimation procedures was evaluated with respect to accuracy. A confidence statement is said to be accurate if the confidence point achieves the desired probability coverage. A Monte Carlo experiment with 100 trials was conducted with a "true" population that experienced contrast between low and high fishing mortality. Observations for the last 25 years were drawn stochastically by adding measurement error. The assessment approaches were VPA-based (ADAPT and XSA with errors on the effort data). The "Delta Method", parametric and non-parametric bootstrap (NPB), and a Bayesian approach were used to quantify coverage and assess the accuracy of confidence limits of estimated interest parameters ($F_{0.1}$, SSB and $TAC_{F0.1}$ in year 26) by comparing against the "true" values. Variations of the Delta Method and bootstrap were used to account for statistical estimation bias. The results indicated that accurate inference statements are possible with the different approaches and that bias correction can improve accuracy when it can be applied. The bias-corrected Delta-ADAPT and bias-corrected NPB-ADAPT applications performed best. Inference statements about $F_{0.1}$ tended to be more accurate than those for SSB or TAC. Some comparisons based on separable models (with errors on both catch and effort) are also presented.

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ICES CM 2000/V:09

Modelling of age-dependent instantaneous coefficients of natural mortality for North-east Arctic cod

V. L. Tretyak

A mathematical model, suggesting that instantaneous coefficients of natural mortality change with age increasing from 3 years and further, is presented. It explicitly reflects a conceptual relationship between natural mortality of cod, maturity age (t_s) and theoretical maximum possible lifetime (t_e) of fish, and implicitly between natural mortality, linear and weight growth Natural mortality coefficients are calculated for cod from 1946–1991 year classes at the age of 3, which can be used for assessment of total and spawning stocks, biological reference points and total allowable catch. Calculations show that the instantaneous coefficient of cod natural mortality varies not only with age but also between year classes to. The idea of the natural mortality being constant in the period of cod life when they are subject to the fishery is very approximate. It leads to an inadequate reflection of the actual decline of relative biomass of older age groups. In the post-war history of the fishery two groups of year classes were identified for which coefficients differ significantly. They are 1946–1975 year classes and those after 1975. In the second group, the mean value of coefficient in the interval (3-t_s) years is smaller, in the interval (t_s -15) is greater.

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ICES CM 2000/V:10

Triple-separable VPA (TSVPA), or a stone to bridge the gap between separable cohort models and nonseparable ones

D.A. Vasilyev

Separable cohort models (SVPA, CAGEAN, ICA, etc) are widely used in fish stock assessment since they allow to get more stable and statistically grounded solution in comparison to nonseparable models, which, as a rule, treat catch-at-age data as exact. In some cases separable cohort models are able to produce unique solution of the system of VPA equations using catch-at-age data only. This is most valuable when auxiliary information is not available.

Unfortunately the basic assumption of separable cohort models, i.e. representation of fishing mortality coefficients as a product of two factors (age-dependent selectivity factor and year (or effort)-dependent one) is sometimes too restrictive for real stock-fishery systems. The stability of selectivity pattern over years is often violated by variations in fishing regime and by natural reasons.

One of well known "natural" reasons why selectivity pattern is not constant over years is that more abundant cohorts (generations) are of higher availability for fishery than less abundant ones. Miscount of this factor in stock assessment, undertaken by means of separable models, may lead to biased stock size estimates.

In the model described here, named Triple-Separable VPA (or TSVPA), an attempt is made to take into account the above mentioned factor by including the "factor of generation" in explicit form into the separability assumption. That is fishing mortality coefficient is now can be represented as a product of 3 factors: age-dependent, year-dependent and generation-dependent. Parameter estimation procedure of the TSVPA includes some principles of robust statistics and allows to estimate all the necessary parameters without auxiliary information.

The ability of the approach to provide more reasonable stock size estimates (in comparison to traditional "double-separable" representation) in the lack of information on CPUE is demonstrated with simulated and real data. The approach described here also seems to serve to bridge the gap between separable and nonseparable cohort models: triple-separabilization not only still allows not to consider catch-at-age data as exact and to get solution in the lack of auxiliary information (as separable models can do), but also to better reflect in the model the cohort-related effects.

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ICES CM 2000/V:11

Blue whiting: results of stock assessment using filtered catch-at-age data

D.A. Vasilyev, S.V. Belikov, and A.I.Krysov

An analysis of blue whiting preliminary filtered catch-at-age data by means of a separable cohort model ISVPA, based on resistant procedures of parameter estimating, has revealed an existence of solution corresponding to good stock state in 1998. Though survey data were not used in the analysis, the results (total stock biomass in 1998 = 7.96 mln.t.; spawning stock biomass in 1998 = 4.6 mln.t.) are in good

agreement with some of survey estimates of blue whiting stock biomass for this year.

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CM 2000/V:12 (Poster)

Overfishing indications in the hake (*Merluccius hubbsi*) stock south of 41°S. southwest of Atlantic Ocean

M. Pérez, A. Aubone, M. Renzi, A. Madirolas, M. Ehrlich, G. Irusta, and M. Simonazzi

The hake stock south of 41°S presents signs of overfishing: total biomass shows a decreasing trend in time; the spawning biomass is below the biologically acceptable levels and presents a decreasing trend as well; catches are sustained only by a few age groups with a trend towards the disappearance of the oldest age groups. The current spawning biomass level is at its lowest historical value and does not guarantee the maintenance of the recruitment levels necessary for the actual level of exploitation of the resource. Significant reductions in the recruitment levels are shown by evidence in research cruises or projected by the assessment model. Changes in the stock age and sex structure have also been detected. In addition, the spawning areas have changed within the stock main reproductive zone where the numbers of eggs collected in the plankton are lower in the latters years. There is no evidence for significant changes in enviromental factors. The information available helps to identify spawning biomass levels (SSB limit), the age and sex structure where a low recruitment is highly likely. This paper aims to show that the main hake stock needs actions for an immediate recovery to biological safety levels in order to avoid the collapse in the near future.

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THEME SESSION

on

Cooperative Research with the Fishing Industry: Lessons Learned (W)

ICES CM 2000/W:01

Getting to yes with stakeholders in fisheries resource assessment - A paradigm shift

J.A. Boutillier

Over the last 10 years, the Invertebrate fisheries on the Pacific Coast of Canada have undergone an order of magnitude increase in exploitation. This increase exploitation has mainly shown up as exploitation of new species and expansion of fisheries into new areas. There are now over 40 species being exploited and another 30 being considered. There has also been an increase in demands on the resource by non-commercial stakeholder groups including First Nations, Sports fishing and aquaculture. Unfortunately these increases in exploitation came at a time of fiscal restraint and there have been no increases in resources to carry out the required assessments. To meet these needs a paradigm shift occurred in the delivery mechanism for assessment to one of collaboration with stakeholders. This shift has been so complete that at this time ever Invertebrate assessment is conducted through a co-operative program with stakeholders. This paper will outline the different types of collaborative processes that we have negotiated. Discussions will centre on the principles, infrastructure considerations, roles and responsibilities, difficulties, pit falls and the lessons learned.

Keywords: assessments, Canada, collaborative research, invertebrates, Pacific.

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ICES CM 2000/W:02

Fishery acoustic indices for assessing Atlantic herring populations

R. Claytor, J. Allard, A. Clay, C. LeBlanc, and G. Chouinard

A method for measuring the spatial and temporal distribution of fish school densities and exploitation rates using fishery collected acoustic data is described. A herring purse seiner fishing on non-spawning feeding aggregations, and a herring gillnetter fishing on smaller, highly dense spawning aggregations, in the southern Gulf of St. Lawrence, Canada, collected acoustic data for this study. The relationship between gillnet catch rates (kg/net) reached asymptotic values at lower than expected densities and was not useful for tracking daily trends in school density. Gillnet and purse seine catch per meter searched was linearly related to density, and likely is suitable abundance indices for stock assessment estimates. A simulation model calibrated with data from the fishery on spawning aggregations indicated that these data are suitable for deriving abundance indices. The properties of the indices were examined over five fish distribution types, four conditions of fishing and fish movement, and sixteen stock sizes. There was a threshold density beyond which exploitation rates remained low. This threshold provides managers with a method for identifying and eliminating spatial and temporal trends in high exploitation rates and preventing overfishing.

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ICES CM 2000/W:03

Spanish experimental fishings: A cooperative research initiative between scientific and the local fishing industry

P.D. Muñoz and E.R. Marcote

The Spanish Institute of Oceanography (IEO) cooperates with the local fishing industry in the search for alternative resources, developing experimental fishings. From 1997 to 1999, 8 high seas freezer trawlers explored international waters in the Atlantic for a total of 543 days, subsidised by the E.U. and the Spanish administrations. The quality of the information compiled was guaranteed by having a biologist on board, managed by the IEO. This scientist compiled the data and biological material which was later analyzed at the laboratory. This cooperation gave interesting scientific and commercial results, which were subsequently shared between both groups. Progress has

been made in knowledge on the biology and distribution of deep-water species as grenadier (*Coryphaenoides rupestris*), smothhead (*Alepocephalus bairdii*), orange roughy (*Hoplostethus atlanticus*), alfonsino (*Beryx splendens*), blue ling (*Molva dipterygia*), deep-water sharks (*Squalidae*) and others as boardfish (*Pseudopentaceros richardsoni*) and pelagic mackerels (*Scomber japonicus* and *Trachurus picturatus*). For the industry, this has entailed exploring new areas (Mid-Atlantic Ridge, Valdivia Bank and seamounts) with innovative techniques and the start of the commercial exploitation of some non-traditional resources. This article describes the methodology used, summarizing the information gathered and the main results, with discussion of the advantages and disadvantages of these initiatives. KEY WORDS: Experimental fishing, research cooperative, trawl, Mid-Atlantic Ridge, Valdivia, seamounts, non-traditional resources, grenadier, smothhead, orange roughy, alfonsino, blue ling, deep-water sharks, boardfish, mackerel.

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ICES CM 2000/W:04

Results of a deep-water experimental fishing in the North Atlantic: an example of cooperative research with the fishing industry

P.D. Muñoz, E. Román, and F. González

This Experimental fishing was conducted by the freezer trawler M/V Puente Sabaris, in international waters of the North Atlantic in February-April 1999. One scientific was on board to collect data and biological material. Seamounts and banks near Azores was explored (Antialtair, Altair, Faraday, Olimpus and Minle) and also Reikjanes Ridge and Hatton Bank. Fishing effort was more intense at Reikjanes and Hatton with deepwater trawling. Most of the catch was obtained at Reikjanes and Hatton. Blue ling (*Molva dipterygia*) was the most caught species, with high catches at Reikjanes (3652 kg/hr.). Roundnose grenadier (*Coryphaenoides rupestris*) was the second species in importance, catch mainly at Hatton and Faraday. Other caught species were boreal shark (*Somniosus microcephalus*), Atlantic halibut (*Hippoglossus hippoglossus*), smothhead (*Alepocephalus bairdii*), black scabbardfish (*Aphanopus carbo*) and orange roughy (*Hoplostethus atlanticus*). All catches were taken at depths of below 600 m. The length range of blue ling was 59-137 cm, with predominance of males. This was also evident in orange roughy, with individuals between 48-69 cm. The length range of roundnose grenadier was 4.5-23 cm. The length-weight ratio was estimated for the main species. Observations of maturity at length was made, most of the individuals of blue ling were mature.

Keywords: blue ling, deep-water, experimental fishing, North Atlantic, orange roughy, roundnose grenadier, trawl.

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ICES CM 2000/W:05

A recent UK joint initiative to revise technical conservation measures regulating the design of mobile gears

R.S.T. Ferro, G.N. Graham, and F.G. O'Neill

Despite a growing realisation that the selectivity of demersal whitefish and *Nephrops* mobile gears in the UK needed to be improved, little has been achieved in the last 20 years. In the past 12 months however, progress has been made in a new atmosphere of cooperation between all parties involved in the management of the fishery: fishermen, managers, stock assessment biologists and gear technologists.

The paper will describe the main causes of this change in attitude. A better than average year class of haddock was spawned in 1999; a beneficial quota deal was struck with Norway contingent on improved conservation; a high level of discards has been sustained in recent years; the fishery has experienced gradually reducing quotas. The paper will describe the options that were available and will discuss the processes of negotiation which have allowed a range of new technical conservation measures regulating gear design to be introduced. The type of cooperative work that was necessary to convince fishermen and stock assessment biologists of the suitability of the solutions will be indicated.

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ICES CM 2000/W:06

Fisheries scientists' struggle for objectivity

K.H. Hauge

Traditionally, objectivity and neutrality along with testability and significance have been important standards of science. However, science has changed profoundly from small-scale experiments to large-scale problems of societal concern. Thus a revised set of scientific standards and ideals of quality is necessary.

Fisheries scientists are educated at universities where traditional ideals are essential. In this paper I discuss objectivity and neutrality as measures of quality and how fisheries scientist relate to these ideals. Scientific ideals are challenged, and examples are discussed within cooperative research, stock assessment and whale counting.

Keywords: fisheries science, objectivity, quality.

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ICES CM 2000/W:07

Government-Industry Cooperative Research in the United States. Provisions under the Magnuson-Stevens Fishery Conservation and Management Act and examples from the Gulf of Alaska and the Eastern Bering Sea.

W.A. Karp, C.S. Rose, J.R. Gauvin, and S.K. Gaichas

The National Marine Fisheries Service (NMFS) Alaska Fisheries Science Center (AFSC) has a long and successful history of conducting research in cooperation with the fishing industry. Many of the Center's annual resource assessment surveys are carried out aboard chartered commercial vessels and the skill and experience of captains and crew are integral to the success of this work. Fishing companies have been contracted to provide vessels and expertise for many different types of research including testing and evaluation of survey and commercial fishing gear and development of improved methods for estimating commercial catch quantity and composition. AFSC scientists have also participated in a number of industry-initiated research projects including development of selective fishing gears for bycatch reduction and evaluating and improving observer catch composition sampling. In this paper, we describe the legal and regulatory provisions for these types of cooperative work and present examples to illustrate the process and identify the requirements for successful cooperative research.

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ICES CM 2000/W:08

Co-managing the Scotian shelf shrimp fishery - so far so green

P.A. Koeller

In recent years the Department of Fisheries and Oceans has been fostering co-operative approaches to stock assessment and management of Canadian fisheries resources. In this paper I describe one such co-management program, that for the Scotian Shelf fishery for northern shrimp *Pandalus borealis*, and the role science has played in it. Drawbacks and advantages of co-operative research are described from a personal perspective, with a view to gleaning basic principles. Predictably, problems appear to fall into two main categories, including those associated with methodological compromises, and those stemming from conflicting objectives. Some examples are provided. A major benefit of conducting science within a co-management program is that it stimulates new ways of viewing the process of fisheries science and management. The "traffic light" assessment method of determining stock status is highlighted as a way to facilitate industry involvement in the final stages of the assessment/management process. As a result, the setting and enforcing of TACs, traditionally a government domain, becomes more of a co-operative action.

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ICES CM 2000/W:09

Designing and evaluating length-frequency surveys for trap fisheries

R. McGarvey and M. Pennington

A survey design for estimating the length distribution of harvested southern rock lobsters (*Jasus edwardsii*) was developed for the South Australian fishery. Volunteer fishers carried out experimental sampling in spring 1996 and autumn 1997 to test three proposed survey designs. A variance components analysis indicated that it would be more efficient to sample one pot per trip from all trips rather than the previous design of sampling multiple pots from a few trips. The variation among licenses (fishers) accounts for most of the remaining sample variance. On-board sampling by scientists, who in the past measured all pots on selected trips, was shown to be of small value in reducing sample variance while costing considerably more than volunteer sampling by fishers. The South Australian rock lobster fishers have adopted a one-pot-per-trip sampling design. Estimators, based on a 3-level sampling hierarchy of

sample pot, day and licensee, are presented for estimating the mean and sample variance of the numbers harvested overall and within each length category.

Keywords: effective sample size, southern rock lobsters, trap survey design.

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ICES CM 2000/W:10

Economic impact of sardine scarcity on the Portuguese canned fish industry: a system dynamics study

J.F. Dias, J.C. Filipe, J.G. Dias, and J. Menezes

In recent years, some data about the *Sardina Pilchardus* stock, along the ICES areas VIIIc and IXa, indicated a potential risk of going beyond biological safe limits. Since the importance of the sardine catches to the Portuguese canned fish industry is critical; an impact evaluation of the foreseeable restrictions was necessary. An integrated system dynamics model of the supply and demand of sardine and of the production of canned sardine was developed; after validation with historical data, three different scenarios were explored. The supply and demand sub-model takes into account the fresh fish auction market and the quantities for industrial use. The system dynamics sub-model of industrial production, that assumes that sardine price is the major variable affecting the industry performance, incorporates the operational parameters usually found in the industry. The simulation results provided information on how the different groups of companies will behave, and help put in perspective the expectable social and economical effects; mutual understanding of the common interests of the Producers' Organizations and the canned fish industry was greatly increased.

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ICES CM 2000/W:11

Introducing a new trawl survey for West Coast slope groundfish

R.D. Methot, J.R. Wallace, and C.W. West

Scientists from the National Marine Fisheries Service's Northwest Fisheries Science Center carried out a bottom trawl survey of the slope zone (100-700 fm) offshore Washington, Oregon, and California aboard chartered commercial trawlers during August - October of 1998 and July - September of 1999. In both years the survey area extended from Cape Flattery, Washington, to Point Conception, California, and focused on the deepwater species complex of Dover sole, longspine and shortspine thornyhead, and sablefish (DTS species). The surveys provided information about the distribution and biological status of these and other slope groundfish resources for stock assessments, and validated methods for conducting such work aboard vessels from this fleet. Goals of the survey included: 1) to develop and test a survey design suitable for multiple-vessel surveys; 2) to develop biological and catch-sampling methods and technology appropriate for use on small chartered trawlers; 3) to obtain data on distribution, relative abundance, and biological status of DTS stocks in the slope zone; and, 4) to assess the feasibility of this approach for developing indices of relative abundance. Data from both years are still being analyzed, with initial emphasis on determining the extent and impact of vessel-to-vessel variations in catching efficiency within and between years. The statistical and methodological implications of using multiple vessels for conducting surveys are discussed. *(Equal authorship)*

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ICES CM 2000/W:12

On the use of skipper's logbook data in the interpretation of trends in fisheries

M.A. Pastoors, J.J. Poos, and A.D. Rijnsdorp

Since 1993 the Netherlands Institute for Fisheries Research (RIVO) has been collaborating with the Dutch Fishing industry in a project aimed at collecting basic data on board of beam trawl vessels. A number of the vessels were equiped with accurate position recording devices that registered the position of the vessel every 6 minutes. In addition, the skippers were asked to keep detailed logbooks of the composition of the catch (kg/species) for each haul. This has resulted in a dataset of around 126.000 hauls over 7 years.

So far, only a part of the dataset has been analysed on patterns in CPUE. First results have been compared to CPUE patterns from the commercial logbook information and from the aggregated CPUE for the total fleet. The theoretical background of the Ideal Free Distribution is used in an attempt to explain the observed the trends in CPUE and the behaviour of the predators (fishermen).

Implications of the use of skipper's logbooks for stock assessment purposes are discussed, both in terms of the relationships between fishermen and research and in terms of inclusion of 'alternative' types of information in stock assessment models.

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ICES CM 2000/W:13

Integrated management of the sea scallop fishery in the Northeast USA: Research and commercial vessel surveys, observers, and vessel monitoring systems

P.J. Rago, S. Murawski, K. Stokesbury, W. DuPaul, and M. McSherry

The sea scallop (*Placopecten magellanicus*) supports the second most valuable commercial fishery in the northeast USA. We describe the recent history of this resource focusing on the integration of research vessel (R/V) surveys with surveys conducted by commercial fishing vessels (F/V) in 1998 and 1999, fishery observer data and electronic monitoring of vessel position. In 1994 large areas of Georges Bank were closed to protect declining stocks of cod, haddock and yellowtail flounder; scallop harvesters were also excluded due to concerns about bycatch. Scallop populations rebounded quickly in the absence of fishing, attaining biomass densities and average sizes rarely observed in the past 30 years. While research vessel (R/V) surveys were sufficient to track the general trends, the fine-scale distribution of commercial-sized scallops and levels of bycatch in commercial dredges could not be estimated without more intensive studies. Cooperative fishing vessel surveys involving government, universities and industry provided sufficient information to characterize the distribution of the scallop resource and the expected levels of finfish bycatch. A limited reopening of one area on Georges Bank in 1999 was accompanied by increased observer coverage (~22%), daily reporting of landings and yellowtail flounder bycatch rates, and electronic monitoring of vessel position for the entire fleet. The combined information from synoptic R/V surveys, intensive F/V surveys, fishery observers and electronic monitoring provided a coherent picture of the scallop resource, rich details on fleet behavior, and new insights into strategies for managing bivalve fisheries.

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ICES CM 2000/W:14

Analysis of CPUE from the Norwegian bottom trawl fleet

A. Salthaug and O.R. Godø

Commercial logbooks with catch and effort data have been collected and recorded by the Norwegian Direcorate of Fisheries since 1971. The applied effort is here standardised, and yearly age disaggregated CPUE indices are calculated separately for Northeast Arctic cod, Northeast Arctic haddock and Northeast Arctic saithe. The correlation between biomass estimates from VPA/survey and commercial CPUE are explored, using different qualification levels. For most of the analyzed species and age groups the trend in CPUE time series is quite similar with that of VPA and survey. Generally, the trend in yearly CPUE seems to stabilize for qualification levels above 20 %.

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ICES CM 2000/W:15

Cooperative government/industry efforts in gear development and gear acceptance in the State of Maine silver hake fishery

D.F. Schick and M. Brown

Fishermen's expertise with the gear and fishing practices was combined with scientists' expertise in experimental design and analysis to improve by-catch release and to adjust size selectivity for silver hake in the Gulf of Maine silver hake fishery. The Maine silver hake fishery has traditionally used 1-3/4" mesh that targets marginally sexually mature fish. When new regulations closed all but two inaccessible areas to this gear due to high groundfish bycatch, Maine fishers asked to develop a Nordmore-style grate system to reduce bycatch to less than the limit of 5% by weight. A cooperative study was initiated and with some iteration, a grate-based fishery was shown to be less than 5% bycatch. Since then a management plan for silver hake was put into place that severely discouraged the taking of small fish.

The gear work has since found the best combination of bar spacing and cod end mesh for the appropriate size selection for silver hake and initial tests of using this in combination with a raised footrope to reduce bycatch level to under 5% have been done. An experimental fishery to continue testing this combination is currently under way.

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ICES CM 2000/W:16

Use of data from the commercial fishing industry in the management of Norwegian spring spawning herring (*Clupea harengus* L.)

A. Slotte

This paper gives three examples of how data collected by the commercial fish industry of Norwegian spring spawning herring could be used for scientific and management purposes. They demonstrate that it may be useful to investigate the possibilities of "free" and valuable data outside the research institutions. The first example describes a new method for estimation of catch at age. This method takes advantage of information of catch by size groups. At landing catches for human consumption are divided into 5 size groups by individual weights as follows: group 1 (>333 g), group 2 (200-333 g), group 3 (125-200 g), group 4 (83-125 g) and group 5 (<83 g). Annually many thousands of catches and hundred thousands of tonnes are been sampled in this way. In the new method these data on size group composition are combined with biological samples with age readings in a similar way as with the traditional method using age at length keys. Comparisons between the new and the traditional sampling of the fishery demonstrate that the new method is more reliable, mostly due to the enormous amounts of size group samples. The second example demonstrates how data on proximate composition (fat and water content) analysed at meal and oil factories and local-processing plants could be used to analyse seasonal and annual variations in energy loss. The third example demonstrates how data on individual weights and gonad weights could be used to assess the maturation process and reproductive investment.

Keywords: commercial data, maturation process, proximate composition, size groups.

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ICES CM 2000/W:17

Cooperative research with the Scotia-Fundy herring fishing industry: Lessons learned

R. Stephenson, G. Melvin, M. Power, J. Fife, D. Lane, and D. Aldous

The Canadian Scotia-Fundy Region herring fishing industry has had a long history of innovative involvement in research and in management. In recent years, this has been extended to include extensive industry sampling for biological characteristics of the catch, quantitative acoustic surveys using industry vessels, collaborative funding and participation in a variety of biological studies (including tagging and documentation of spawning grounds), and participation with industry information in the assessment process. This paper reviews and evaluates what has been achieved in this case study, and attempts to place in the broader context of the hypothesized benefits of collaborative approaches and co-management generally.

Cooperative research has had both positive and negative aspects. It has demanded a very high level of time and financial commitment, involvement and cooperation from a wide spectrum of members of the industry and government. It has, at times, demonstrated the conflicting priorities of resource harvesting and collection of scientific information and survey data. As hypothesized by much of the literature on co-management however, this case study suggests that there has been improved awareness of scientific issues, feelings of ownership and care for the resource resulting from cooperative research and involvement in management.

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ICES CM 2000/W:20

The Scotian Shelf and Southern Grand Banks Atlantic halibut (*Hippoglossus hippoglossus*) survey - Collaboration between the fishing and fisheries science communities

K.C.T. Zwanenburg and S. Wilson

Since 1970 Canada has engaged in standardised trawl surveys to provide estimates of fish population abundance on the Scotian shelf. These surveys give highly variable abundance estimates for Atlantic halibut (*Hippoglossus hippoglossus*) a valuable, commercially exploited species. The groundfish surveys were not

designed to estimate abundance of this non-schooling species and do not cover the entire geographic range of the population. In 1998 a longline survey for Atlantic halibut was implemented. The survey is collaboration between Canada's Department of Fisheries and Oceans (DFO) and the community of expert halibut fishermen (15-20 vessels) that exploit this species on the Scotian Shelf and Southern Grand Banks. A self-funding, long-term (10 year plus), two-stage design consisting of stratified random and commercial index phases was adopted. The stratified random phase provides unbiased estimates of population abundance while the commercial index phase provides estimates of commercial catch per unit effort. The ongoing survey has already provided a wealth of information on halibut distribution, population size and age structure (n @ 12,000 fish measured), and diet composition. We give an overview of project design and implementation, the manner in which the project has provided fishermen with a voice in the resource management arena, and a summary of the biological results to date.

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ICES CM 2000/W:21

The unintended impacts of gill netting in European waters – quantifying and mitigating the 'ghost fishing' phenomenon.

P. MacMullen

Targeted gill netting is a highly selective fishing method, which has generally low levels of unintended impacts. Capital and energy costs are also low compared to many other fishing methods. Entry to the sector is relatively easy and effort levels are often difficult to monitor and control. High levels of effort and conflict with towed gears can result in high numbers of non-target species being taken and significant amounts of gear being lost. The loss of gear raises questions of quantifying that loss in some way; identifying the range of possible outcomes, their relative impacts and significance; and the means by which unacceptable impacts may be mitigated.

The European Commission has supported two collaborative research programmes. The first was a feasibility study into quantifying loss; the simulation of loss and monitoring the evolution of experimentally deployed nets. The study was restricted to water depths of ~30m. The second, ongoing, study develops the themes of loss simulation and monitoring. It covers fisheries from shallow water wrecks through to those prosecuted on the slope at ~1200m. Shelf fisheries are covered from Norway through to the Algarve and Mediterranean. The current study has also identified the factors which predispose certain fisheries to high levels of loss as well as those which determine the significance of loss – that is the potential for prolonged ghost fishing.

Future work will look at the need for, and cost-effectiveness of, various options for mitigating the impacts of lost nets or minimising loss levels.

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THEME SESSION

on

Fisheries Managers and Scientists (X)

ICES CM 2000/X:01

The precautionary approach: A user's view

S. Brown

Fisheries managers have a strong interest in the development of a scientific consensus on key concepts and definitions under the Precautionary Approach. They have to take informed but politically sensitive decisions on stock sustainability. They also need to communicate to the industry the significance of the precautionary science in forming those decisions. We are concerned that the Precautionary Approach is being developed by fisheries scientists without adequate recognition of the need to be able to communicate its validity to the fishermen. The presentation of the ICES stock assessments within a precautionary framework in 1998 was poorly prepared for the outside world, and in consequence, provoked initial hostility from an industry which has still to be persuaded that the Precautionary Approach is a major advance in ensuring stock sustainability.

Over prescriptive, as well as inconsistent presentation of management options, particularly in relation to F reference points, risks setting scientists and managers in apparent conflict and so reducing the credibility with the industry of the Precautionary Approach, as too does the spurious accuracy (given the deficiencies in the database) of recommendations on marginal annual variations in management options. By comparison, medium term management strategies, as with jointly managed EU-Norway stocks, attract greater acceptance from the industry.

In refining and consolidating the PA framework to provide more consistent definition and usage, managers' needs must be taken into account. Developments, which may be intellectually convincing will not convince the industry unless they are susceptible to accessible explanation and carefully prepared in presentation.

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ICES CM 2000/X:02

Complementing the ICES advisory process with stakeholder input

R. M. Cook

For a variety of reasons, the ICES advisory process delivers much of its advice late in the year shortly before management measures are introduced. For stakeholders and managers, almost no time is available to digest the implications of management advice, which prevents both commercial planning, and well considered management action. It also militates against adequate peer review of assessments. This is particularly true for North Sea assessments which are conducted in October, shortly before ACFM meets and the EU and Norway meet to negotiate TACs for the up-coming year. In a recent initiative, the North Sea Commission has sponsored a series of meetings between scientists and the fishing industry which will attempt to perform assessments earlier in the year and provide an opportunity for fishermen to have an input into the assessment process. It will also offer a means of taking a more strategic view of the management of fisheries. It is intended that this process should complement the ICES process by completing preliminary assessment work early in the year, thus reducing the work load for the ICES assessment working group and providing additional information from non-traditional sources which may assist ACFM in its review and advisory role.

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ICES CM 2000/X:03

Fisherman and scientists: collaboration as the basis for stock recovery

B. Deas

In most European fisheries, the past 20 years demonstrates an almost inverse relationship between the weight and complexity of fisheries legislation and the success of this regulatory framework in halting the depletion of commercial fish stocks.

This paradox represents a major challenge to fisheries management and fisheries science. If ICES is to do more than simply chart the decline of fish stocks, management measures must become effective and to do this the artificial divisions between fisheries scientists, fisheries managers and fishermen, will have to be dissolved.

This paper argues that the absence of meaningful involvement of the fishing industry in the development and application of stock recovery measures has effectively undermined the conservation strategies,

which have been implemented under the Common Fisheries Policy. Stock recovery programmes are likely to continue to be unsuccessful unless this weakness is addressed.

Whilst it is recognised that ICES must maintain the highest standards of independence and scientific credibility, it must also become more relevant by directly addressing the concerns of the fishing industry. Ways of incorporating and using knowledge on fish stocks held by fishermen must be found, along with stock assessment timetables which accommodate the views of the fishing industry; ways of thinking more compatible with an adaptable, responsive, fisheries regime that encourages its legitimacy in the eyes of those subject to it, must be developed.

Overcoming the false dichotomy that separates fisheries scientists and fishermen is a precondition for stock recovery. This paper discusses ways in which this could be achieved.

Keywords: involvement, legitimacy, precondition.

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ICES CM 2000/X:04

Multi-annual strategies: improving stock management and the dialogue between scientists and managers

F. Gauthiez

Recent ACFM recommendations have led to considerable debate between managers and scientists. The dramatic decreases in TAC, which were recommended in some cases, were especially problematic. They were interpreted by managers as a lack of realism of the precautionary approach, since a larger range of alternative proposals was not considered.

This paper examines in a first part some reasons for the negative perception of ACFM advice. First, the definition of reference points is often ambiguous and unclear. Second, the use of fishing mortality as a unique control variable is not always well understood. Third, the proposed scenarios do not consider progressive and step-by-step approaches to problems.

It is suggested in a second part that multi-annual management strategies should improve substantially the form of advice and its applicability; they should therefore improve the dialogue between ACFM and managers. To some extent, these strategies could allow to clarify the point of the compatibility between the precautionary approach constraints and the socio-economic constraints, especially the stability of yields. Some examples are considered, and a format of advice table is proposed.

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CM 2000/X:05

Regime Shifts and Fisheries Management

Joe Horwood

Fisheries are subject to major changes of state driven by ocean-atmosphere interactions. In the North Pacific, ecological changes are associated with the relative strength and position of the Aleutian low pressure system. These have driven changes in fisheries, including increases in sardine catches of 10 million tonnes off Japan and Peru. In the North Atlantic, fluctuations in the relative strength of the high pressure systems off the Azores and at Greenland have major effects on the Atlantic ecology and fisheries. Cod and haddock at Greenland need a negative NAO index. The gadoid outburst in the North Sea was associated with high recruitments during periods of negative NAO index.

Such ocean-atmosphere changes are quasi-periodic, and operate over time and space scales that cannot be neglected by fisheries scientists and managers. They impact upon the quality of assessments, and upon fisheries reference and management points. The fact that it may take several years to recognise a change of state is of key importance. The international development of advice for fisheries management, in a precautionary context, needs to acknowledge and incorporate such important events.

The ICES approach to providing precautionary reference and advice is in its infancy, and may well develop and change significantly to incorporate natural and anthropogenic changes. As ICES develops its approach it must take with it all its key stakeholders.

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ICES CM 2000/X:06

Analysis of communication over and understanding of the 'precautionary approach'

M. Pastoors, P. Bailey, and K. Hiis-Hauge

The precautionary approach to fisheries has been implemented into the European fisheries management over the last two or three years. We analyse the process of implementation and focus on the communication on the contents of the precautionary approach between different actor groups during that process. The theoretical background employed in the analysis is based on the notion of discourse coalitions, i.e. relatively loose coalitions of actors that unite is a seemingly similar interpretation of key concepts. It is shown from the analysis that the closure reached in the implementation of the precautionary approach in fisheries management is based on a very loose understanding of both the concepts 'precautionary', 'approach' (instead of e.g. principle) and 'reference point'. Also there appears to be substantial area for manoeuvring during and after implementation of the policy measures. It is concluded that the notion of discourse coalitions provides a suitable concept to describe the interactions between different actor-groups. The final conclusion is that it is not very likely that communication between researchers, managers, fishermen, conservationists and the general public will unite on a single interpretation of the concepts analysed in this paper. In a sense the concepts are devised to allow for multiple interpretations (otherwise no closure would occur) and therefore they will keep multiple interpretations. However, it is argued that awareness of the constraining characteristics of the current discourse on the precautionary approach could help in the design of new ways of communication between the different actors involved.

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ICES CM 2000/X:07

Developing a wild salmon policy for Pacific Canada

L.J. Richards

In March 2000, Fisheries and Oceans Canada released a discussion paper entitled 'Wild Salmon Policy'. The Wild Salmon Policy is one of a series of papers that specify operational policies and guidelines for managing Pacific salmon within Canada. Other papers in the series address fishing sector allocations and selective fishing practices. The wild salmon policy is a science-based document that identifies the need to conserve the genetic diversity of wild Pacific salmon and to protect their habitat. The policy specifies a management system based on six principles that include the concept of limit and target reference points. With the release of the policy in March, Fisheries and Oceans Canada committed to a six-month period of extensive stakeholder consultations. The consultations will allow discussion of the principles and sharing of information on the impacts of the proposed policy on fisheries management practices. I discuss some of the scientific issues associated with development of the policy, the debates between scientists and fishery managers on the definition of reference points, and preliminary outcomes from stakeholder consultations. These issues are similar to those raised for other species in other jurisdictions.

The draft policy and background information is available from www-comm.pac.dfo-mpo.gc.ca/wsp-sep-consult/Laura J. Richards.

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ICES CM 2000/X:08

A review of the process leading to the establishment of limit and precautionary reference points for the stock of Norwegian spring-spawning herring

I. Røttingen

The present paper reviews the process within the Regional Coastal State Management Organisation that in October 1999 led to an agreement on a long time strategy for Norwegian spring-spawning herring. Limit and precautionary reference points are fundamental parts of this long time management strategy. Emphasis is put on the interaction between the advice on the management of the stock (including estimated values of the reference points) put forward by ICES, and the response from the management organisation.

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ICES CM 2000/X:09

Stock assessment bias and variation, analysed retrospectively from ICES quality control sheets, and introducing the PA-residual

S.T. Jónsson and E. Hjörleifsson

After each assessment at ICES, stock summary parameters reference fishing mortality, based on an average for an age range, recruitment and spawning stock biomass (SSB) are filled into a quality control sheet (QCS). The data have been collected for the

assessments 1989–1999 for more than 60 stocks. Contemporary estimates of reference fishing mortality (F) and year class strength as numbers in the recruiting age group (R) in the final year of the assessment, SSB at the start of the assessment year (B1), SSB projected to the end of the assessment year (B2) and SSB projected one year further ahead (B3) from the QCSs were analysed retrospectively by comparing them to current estimates of the same parameters. Recruitment estimation is both least precise and accurate and we tend to overestimate R. Fishing mortality estimation was least biased and variable. SSB was on average overestimated by approx. 3–5\%, variability increases from B1 to B3, and B2 tends to overestimate SSB more than B3. The residuals of contemporary to current estimates of F and B2 were compared to the margin between limit and target reference points as proposed by the ACFM SGPAFM. A substantial number of assessments were further off the mark than the difference between limit and target reference points, 20% of SSB estimates at the end of the assessment year and 12% of fishing mortality estimates.

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THEME SESSION

on

Downturn in North Atlantic Salmon Abundance (Y)

ICES CM 2000/Y:01

ENSO- and regime-scale variation in the biogeography of Gulf of Alaska micronekton as a driving mechanism for observed growth trends in Pacific salmon

K. Aydin

The adult body weights in many Pacific salmon stocks (*Oncorhynchus* spp.) are negatively correlated with sea surface temperature in the northeastern Pacific Ocean. The mechanisms behind the correlation may be due to; (1) a physiological response of salmon to warming surface waters; or (2) shifts in the abundance or composition of prey species. Determining the relative importance of each mechanism is critical to predicting the effect of climate change on salmon populations. In this study, I summarise empirical studies of oceanographic conditions, salmon food habits, and salmon growth in the Gulf of Alaska during the 1950s, 1980s, and 1990s. I use bioenergetics models to determine the variation in the factors determining salmon growth. In particular, I show a relationship between surface oceanographic boundaries determined from CTD data, the southern limit of salmon distribution, and the northern limit of a micronektonic squid species (*Berryteuthis anonychus*), a dominant salmon prey item in the region. I use the area of species overlap to define a zone of "highest salmon growth," the size of which varies on both ENSO and decadal time scales. I calculate the area of squid/salmon overlap from oceanographic data for the years 1950-1998, and show that variation in this overlap explains much of the negative correlation between sea surface temperature and adult salmon body weight. This suggests that biogeographic variation in food web structure, with micronektonic squid as a keystone species, is a mechanism that contributes to the interannual variation in salmon growth in the northeastern Pacific.

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ICES CM 2000/ Y:03

The status of Icelandic salmon resources

Árni Ísaksson

The Atlantic salmon is of great economic value in Iceland, especially with respect to angling. The fishing rights in rivers and lakes are privately owned and go with the adjoining land. The river owners are obliged to form an association, which takes all major decisions on fisheries and enhancement.

Although net fishing was important, the angling share has been increasing and has recently been close to 85 % of the harvest. The Icelandic angling statistics are very accurate and among the best in the world. Although total catches and returns to freshwater have decreased in recent years, especially in the two-sea-winter component, one can say that the Icelandic salmon stocks are in reasonable state. Effects of pollution on salmon rivers have been minimal and acid rain has not been a problem, probably due to the nature of the bedrock, the climate and a great distance to major industrial continents.

The establishment of Kollafjörður Fish Farm in the 1960s, which conducted salmon cultural and ranching activity, and the prohibition of salmon harvest in the sea was the impetus for experimental private ranching in Iceland in the 1980s. At the present time private ranching of Atlantic salmon is not profitable and all ranching stations in Iceland have closed down. Enhancement of rivers with fry and smolts, however, using indigenous stock is common. Successful enhancement with smolts for angling purposes has been applied in the Rangá river, which does not produce salmon naturally.

The increase in salmon farming and ranching has been of concern. Some fear that straying of reared and ranched fish into rivers may be detrimental to the wild stocks. Enhancement and ranching programs have yielded a great deal of practical information on the straying of ranched salmon into rivers and between ranching stations as well as the straying of wild fish into ranching stations and between rivers.

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ICES CM 2000/Y:04

Rod catches as indicators of abundance in the Scottish salmon fisheries

A.F. Youngson, R.J. Fryer, and J.C. MacLean

Over the last decade marked downturns have occurred in some components of Scottish coastal and river fisheries. In recent years, parr production and smolt recruitment have declined in some streams that

previously proved robust to variation in the abundance of spawners. All these changes have renewed pressure for the development of an accurate and sensitive assessment system for use in the management of the Scottish fisheries. This process is constrained because the fisheries are complex and because the populations driving them are heterogeneous - both within and among catchments. In particular, sub-catchment populations within the major rivers vary markedly, and with some independence, in the contributions they make to the fisheries on both temporal and spatial scales. A new approach has been devised towards developing a formal assessment system based on rod catch data, and targeted near the population level. It is based on the catch records that are compiled for each month of the Scottish fishery (February–October) and for all its separate elements. Recording is on fine geographical (ca. < 10 km) and temporal (monthly) scales, and the recording system has been in place since 1952. It is intended that the new assessment system should provide a key to examining the causes of underlying changes in salmon abundance. Coupled with a radical reappraisal of management options, it is intended that the new system should also allow targeting of management action to best effect.

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ICES CM 2000/Y:05 (Poster)

Microsatellite variation and estimation of genetic relateness in Atlantic salmon

G. Blanco, Y. Borrell, E. Vázquez, and J.S. Sánchez

The human intervention (contamination, destruction of habitats, over fishing, changes in the marine ecosystems, etc.) and the climatic change, they are the reasons more frequently used to explain the degradation of the salmon populations in the North Atlantic. The situation is even more serious in the south end of the distribution where the salmon has disappeared of many rivers and the remaining ones there is a constant decrease of the populational number accompanied by changes in the structure of ages when being disappearing the MSW. A laboratory experiment is presented that studies the possibility to use the polymorphism of the loci microsatellites to determine the genetic relatness between individuals and the possibility of their parentage assignment. The last application of the results would be about asses precisely the genetic relatness between broodstock the, of unknown pedigree, of wild populations of Asturian rivers to value if the inbreeding level that exists at the present time is an important cause in the explanation of the deterioration of these populations, and to design future performances

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ICES CM 2000/Y:06 (Poster)

The application of genetic variation at microsatellite loci in Atlantic salmon (*Salmo salar*) stock identification

J.A. Sanchez, M.D. Ramos, H. Pineda, Y. Borrel, E. Vázquez, and G. Blanco

During the last decades, habitat modification and over-fishing have contributed to the decline and extinction of a great number of Atlantic salmon (*Salmo salar*) natural populations. In addition, natural populations are being altered as the results of interaction and interbreeding with farmed escapees or non-native fish planted into rivers for the purpose of stock enhancement. In this context the knowledge of genetic diversity and stock structure is a prerequisite for the successful management of this species and to provide guidelines for optimising its population enhancement and conserving its genetic resources. The low levels of genetic variation at protein-coding loci have limited their usefulness in Atlantic salmon management programmes. This study investigates the patterns of genetic diversity of five microsatellite loci in order to assess their efficiency for distinguishing salmon stocks using eight natural populations (six European and two North American) and four hatchery stocks (three Norwegian and one of Canadian origin). A clear discrimination between North American and European fish based on unique alleles can be made. For samples of the same continent, the assignment efficiency is lower but there was a significant tendency for the incorrectly classified fish to be assigned to the nearest geographical populations.

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ICES CM 2000/Y:07

Summary of the ICES Working Group on North Atlantic Salmon

N. Ó Maoiléidigh

The ICES Working Group on North Atlantic Salmon reported to ICES and NASCO in 2000. This paper summarises results of the Working Group report.

Run-reconstruction estimates of pre-fishery abundance of non-maturing 1SW salmon from southern areas of the North-East Atlantic have been volatile for the period 1971 to 1998. Three distinct periods are noted leading to an overall decline in the past 14 years. In 1996–1998, it was estimated that even in the absence of all fisheries, the numbers of non-maturing recruits for the southern area were below the proposed spawning escapement reserve (SER). Non-maturing 1SW salmon from the northern stocks of the North-East Atlantic have declined since 1985, particularly in 1986–1987. The recovery of stocks indicated in 1988 did not continue in 1999. Measures of adult returns back to monitored rivers within the NEAC area showed declines in returns for 50% of the rivers. Analysis of attainment of conservation limits (CL) indicated variable status of salmon stocks in different rivers in the NEAC area. Some rivers have never or seldom achieved their CL over the past 10 years, while others have been consistently below their CL. Many rivers, which have reached their CL in most years, show a decreasing trend in escapement. It was also noted that there was no tendency to recover for those rivers with low escapement values.

For stocks originating in North America, the run-reconstruction estimate of pre-fishery abundance of non-maturing 1SW salmon for 1998 was 20% higher than in 1997, with these estimates being the lowest on record. I addition to the steady decline in non-maturing and maturing salmon over the last 10 years, maturing 1SW salmon (grilse) have become an increasingly large percentage of the North American stock complex. This percentage has risen from about 45% at the beginning of the 1970s to between 65 and 84% in the last 5 years. Returns to the important Gulf, Quebec and Scotia-Fundy production areas were either the lowest or second lowest of the 29 year time series for 1971 to 1999. The estimated returns and spawners to USA rivers in 1999 were 23% below the 1998 estimate and 32% and 52% below the 5-year and 10-year means respectively. Egg depositions were exceeded or equaled in only 37 of the 67 assessed rivers in Canada and were less than 50% of requirements in 15 other rivers. North American stocks remain low relative to the 1970s. The 1SW non-maturing component continues to be low with river returns and total production being the lowest recorded. In addition, returns in 1999 of maturing 1SW salmon (grilse) to North American rivers were very low. It is unlikely therefore that any improvement in 2SW salmon returns will occur in 2000.

The implications of these results are discussed in relation to quota setting and national management strategies in all Atlantic salmon producing countries.

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ICES CM 2000/Y:08

Recent developments in salmon conservation through international cooperation in NASCO

M. Windsor and P. Hutchinson

The North Atlantic Salmon Conservation Organization (NASCO) is the international treaty organization charged with fostering international cooperation on the conservation, restoration, enhancement and rational management of wild salmon stocks in the North Atlantic Ocean. The paper will summarise progress in developing the scientific questions that NASCO requires to carry out its work. The increased catch restrictions, including quotas for Greenland and the Faroe Islands, buy-outs by Canada and others, and the increased use of catch and release and other conservation measures, are summarised. NASCO is increasingly concerned about the impacts of aquaculture, genetic, disease, parasites and environmental aspects, and progress on these issues will be summarised. The increasing adoption of a Precautionary Approach by NASCO will be outlined.

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THEME SESSION

on

Spatial and Temporal Patterns in Recruitment Processes (Z)

ICES CM 2000/Z:01

Squid interspecific competition: possible impact of *Illex argentinus* on to *Loligo gahi* recruitment in the Southwest Atlantic

A. Arkhipkin and David Middleton

The catches of two abundant Southwest Atlantic squid, *Illex argentinus* (Ommastrephidae) and *Loligo gahi* (Loliginidae) in Falkland waters between 1990 and 2000 were analysed. Despite reasonably similar fishing effort due to the regulation of the fisheries, the total catches of both squid varied considerably from year to year. Usually, the areas of squid concentrations are separated, with *I. argentinus* being the most abundant to the northwest in February–May, and *L. gahi* to the southeast of the Islands in February–May (first cohort) and August–October (second cohort). However, in some years *I. argentinus* do intrude in great numbers into the 'Loligo area' in April–May, possibly affecting either directly or indirectly the abundance and recruitment of the *L. gahi* second cohort. Correlation analysis of the catches from the same year showed that catches of *I. argentinus* in the first half of the season (Februar–March) and catches of the first cohort of *L. gahi* (February–May) did not correlate ($r = 0$), whereas catches of *I. argentinus* in the second half of the season (April–May) and catches of the second cohort of *L. gahi* (August–October) are negatively correlated ($r = -0.614$, $P < 0.1$). Possible reasons of such a negative correlation in abundance of both squid species and their implications to the fishery management are discussed.

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ICES CM 2000/Z:02

Temperature and growth rate effect on the otolith size-fish size relationship estimated for Baltic herring from the Vistula Lagoon

D.P. Frey

The daily growth increments of otoliths were used to estimate the age of larval and juvenile spring-spawned herring (*Clupea harengus* L.) collected between April and June 1999 in the Polish part of the Vistula Lagoon (Baltic Sea). The hatching and spawning time were back calculated from otoliths and the results were related to temperature conditions. Two cohorts of herring larvae were distinguished. The growth of 12–38 mm (SL) herring was linear and the rate was 0.56 mm d-1 for the first cohort and 0.68 mm d-1 for the second one. There was positive relationship between growth rate of herring and mean water temperature for larvae and juveniles larger than 24 mm. Smaller larvae were growing with the same rate despite evident differences in temperature experienced by larvae from the first and second cohort. Differences in growth rate between cohorts were not related to feeding conditions, which during analysed period (April–May) were very favourable. The relationship between otolith size (perimeter, length, width, area) and fish size (SL) was calculated with regard to the assumption of proportionality between the otolith and somatic growth of a given specimen. The results indicate that slower growing individuals from the first cohort had relatively smaller otoliths than faster growing ones from the second cohort, what is against so called uncoupling theory. Analysis of the marginal increment widths shows that differences in otolith size-fish size relationship among cohorts were related to differences in metabolic rate caused by temperature fluctuations. Larvae, which experienced higher temperatures, had larger otoliths.

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ICES CM 2000/Z:03

Some environmental factors that influence the growth of Arcto-Norwegian cod from the early juvenile to the adult stage

K. Helle, B. Bogstad, G. Ottersen, and M. Pennington

Previous studies show a positive and significant correlation between abundance and the average length of the 0-group Arcto-Norwegian cod in the Barents Sea. The average length at the 0-group stage has also shown to be positively correlated with the abundance as three yeas old. In contrast, there is a significant negative correlation between average length at the 0-group stage and average length at later stages (>1 year old). No correlation was detected between the average 0-group length and average length at age 1. From age 2 to age 8 a significant negative correlation was found with the strongest negative correlation between the average length at the 0-group and the average length at age 5 and 6. These results indicate that in addition to be a predictor of future year class strength, average length of the 0-group also can be used to predict the future average length.

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ICES CM 2000/Z:05

Eelpout abundance as an index of changes in the fish community of Gdansk Bay in 1985–1999

I. P.-Lipska

Demersal fish assemblages within the Gdansk Bay were classified on the basis of surveys effected from 1985 to 1999. Since 1985 the number of eelpout caught per 1-hour trawl increased from 0,3 to 373 kg. per research station.

Also the fish showed an extension in distribution within the area. This facts may be explained by the changes occurred in the last decade in the environment. First - heavily exploited flounder stocks - the main competitor for eelpout. Second - an improvement in the water quality in the Gdansk Bay due to protective procedure.

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ICES CM 2000/Z:06

Parasites and pigmented patches as indicators of intraspecific structure of *Sebastes mentella* in the Irminger Sea

Yu.I. Bakay

The paper gives results from studies on parasite fauna of *Sebastes mentella* obtained during different years, as well as occurrence of pigmented patches on skin and in muscular tissue of fish caught at different depths in pelagial of the Irminger Sea. A conclusion has been drawn of inexpediency of using minor differences in occurrence of fish with pigmented patches as a criterion for intraspecific differentiation of *S. mentella*. Absolute similarity of parasite fauna composition, equal rate of infestation by parasites of most species, similar peculiarities of infestation by *Sphyrion lumpi* and pigmented patches, indicate the common conditions of redfish habitation during a period foregoing the studies and, thus, give evidence in favour of the same origin and integrity of *S. mentella* stock, of the upper (0–500 m) and lower (500–1000 m) layers of its dwelling in the Irminger Sea.

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ICES CM 2000/Z:07

The impact of fishing disturbance on benthic nutrient regeneration and flux rate

P. Percival and C. Frid

Nitrogen products are often thought to be a major limiting factor for photosynthesis by marine primary producers, ultimately, therefore, fisheries yield is dependent on the amounts of new and regenerated nutrients within the system. It is generally held that greater than 90% of marine primary production is remineralised within the marine system. However, the contribution to this figure from sedimentary processes is less well understood. Little attention has been paid to the potential change in nutrient regeneration dynamics and flux rates as a result of fishing disturbance of the seafloor. Flux rates are highly dependent on the oxidative state of the sediment, its particle size and organic content. Physical disruption by towed bottom gears perturbs the oxidation state of the sediments. The depth of swathe cut into the sediment by trawling varies depending on the fishing gear used and sediment type. This study derives estimates of benthic remineralisation and nutrient flux including consideration of the role of benthic disturbance by fishing vessels. Results suggest that this area warrants further investigation. For example, estimates based on current data indicate that within the ICES statistical sub-rectangle 39E8 benthic flux rates, based on a two hour chemical recovery following trawl disturbance, increase by 1.3% for nitrate + nitrite and 5.6% for ammonia.

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ICES CM 2000/Z:09 (Poster)

Tagging experiments on hake, anglerfish and other species in the Bay of Biscay

Paulino Lucio, Marina Santurtún and Iñaki Quincoces

During autumn of 1998 and spring and autumn of 1999, several tagging experiments were carried out on board of the Basque commercial fleet in the Bay of Biscay (ICES Divisions VIIIb and c). Different species were targeted: mainly Hake (*Merluccius merluccius*) and Anglerfish (White Anglerfish, *Lophius piscatorius*, and Black Anglerfish, *L. budegassa*) but also Horse mackerel and Mackerel.

After studying all different modalities of fishing gears, longliners working in rather shallow waters (< 80 meters) resulted the most suitable for tagging Hake and Horse mackerel. Although all kind of nets operating in shallow and deeper water (72-720 meters) are able to caught Anglerfish subjected to be tagged, bottom trawling resulted in the best gear to get Anglerfish in rather high numbers.

Fish were marked externally with "spaghetti-tags" and internally by means of an injection of tetracycline.

A total number of 152 Hake (22-70 cm of total length) were tagged. Also, 213 Black Anglerfish (27-79 cm), 115 White Anglerfish (20-82 cm), 106 Atlantic Horse mackerel (*T. trachurus*), 5 Mediterranean Horse mackerel (T. mediterraneus), 8 Blue Horse mackerel (*T. picturatus*), 8 Mackerel (*S. scombrus*) and 8 Chub Mackerel (*S. japonicus*) were marked in the same way.

To date, 2 Hake, 2 White Anglerfish 2 Black Anglerfish and 1 Atlantic Horse mackerel have been recaptured.

Key words: Anglerfish, Bay of Biscay, Hake, Horse mackerel, Mackerel, recapture, tag, tetracycline.

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Tagging experiments on horse mackerel in captivity. (An experiment of survival of these species tagged with external and internal tags).

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During January of 2000 a tagging experiment of captive Horse mackerel (*Trachurus trachurus*, L. 1758) was carried out in the Aquarium facilities held in San Sebastian-Donostia (Basque Country, Spain). Twenty-five Horse mackerel caught by hand and line in the border of ICES Divisions VIIIb and c were kept several months in an exhibition tank at the Aquarium. Fish, ranged from 15-35 cm of total length, were marked externally by "spaguetti-tags" and internally by means of tetracycline injections and were kept tagged during more than a month.

The objective of the experiment was to study the rate of survival of these species at the time of tagging and in the next days, and also to examine the deposition of tetracycline in the fish hard structures (otoliths, vertebrae and scales). At the end of the experiment 16 individuals survived. Three fish were sacrificed to examine the deposition of tetracycline and the rest of them were released into the open sea.

Data on survival rates are presented as well as photographies of Horse mackerel otoliths, taken by means of a binocular microscope provided with epifluorescence.

Key words: Aquarium, Horse mackerel, tag, tetracycline, recapture, survival rate.

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Oocyte diameter evolution along the year and batch fecundity of hake in the Bay of Biscay (ICES Divisions VIIIa, b, d).

Hilario Murua, Marina Santurtún, Iñaki Quincoces, and Paulino Lucio.

A monthly study of the changing diameter of Hake (*Merluccius merluccius*, L. 1758) oocytes from the Bay of Biscay (ICES Divisions VIIIa,b,d) was carried out. Two different length strata were chosen for each month: females of 45-50 cm of total length (presumably, first time spawners) and females =50 cm. For each stratum in each month of the study period (1996-1998), 1-5 females were studied. Two sub-samples from the gonad medium part were taken.

Separated oocytes were observed under a profile projector provided of a digital measuring system. For each sub-sample, 200 oocyte diameters were measured. Overall, 41 fish and 80 sub-samples were examined.

A total of 175 hydrated gonads of 43-79 cm length Hake were analysed for batch fecundity from the first semester. Three sub-samples, 0.5-1.0 g, of each gonad right lobule were examined by counting the hydrated oocytes in them.

The figures sequence on the evolution of the oocyte diameter increment along the year follow this pattern: higher frequencies of large oocytes appear from January to June (when the spawning occurs) in larger fish, whereas a very high proportion of small oocytes for the same period was observed for fish of 45-50 cm length. Along the year variable quantities of small oocytes are always detected. Batch fecundity results related to Hake weight and length are also presented.

Key words: Batch fecundity, Bay of Biscay, Hake, Oocyte diameter, *Merluccius merluccius.*

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ICES CM 2000/Z:12 (Poster)

Histological study of the gonadal development of armed gurnard, *Peristedion cataprhactum* (L. 1758)

A. Terrats and G. Petrakis

Armed gurnard (*Peristedion cataphractum* L. 1758) is a Peristediidae fish distributed in the Mediterranean and the Atlantic from Bay of Biscay to south of Morocco at depths ranging from 30–700m. This species is very abundant in the Ionian Sea, and while it is of no commercial value it constitutes a key factor for the ecosystem. In this work some results of a histological study on reproduction and recruitment process of armed gurnard are presented. The material was collected in the framework of the 'Deep water fisheries' project financed by the EU (FAIR: 95-0655) during twelve monthly sampling cruises (December 1996–November 1997) at depths between 300–750m in the Ionian Sea. At the end of the study, a total of 109 histological samples of male and 136 samples of female-armed gurnard were prepared, examined and described. A total of 5 gonad development stages for both females and males were considered: 1) immature or virgin, 2) in maturation or resting, 3) mature, 4) pre-spawning and spawning, and 5) post-spawning. The different development stages for the oocytes (oogonia, chromatin nucleolus stage, perinucleolus stage, vitellogenesis, nuclear migration and hydration), and of the spermatozoa (spermatocytes, spermatids and spermatozoa) have been also described. The results of the histological analysis showed a very expanded spawning period for armed gurnard in the Ionian Sea that lasts from May to September. As a consequence of the long duration of this period is an elongated recruitment process which lasts from July to December.

Keywords: armed gurnard, histology, maturity, *Peristedion cataphractum*, recruitment, reproductive cycle.

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ICES CM 2000/Z:13 (Poster)

Pigment transfer from phytoplankton to copepods in nutrient-enriched mesocosms

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We study how microalgal pigments are transferred to pelagic copepods, and their role as precursors for astaxanthin, the red pigment in e.g. crustaceans and salmon. In summer 1999 we performed two mesocosm experiments at the Norwegian coast, using enclosures of 2 m^3. One of the experiments was situated in the Trondheim Fjord (salinity 27 psu), the other in an inlet of the open ocean at Hopavågen (salinity 35 psu). The experiments lasted 8 days and 11 days, respectively.

By adding a surplus of nitrogen and phosphorous (N-P treatment) in natural seawater, we created a flagellate bloom (chromophytes and dinoflagellates). When also extra silicate was added (N-P-Si treatment), diatoms dominated the phytoplankton. When an algal bloom (defined as Chl a content >20 mg m-3) was established after 5 days, we added copepods. Pigment analyses of algae and copepods were made by HPLC (High Performance Liquid Chromatography). Major and taxonomically significant pigments of algal classes were found. The pattern we discovered in the two experiments was similar. Fucoxanthin, peridinin and diadinoxanthin (more than 10% and in order of importance) were the major pigments in the N-P treatment, fucoxanthin and diadinoxanthin in the N-P-Si treatment. The carotenoids in the copepods have not yet been analysed. This experiment was carried out within a larger project dealing with a reproductive disease in the Baltic salmon (M74 syndrome), funded by the Knut and Alice Wallenberg Foundation and the Norsk Hydro Research Foundation.

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