

**MINUTES OF THE  
ADVISORY COMMITTEE ON ECOSYSTEMS**

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International Council for the Exploration of the Sea  

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## **1 OPENING OF THE MEETING**

The Chair, H.R. Skjoldal, opened the meeting at 9.30 hrs and welcomed the members to the first meeting of ACE. The General Secretary then welcomed the participants and noted that this new Committee responds to the needs of the Commissions that ICES works with providing marine scientific advice, as well as the needs of ICES Member Countries. He noted that ACE is seen by some as a Committee that should develop new ideas on the ecosystem approach, while others feel that the ICES Working Group machinery should be used for this purpose. He encouraged ACE to stimulate new approaches, but to utilize the system to develop these ideas in greater detail.

The General Secretary pointed out that the European Commission requested and has been granted observership on ACE as it has on ACFM. There is one question, concerning by-catches of small cetaceans in fisheries, from the EC that will be considered at this meeting. Although this observership in ACE is not part of the Memorandum of Understanding between ICES and the EC, this will be taken up when this MoU is next up for renegotiation.

The Chair noted that there are expectations concerning the work of this Committee, both within ICES and in the broader community. He noted that all ICES Member Countries are represented on ACE, along with the Chairs of four Science Committees and, at this meeting, the Chairs of two Working Groups. The participants then introduced themselves, indicating their areas of scientific work. The list of participants is attached as Annex 1.

As this was the first meeting of ACE and many of the members had not previously been associated with an ICES Advisory Committee, the General Secretary pointed out the duties of the national experts on Advisory Committees. Members are appointed to the Committee by their national Delegates and confirmed by Council. By their appointment, members are required to take on certain tasks and to use their particular expertise to review the material and join in the overall discussion to ensure that the best advice is prepared. The Chair may assign tasks to individual members, but all members should join in on the evaluation and development of the material produced. There is no voting on decisions, but conclusions and recommendations are reached by consensus, based on the discussion and arguments presented. The people receiving advice from ICES, whether Member Country or regulatory Commission, request this advice because it is independent. Although the members are nationally nominated, each member has been appointed by the President of ICES and is acting in an individual capacity. Thus, the advice should be objective and independent, and not "coloured" by national considerations. He also pointed out that ACE has been authorized to speak on behalf of ICES, without review or approval by any other ICES bodies.

The Chair pointed out that the establishment of ACE was the outcome of discussions within ICES over several years. Various potential types of committees had been proposed, but ACE was the ultimate outcome. As stated in C.Res. 2000/4DEL01, ACE will have the primary responsibility for scientific information and advice on the status and outlook for marine ecosystems, and on exploitation of living marine resources in an ecosystem context. ACE will provide response to requests for advice from the Commissions, other regulatory agencies, and Member Countries.

The Chair noted that the role of ACE must be seen in the context of the roles of the two other Advisory Committees, ACFM and ACME, and he warned against ACE becoming a wedge rather than a bridge between these two Advisory Committees. He was pleased that there are some members from ACFM and also from ACME on ACE, so that the views of these other committees may be taken into consideration in the work of ACE.

He pointed out that the work of ACE will be based on the work of expert working groups, but the present structure of ICES working groups has not been designed to cover ecosystem issues and he would like ACE to begin consideration of changes to the Working Group structure to take these issues better into account.

In the work of ACE, the Chair stated that the usual scientific standards should be used, with logical debates and the use of references to support statements.

The Environment Adviser provided information on various practical items, including facilities available and the computer network system.

## **2 ADOPTION OF THE AGENDA AND SCHEDULE OF THE MEETING; DESCRIPTION OF PROCEDURES**

The Chair reviewed the agenda and noted that the inventory from the Consultative Committee, prepared at its September 2001 meeting, will be covered under agenda item 4.2 and there will be a new item 8.3 on data management for integrated assessments.

The Chair stated that the timetable would be amended to begin the consideration of item 8 on Tuesday morning, instead of on Wednesday morning. This will then permit the final discussion of item 7 on Wednesday morning and work on finalizing the draft report could begin on Wednesday late afternoon.

M. Tasker pointed out the problem of having sub-groups for items 5 and 7 concurrently because there are several people on both groups.

F. Colijn stated that he has brought a paper on Ecological Quality Objectives on eutrophication issues that he would like ACE to consider if there is adequate time.

O. Misund stated that the Working Groups under the Fishing Technology Committee have discussed gear issues in relation to cetacean by-catches and he would like this material to be considered under agenda item 7.

S. Jennings asked whether there were any requests associated with items 4, 8, 10 or 11. S. Jennings stated that presumably more emphasis and priority should be given to the items that have been requested by a Commission. The Chair responded that this is part of the overall terms of reference for ACE, as he read out earlier in the meeting. He stated that ACE should provide a stimulus for this work, but that priority will certainly be given to work on the requests.

With these comments, the agenda was adopted. It is attached as Annex 2.

### **3 CHECKLIST OF REQUESTS FROM REGULATORY COMMISSIONS**

The Environment Adviser provided some background for the requests that ACE was to handle:

#### *1. OSPAR Commission*

OSPAR had made a request concerning EcoQOS for marine mammals and seabirds in the North Sea (see Agenda items 5.2 and 5.3 respectively)

#### *2. Fifth North Sea Conference*

There was a request concerning a fisheries paper titled, "The Status of Fisheries" (see Agenda item 6)

#### *3. European Commission*

This request concerned by-catch of small cetaceans (see Agenda item 7).

K. Patterson, the Observer from the EC, emphasized the essential elements of advice:

- a) The advice should provide information on an assessment of the present situation;
- b) The advice should be clear as to what should be done by managers;
- c) Detailed scientific support should be provided for the advice given;
- d) A practical basis should be provided for why the advice given should be followed: what are the consequences if this advice is not followed;
- e) What are the options and the consequences associated with these options?

### **4 DEVELOPMENT OF A FRAMEWORK FOR AN ECOSYSTEM APPROACH TO OCEAN MANAGEMENT (CONCEPTUAL AND OPERATIONAL ASPECTS, INCLUDING LINKAGES BETWEEN FISH STOCKS AND THE ENVIRONMENT)**

The Chair provided the background for this item, noting that this topic has been discussed during the past two years by the Study Group on Ecosystem Assessment and Monitoring (SGEAM) and ACME. He noted that there are two traditions in ICES: that on the fisheries side, taking a very quantitative approach to stock assessment and using empirical models to estimate how fish stocks will evolve under certain conditions. On the environmental side, quantitative information is used, but there is little use of models but rather more use of expert opinions in developing assessments of the state of the environment. He encouraged ACE to find ways to merge these two ways of working.

This agenda item can serve as a basis for future work of ACE, providing a general map for how the work of ACE can develop.

#### **4.1 Conceptual Framework**

P. Keizer introduced this item, based on material from SGEAM. There are implications for the structure of the work within ICES, including whether more work should be done on a regional basis, such as is proposed by SGEAM.

It was proposed that ACE discuss the issue of the regional handling of ecosystem assessments, based on regional working groups. A re-organization on a regional basis has major implications for the work load as well as for the contact with management.

It was pointed out that in Canada there are three oceans with regional laboratories and it has been very difficult to have a national perspective on environmental assessments, to provide equal opportunities and protections. This is undoubtedly even more difficult on the scale of the EU. Advice based on a local or regional basis is often based on a rather parochial view and cannot be used on a wider basis, nor is it possible to attain consistency on a broader basis. Caution was expressed on providing advice on a regional basis.

The Chair pointed out that the concept of regional advisory bodies was rejected by ICES, however, the assessment of fish stocks is conducted on a regional basis, reflecting the geographical character of fish stocks. The advice is provided by an overall advisory body, ACFM. For ecosystem assessments, the assessments must be based on regional material, but the advice should also be provided from a broader context. The end purpose of environmental assessments is to evaluate the impact of management actions. However, policy and management actions are associated with value judgements, and the evaluation of the effectiveness of these measures may be coloured by these value judgements. He feels that ICES should extend its role into the provision of scientific assessments on the environment and ecosystems, to give a true scientific basis for further evaluation in a management context.

In the further work on this topic, it was noted that relevant definitions need to be considered and agreed.

#### **4.2 Operational Aspects, including Ecosystem Inventory**

F. Colijn introduced this item, pointing out the need to have ecosystem information obtained in a consistent manner. He doubted, however, whether there was adequate information available on a regional basis to conduct these assessments.

It was proposed that a new system for ecosystem assessment be built on the regional biological assemblages.

However, it was pointed out that by incorporating more aspects into these assessments, greater uncertainty is included in the individual parameters owing to the greater uncertainty in newer parameters added as well as uncertainty in the interrelationships. So even though there may be more realistic estimates, the uncertainty will be considerably greater. This will then affect the perception of the quality of our advice to the customers.

It was noted that this is a key problem in major ecosystem assessments and we should be aware of the difficulties and the limitations in the use of mathematical models as part of our descriptions of ecosystems.

From another aspect, it was noted that most marine industries work on the basis of environmental impact assessments and strategic environmental assessments. Thus, industries other than the fishing industry have been required to develop statements of the impact of these industries on the marine environment, and it should be considered whether the fishing industry should not be required to conduct an environmental impact assessment, also, rather than having government institutes trying to estimate the impact of fishing on the ecosystem.

It was stressed that there is a serious trade-off between the provision of advice on single aspects, e.g., single stocks, with a particular uncertainty, and the provision of broader, more ecosystem-based advice but with a much greater uncertainty. However, the greater the uncertainty, the greater the ability of persons who want to resist the actions required to implement this advice based on the uncertainties.

It was further questioned whether there is a customer for ecosystem advice and whether ICES Member Countries and their relevant institutes are willing to reorganize their structures to provide the basis for this new type of advice.

After discussion, it was agreed that further consideration of the issues under this agenda item would be made in association with the issues under agenda item 8 in a sub-group.

The sub-group prepared a brief document summarizing its consideration of these issues.

In the discussion of this document by ACE, there was a comment that the Regional Ecosystem Groups (REGs) that were recommended in this document must be considered carefully, as the assessments are already being done by existing groups and the REGs will undoubtedly require the same scientists to serve on them. In clarification, it was pointed out that the REGs would not cover fisheries assessments, but would rather conduct periodic environmental

assessments. There are already a large number of meetings, so some strategy should be developed to best utilize the time and effort of the relevant experts.

It was agreed that further thought should go into this document to take into account the needs of the wider ICES community. The Chair stated that ACE will return to this topic at the ACE Consultations Meeting on 24 September 2001.

The Chair stated that he would like to work towards an ICES glossary of terms and would like to agree on some of these terms at this meeting. Many of these terms mean different things to different people and there is a great risk of scientific misunderstandings based on different interpretations of key terms.

The Chair also would like consideration of the broad theories underlying ecosystem advice. He noted that there is a theory underlying ACFM advice and would like a clear explanation of this theory. For future ecosystem work, it would be valuable to agree on a clear concept and theory on which to base future advice.

In addition, there is the question of the use of models and when the use of models will reduce uncertainty or increase uncertainty. There is also the issue of the term "integrated assessment" as well as the term "assessment", which is used in many contexts. This issue needs careful consideration. Another issue concerns "operational fisheries oceanography", with the use of numerical models for ocean physics and other information in the description of the physical habitats for fish and their implications.

ACE then reviewed the document "Conceptual considerations of a scientific framework for ICES ecosystem advice, including an ecosystem approach for the sustainable use and protection of the marine environment".

In the discussion of this document, it was commented that it is important that broader agreement be reached on the main contents of this document, as some of the proposals are far-reaching, particularly the proposed Regional Ecosystem Groups. It was felt that this type of report is very important so that ACE will have a clear framework for its work and will know the direction in which it is going. The intention is that this paper will serve as a basis for further discussion of this topic in ICES.

The comment was made that this document is useful and helpful, but that it needs to be studied carefully by persons who have not been associated with ACME and thus are not familiar with these concepts. It was proposed that this document be considered as a working document for further work. However, a brief summary of these concepts could be included in the ACE report. More time should be given to permit further discussion of the concepts before they can be adopted for use in ACE/ICES.

It was noted that there are two cultures meeting in ACE, the fisheries culture and the environmental culture, and neither is superior to the other. Members were encouraged to familiarize themselves with the background to the culture with which they are not already familiar. ACE is intended to serve as a bridge between these two sides, and this will require some work. One problem is also that there is inadequate integration between fisheries and the environment at the working group level; this is one of the bases for the proposal of Regional Ecosystem Groups that could serve to integrate assessment activities at a basic level.

It was recommended that a sound scientific justification be prepared for any change to the assessment procedures.

On the topic of developing a single, unified foundation for an ecosystem approach, it was pointed out that this is very important. However, there have been a diversity of theories that could serve as a basis for ecosystem advice, and this must be kept in mind. The costs and risks of choosing the wrong theoretical set of constructs should be considered, as well as the aim of choosing something that is better than the present system of developing advice.

It was felt that the document at present does not cover all relevant areas and that it mainly covers ecosystem concepts in fisheries, but does not cover the environmental assessment issues, e.g., understanding contaminants in an ecosystem context.

After discussion, ACE agreed that the first two pages should be prepared for inclusion in the ACE report; this will be circulated via e-mail for final agreement at the ACE Consultations Meeting. The entire document, along with the associated paper from ACME, will be annexed to the minutes of the ACE meeting for further consultation and development. This is contained in Annex 3.



Comments were made on the first figure in the document, particularly with regard to the time scale associated with the various boxes and some missing relationships in the diagram. It was felt that further dialogue is needed before such a diagram can be published.

The EC Observer stated that, to sell a new basis for advice to ICES customers, clear statements should be made to demonstrate the advantages of the new system over the present system of advice.

It was agreed that all members would carefully review the document and send comments for further amendments to Ole Misund and Paul Keizer by 10 September 2001. The section for the report will then be revised and distributed for final consideration at the Consultations Meeting.

## **5 ECOLOGICAL QUALITY OBJECTIVES**

### **5.1 General Consideration of Concept**

The Chair provided the background for this issue, which dates back to the Third North Sea Conference in The Hague in 1990, which requested the North Sea Task Force (a joint group between ICES and the Oslo and Paris Commissions) to consider the ecosystem approach to fisheries and environmental issues. This work was first initiated by a series of workshops, most recently the Workshop on Ecological Quality Objectives in the North Sea in Scheveningen, The Netherlands, in September 1999. Following this Workshop, OSPAR requested ICES to draft EcoQOs on sea mammals and seabirds. These requests were considered by the Working Group on Marine Mammal Population Dynamics and Habitats (WGMMPH) and the Working Group on Seabird Ecology (WGSE), respectively. The Working Group on Ecosystem Effects of Fishing Activities (WGECO) also considered EcoQOs at its most recent meeting from a broader perspective, and has a history of considering ecosystem metrics over a number of years.

The Chair reported that OSPAR is also considering EcoQOs for four aspects of eutrophication: plankton communities, benthos communities, oxygen conditions, and nutrient conditions. There are also papers on threatened and declining species, fish communities, and benthos communities, and they have been reviewed by WGECO. Norway has been responsible for EcoQOs on commercial fish stocks and habitats.

M. Tasker introduced the general considerations as a background to this issue, based on material from the WGECO report. He noted that the terminology is very important in this context, and that there are conflicting meanings of certain terms depending on whether they have been used in a fisheries or an environmental context. WGECO conducted a considerable amount of work on terminology, and he recommended that ACE use these definitions in its work.

He pointed out that potentially there is a very large number of EcoQOs that could be adopted and this could be too much for management; accordingly, potential EcoQOs should be reviewed carefully so that there is a restricted set that can clearly be handled. He then listed a series of general criteria to serve as guidance in the selection of EcoQOs.

The ACE then discussed fisheries target and reference points and their basis. This will be discussed further in the sub-group.

It was noted that the handling of the EcoQO issues by the four Working Groups (PGEQO, WGSE, WGMMPH, and WGECO) was consistent, but that WGECO brought the issues together in the best overall way. Thus, the WGECO report should be used as the basis for the general considerations on EcoQOs.

### **5.2 EcoQOs for Marine Mammals in the North Sea**

K.-H. Kock summarized the status of the preparation of material for this item. He noted that there was good information on the status of North Sea populations of seals, but data on the status of populations of cetaceans was considerably poorer.

A. Bjørge informed ACE on the outcome of the WGMMPH discussion on EcoQO indices, but pointed out that it had been very difficult to set actual levels for most of these indices.

The Chair also drew attention to Doc. ACE 2001/5/1, which is the result of the initial consideration of EcoQOs at the June meeting of ACME. This should be considered by the sub-group in their further work on EcoQOs.

### **5.3 EcoQOs for Seabirds in the North Sea**

T. McMahon stated that the WGSE had conducted very thorough work on this topic. He felt that this served as a very good basis for the further consideration of this topic.

M. Tasker pointed out that the table of populations of the seabird species covered was based on old data; it would be possible to update this table, but without peer review by seabird experts.

F. Colijn requested that in future work on marine mammal and seabird EcoQOs, ACE should try to develop further the linkage with fisheries, to the extent possible.

It was felt, however, that all links to human activities should be considered.

#### **5.4 Consideration of Possible EcoQOs for Fish Communities and Benthos Communities**

S. Jennings noted that there is no specific request for EcoQOs for fish and benthic communities, and while it is clear that fishing has had a clear effect on these communities, it is not clear how these could be linked to an EcoQO. WGECO considered this issue carefully and decided that it was difficult to determine relevant EcoQOs for these communities.

The EC Observer mentioned the new request from the EC concerning whether the fisheries limit points are considered within the ecosystem approach. The Chair pointed out that this request will be considered by MCAP at its meeting later this week and that ultimately there will be formulated terms of reference for handling this request. He suggested that the sub-group keep this request in mind in their discussions. However, given the importance of this question and the fact that the issue was not able to be given to a Working Group for consideration, the Chair felt that a final response should not be provided at this meeting.

J. Rice stated that WGECO has considered this issue at several recent meetings and he felt that it would be possible to provide a response at this meeting.

H. Sparholt asked the sub-group to consider whether it is necessary to have both a fishing mortality limit as well as a spawning stock biomass limit. If it is adequate to keep the spawning stock biomass at a certain level, then he questioned whether it was necessary to have a fishing mortality level also.

S. Jennings stated that a broader approach should be taken in discussing this item than simply the reference point/limit system used for commercial fish stock assessment.

F. Colijn mentioned the paper by scientists from Norway and the Netherlands on EcoQOs for nutrients and eutrophication effects and he would like to have some consideration given to this issue in the sub-group. The Chair stated that priority should be given to the requests for EcoQOs from OSPAR and this new paper should only be considered if there is adequate time.

After considerable discussion of the issues under this agenda item in the sub-group, ACE reviewed an overall draft on this topic. A number of comments were made on this document, including on the use of terminology. This document contained an initial section explaining the background and history of EcoQOs and the terminology that is used in the document. The next sections provide responses to the OSPAR requests for material relevant to EcoQOs on marine mammals and seabirds. Thereafter is a short section responding to the recent request from the EC concerning whether precautionary reference points as currently defined by ACFM can serve as EcoQOs. The final section contains a consideration of possible EcoQOs for fish communities and benthos communities, responding to internal ICES requirements.

There was considerable discussion on this draft and a number of amendments were requested. It was noted that there are still problems with a consistent use of terminology and it was agreed that MCAP should be requested to resolve these terminological inconsistencies as quickly as possible. There was discussion about the sentence referring to seal hunting on the Norwegian coast. This sentence was deleted.

Several additional amendments were made and ACE then adopted this section for its report.

## **6 FISHERIES DOCUMENT FOR THE FIFTH NORTH SEA CONFERENCE**

The Chair provided some background for this issue, based on the history of the work for the North Sea Conference process. Updated information from the previous North Sea Conference and the Intermediate Ministerial Meeting will be presented at the Fifth North Sea Conference, and ICES has been contracted to provide the background document on fisheries. ICES contracted Poul Degnbol to prepare this material for review by ACE.

P. Degnbol stated that when this contract was discussed, it was decided that this report should be based on the North Sea component of a report prepared by ICES on "The Status of Fisheries and Related Environment in Northern Seas" for the Nordic Council of Ministers.

He drew attention to the conclusions of the 1997 Intermediate Ministerial Meeting on the Integration of Fisheries and Environment in the North Sea as serving as the basic requirement for this document. The basic tables have been reproduced from the 2000 ACFM report.

It was commented that this report is quite lengthy and the message may be lost in such a long document. It was thus proposed that an Executive Summary be produced of this report, in a balanced way that covers the issues according to ICES policy.

Also, only one aspect of the interactions between seabirds and fisheries has been mentioned in this document, but there are several other issues that should be discussed to create a better balance in the coverage.

It was noted that this document explains the ICES system for providing fisheries advice, including the definitions of the reference points,  $B_{lim}$  and  $F_{lim}$ . However, these definitions can be confusing, particularly in the statement of the uncertainties. These terms should be clarified for the reader. Terms and concepts are very important and ACE must consider them in its further work.

Specific comments were made on the section dealing with the sustainability of fisheries, as the perspective of this section was not clear.

One proposal was that, given the imbalance in the report, it would be best to give the North Sea Secretariat only an executive summary of this report as it would be difficult to prepare an overall balanced document. However, the text should be made clearer concerning the definition of reference points.

It was pointed out that the material for the North Sea Secretariat must be completed before the end of the ACE meeting, but the longer overall report could be left open for additional intersessional work, if ACE would like to recommend that this report be published in the *ICES Cooperative Research Report* series.

After the above discussion and after the lunch break, the Fisheries Adviser explained in greater detail the requirements of this report. He mentioned that ICES should not deal with coastal water fisheries like those on *Crangon* and blue mussels. ICES is neither expected to deal with seabirds, sea mammals or ecosystem effects of fishing, as this will be dealt with by others. Furthermore, the task for ICES is only to produce a background document.

In the discussion, it was noted that there is considerable material on fisheries in the Species and Habitat Issues group for the North Sea Conference. It was not clear why there was this overlap in handling of fisheries material.

It was further agreed that the introduction to the fisheries report should specify clearly the scope of the document. As this background document is mainly a compilation of already published material, it should not be published as a CRR report, but maybe it should be made available on the ICES home page on the Web.

The introductions should be more clear about the scope and limitation of the report in order to avoid confusion about for instance which parts of the North Sea ecosystem it was dealing with.

It was agreed that an executive summary would not be made. It will be made by the Conference Secretariat.

It was agreed that the ACE sub-group dealing with the issue should go through the report and update and correct it where needed. After the sub-group considered the report in detail, a revised document was presented to ACE. This was considered and a number of amendments were made. With these changes, the report was accepted by ACE for transmission to the North Sea Secretariat.

## **7 EU REQUEST ON BY-CATCH OF SMALL CETACEANS**

J. Rice presented a draft section for the ACE report with material taken from WGMMPH and other materials available in advance of the meeting. This section included background material, discussion, and recommendations.

In the discussion, it was felt that this was a very good draft section. However, a distinction needs to be made between small and large cetaceans. In terms of the effects of contaminants, there is some evidence that the first-born for a female

receives a “dump” of the mother’s contaminants and probably dies shortly after birth. It was also pointed out that EU Member Countries are required by the Habitats Directive to monitor the by-catch of small cetaceans and this should be highlighted in the ACE report.

It was pointed out that there have been a number of strandings of small cetaceans in the Bay of Biscay and this should be measured.

It was felt that too much emphasis was placed on the value of the use of acoustic deterrents. Studies have shown that there are a number of problems with the use of pingers and this should be mentioned. Also, more mention should be made of the use of closed areas to fisheries in decreasing or preventing by-catches.

The figure given for the maximum annual rate of increase of the population in this section was noted as well as higher figures from an ASCOBANS report, so some mention of the reasons for choosing this figure should be given. The role of contaminants was also mentioned, particularly the long-term aspect of the effects of contaminants on the immune system of marine mammals; some mention should be made of the time scale of the risk of mortality due to contaminants in relation to mortality due to fisheries by-catch.

Noting the need for data on fishing effort, it was queried as to whether there are useful sources of data on fishing effort according to gear. However, existing sources of data were not considered to be relevant. It was recommended that ICES seek this type of data from EUROFISH. It was further noted that recommendations on the collection of data on fishing effort could easily be made more useful if small changes were made in the collection and collation of these data.

In the broader sense, it was mentioned that consideration should be given to the types and spatial aspects of the collection of information on fisheries and fishing activities.

This subject was considered in detail in a sub-group of ACE and the text was amended based on the discussions in this sub-group.

It was noted that much of the advice presented here is the same as the ASCOBANS/IWC advice and it was queried as to whether a statement of support for this advice should be clearly made; however, ASCOBANS has no formal scientific committee and is a political body. It was pointed out that ICES and ASCOBANS have different roles; ICES has a continuing role of reviewing the status of marine mammals from a scientific standpoint, while ASCOBANS makes political decisions on issues of small cetaceans. It was felt that, to help the managers that receive the advice, it would be useful to state that this ICES advice is compatible with the ASCOBANS decisions on this topic.

It was pointed out that the mortality figure of 1.7 % is based on simulations of populations other than small cetaceans, prepared by an ASCOBANS/IWC working group, and was considered by WGMMPH to be the best available at this time. Accordingly, the ACE accepted this figure for use in this advice, but noted that WGMMPH plans to conduct further work on this mortality figure in the future, but had not been able to do so for its 2001 meeting.

There was a discussion as to whether the text recommending that managers and scientists should commence discussions with industry groups to plan mitigation programmes for specific fisheries collaboratively should be included. It was commented that this is not scientific advice, but rather tells the managers how to use this advice and thus can be considered beyond the scope of the role of ICES. While this type of action can be handled successfully, there are also many cases where there have been significant failures. Accordingly, it was agreed that this sentence should be removed.

A final draft of this text was reviewed and several amendments were requested and approved. There were still some figures missing from some of the tables, so it was agreed that members could continue to submit additional figures to J. Rice until the end of the week. The EC Observer pointed out the importance of having clear material on the stranding of cetaceans, along with references for these figures.

ACE agreed the text, with the suggested amendments and with the additions to the table that will be supplied. As it was felt that references to the figures in the table were important for further use, members were given until close of business on Tuesday, 4 September to send these references to J. Rice and the Environment Adviser.

## **8 INTEGRATION OF ENVIRONMENTAL AND FISHERIES CONSIDERATIONS IN AN ECOSYSTEM CONTEXT**

The Chair presented the background for the development of a framework for an ecosystem approach to ocean management, based on discussions in ACME at its June 2000 meeting. He noted that environmental assessment is a

complex and difficult task owing to the many uncertainties in relationships among the various components of ecosystems and the lack of understanding of ecosystem properties. He outlined the information required for the assessment of the different variables in the marine environment. However, based on the experience gained in the OSPAR assessments, it is very difficult to assess the impact of contaminants in the marine environment, even when concentrations exceed OSPAR Ecotoxicological Assessment Criteria by two orders of magnitude. Some effects of eutrophication, such as from hypoxia/anoxia in bottom waters, are very obvious, while effects on biological communities are more subtle.

He pointed out that in addition to the regular assessments on fish stocks, assessments should also be made on other biological communities, such as the plankton and the benthos.

Environmental assessments have been carried out by regional commissions such as HELCOM, OSPAR, and AMAP. The Chair proposed that ICES become more involved in the preparation of scientific assessments of the marine environment or components thereof. He then provided an overview of the potential use of oceanographic data summaries in understanding the dynamics of fish stocks and in fish stock assessment. He pointed out that there are many challenges for ICES in the use of the data, particularly in the use of the oceanographic data. The ICES Annual Ocean Climate Status Report is a good product of these data, but it could be improved to include seasonal summaries and other aspects.

### **8.1 Operational Fisheries Oceanography: Concepts and Applications**

J. Rice pointed out that operational fisheries oceanography has the meaning in the fishing industry of using oceanography to improve the efficiency of fishing activities; this is probably not what is intended here. The usage should be clarified. A better term could be “physical” fisheries oceanography, as this term is commonly understood. He reported that the proceedings of a symposium held about the influence of the El Niño phenomenon on fisheries in the North Pacific have recently been published and recommended this as useful reading; this shows that only a few key types of measurements can provide a great deal of information relevant to the dynamics of fish stocks.

On the issue that it is not possible to measure all aspects of the ecosystem, it was pointed out that we need to identify those aspects that should be measured. We need to reduce the complexity by identifying key components that need to be assessed so that we do not drown in the data that would otherwise be applicable.

It was proposed that a process-oriented system be developed, based on fluxes, forcing, and other processes. The NAO should also be taken into account.

It was pointed out that temperature indices are already being used in stock assessments, for example, for anchovies in the Northeast Atlantic and for the Californian sardine. Other examples are also available in terms of the use of the flow of major currents distributing water masses in relation to stock developments.

The EC Observer stated that this issue has been discussed in the context of GLOBEC and other projects, but has been resisted by ACFM because the statistical power of some of the environmental indices has been very low and past short-term forecasts based on them have been misleading. There may, however, be a greater role for fisheries oceanography in a longer perspective, concerning the future development of a stock.

### **8.2 Framework for Ecosystem Assessment: Integration of Information on the Marine Environment and Living Marine Resources**

O. Misund stated that two documents were relevant to this topic: a section from the 1999 WGECO meeting on reference points and material from ACME on ecosystem assessment. Further discussion is needed to bring these issues forward, which should be conducted in a smaller group.

S. Jennings stated that he felt that this issue and the issues under Agenda Item 4 really needed to be put into a broader framework, such as a working group, so that wider expertise could be incorporated into this work to develop a better approach and gain a wider acceptability in the scientific audience. He also felt that wider participation is needed at the working group level.

The Chair stated that his intention here is to define the overall direction of this work so that a working group or other such group can be charged with the further development of the framework. They should have clear guidance for this work, as well as ultimate review by ACE.

It was felt that key conditions and their associated variability should be identified to serve as a background for fish stock assessments. As we learn more about the physical system, we will undoubtedly be able to transfer our understanding of a system in one area to a better understanding of another area.

### **8.3 Data Management for Integrated Assessments**

The Chair pointed out that there is a need for greater availability of data to be able to conduct integrated assessments. The European Environment Agency (EEA) runs an Inter-Regional Forum, comprising representatives of EEA Topic Centres and regional Commissions, including ICES. This Forum has created working groups on data management, GIS, and indicators.

H. Lassen reported that some years ago it was decided that ICES should integrate data handling and use across disciplines and this process has been started in the Secretariat. In June 2001, the Consultative Committee proposed that a Study Group be created to support this work by identifying the needs for data integration and the priorities in this work. This will include review of the spatial and temporal aspects of data integration. A Theme Session will also be held for presentation of the actual applications of data integration.

F. Colijn stated that he, as Chair of the Oceanography Committee, will request the Working Group on Marine Data Management (WGMDM) to consider wider aspects of data management. Traditionally, this Working Group has only considered oceanographic data, but there is a need to work on a broader basis at the present time. This Working Group has mainly been working on technical issues, in terms of data centre activities.

Some questions have been raised on national levels as to why oceanographic data are submitted to ICES when no real use have been made of these data. The Chair felt that these data should be used and that the needs for these data should be identified so that appropriate products can be prepared.

Some terms of reference have been prepared for a new Study Group on data integration requirements. These terms of reference will be reviewed by S. Tjelmeland, K. Myrberg, J. Haelters, and F. Borges.

ACE felt that it would be useful to hold a Theme Session giving examples of integration of data in assessments. A detailed proposal needs to be developed for the content of this Theme Session. This will be developed by the above-mentioned group.

Proposals were prepared for the terms of reference for a Working Group on Integrated Data Management and for some Theme Session topics for the Annual Science Conference. It was agreed that these should be considered again at the Consultations Meeting.

## **9 MARINE HABITAT CLASSIFICATION AND MAPPING**

G. Janssen presented a draft section for the ACE report based on material from several Working Groups and other meetings. He stated that a consensus is emerging on the use of the EUNIS classification system, but there is still a need to review other systems, such as the ARC system.

In the discussion, it was reported that work is not continuing on the ARC system at the present time. It was also pointed out that there are good examples of the use of habitat mapping in fisheries, particularly for benthic shellfish.

J. Rice noted that WGECO was concerned about the differences in scale between the habitat mapping capabilities and the actual use for fisheries, in particular, the scale of EUNIS is too large for many uses of the system. WGECO had serious reservations about the EUNIS system and he felt that they have not been adequately reflected in the draft text.

The Chair pointed out that the EUNIS system is hierarchical and incorporates a description of the main biota in a habitat at more detail at the lower levels of the system. The biological details will be layered on the bathymetric information. For these maps, there is a need for data on species and communities, so there is also a data issue to be considered for ICES in terms of data management and tools for using these data.

In Norway, a compilation has been prepared on the distribution of coral reefs that has mainly been prepared by fishermen based on their experience. Some of this has been checked by video and ROV. Between 30 % and 50 % of the Norwegian coral reefs have been damaged by fishing over the years. Some of this area has been protected from fishing.

M. Tasker stated that EUNIS could be useful at a lower level and we know what is happening at that lower level, but it is difficult to scale up to the higher level.

T. Noji stated that the utility of EUNIS is not necessarily related to fisheries; there are other applications also. Since the basis for the marine component is the geophysical mapping of the seabed, this will be very useful for certain applications. Originally there was no pelagic component to EUNIS, however, some work has now been done on a pelagic component; this should be reviewed.

Concerning the WGECO comments, there are a number of benthic ecologists on WGECO and they reviewed the use of EUNIS for their requirements. Given the large amount of resources that will be required to implement any classification system, it would be best that only one system be designed that meets as many needs as possible. Thus, such a system should be carefully designed to cover these aspects.

L. Pihl stated that he could see a number of uses of this classification system if it is implemented on a large scale, particularly in conservation uses.

E. Andruliewicz stated that he had tried to use the EUNIS system in the context of laying marine pipelines, but found that it was not practical.

Draft text for the ACE report was reviewed, concentrating on the recommendations. This text was adopted with some amendments.

## **10 PLANS FOR THE WORKSHOP ON ECOSYSTEM MODELLING**

J. Rice provided the background for the Workshop on Ecosystem Modelling, based on the work of the Working Group on Ecosystem Effects of Fishing Activities (WGECO). He stated that there is a need to provide for an objective evaluation of the various ecosystem models, in the way that single-species fish stock assessment models are evaluated.

The Chair noted that the Planning Group for the Workshop on Ecosystem Models (PGEM) has also stated that there is a requirement for funding for some of the activities, particularly to ensure the participation of key persons in the proposed Workshop.

S. Jennings presented information on this topic, which originally arose from suggestions by WGECO. He pointed out that the plans for this workshop have been developing over several years, so that some of the proposed model comparisons have already been conducted or are in progress. He proposed that ACE agree to support the continuation of this work and that the Planning Group meet in one or two years' time to review the status of the work. However, the request for financial support for the Workshop was considered to be beyond the scope of ACE.

In the discussion, the type of models covered was noted and it was agreed that it is the upper trophodynamic models that should be covered. It was further pointed out that since the Planning Group meeting took place, a number of the model comparisons proposed by the Planning Group have received funding. Thus, there may be no need to actually hold the Workshop, but there will ultimately be a need to have an overall review of the outcome of these model comparisons.

Accordingly, the ACE felt that there may be no need to hold the Workshop, but did not want to discourage the continuation of the Planning Group's coordination of this activity.

A paper was prepared concerning the future of this ecosystem modelling work. As there was little time left in the meeting, it was decided that this should be considered at the ACE Consultations Meeting.

## **11 BIODIVERSITY ISSUES**

The Chair stated that in mid-2000 Denmark requested ICES to prepare a background document for the national consideration of biodiversity issues. This was prepared in the autumn of 2000 and reviewed by ACME by correspondence in late 2000. The Chair stated that this paper could be used by ACE in further work on biodiversity issues.

S. Jennings drew attention to the EU Biodiversity Action Plan for Fisheries as being of interest in this context. This contains some fairly specific actions, including providing enhanced knowledge in relation to biodiversity and monitoring other habitats and organisms than those that are normally monitored for fisheries. The EU Observer provided a copy of this document for the information of ACE.

It was also pointed out that FAO has a relevant document on biodiversity in relation to fisheries.

The Chair felt that it could be useful to prepare a summary of national plans on biodiversity issues and requested the members to contribute to this inventory of national biodiversity plans. He felt that biodiversity plans should be an integral component of the overall ACE strategy for dealing with ecosystem issues and advice.

E. Andruliewicz felt that we are lacking some basic knowledge in relation to biodiversity, such as lists of endangered, indicator, and charismatic species in the marine environment. He felt that this should be worked on in the ICES community.

These are scientifically challenging tasks on which it would be useful for ICES to work. It was recalled that there had been a Mini-Symposium on Biodiversity in 2000 and suggestions had been made at that time for further work in ICES. Very specific recommendations had been made for how ICES could contribute to this work, but ICES has not acted on any of these recommendations to date. This may require the establishment of a new working group, which was tried about three years ago and failed dismally. There is a lot of "empty" work being churned out on biodiversity, but real work needs to be done to advance on this issue and someone must be willing to do some new creative work to go forward.

ACE members were requested to prepare a summary of their national biodiversity plans, to be annexed to the minutes as a supplement to the report on biodiversity prepared for Denmark last year.

Draft text for the report was reviewed. The annex of national plans for biodiversity conservation was very incomplete, with information on only three countries.

It was proposed that an index of biodiversity be related to the EcoQO issue. This is, however, a very broad issue and is included in this framework.

It was pointed out that over the past few years there has been a Mini-Symposium on Biodiversity and a failed Study Group on Biodiversity. ICES needs to concentrate more on this issue if it intends to establish real credibility and a real leadership role on this issue. At the present pace, ICES will not make any progress and will fall behind other organizations. It was noted that one recommendation from the Mini-Symposium was for ICES to focus on conservation in relation to biodiversity, in terms of species and also habitats.

At this stage, ACE should focus on a work plan in relation to biodiversity. Clear actions need to be taken. It was pointed out that the ICUN established a working group to set up criteria for biodiversity in marine systems; this work has now been completed, without any input from any scientist associated with ICES. Also, OSPAR has agreed on criteria for biodiversity evaluations without consulting ICES.

ACE agreed the text, without the annex, for inclusion in the report. ACE agreed that it must pay more attention to this issue, perhaps by reviewing the criteria developed by other organizations in relation to biodiversity. This will be considered in more detail at the ACE Consultations Meeting on 24 September.

## **12 PROPOSAL FOR A DIALOGUE MEETING ON MARINE ECOSYSTEMS**

The Chair provided the background for the discussion on the development of a proposal for a Dialogue Meeting on Marine Ecosystems. There have been twelve Dialogue Meetings, eleven of which have been on fisheries and the twelfth has been on environmental issues. In reviewing the outcome of the Twelfth Dialogue Meeting, the Consultative Committee recommended that ICES hold a Dialogue Meeting on the ecosystem approach issue.

T. Noji stated that he has reviewed the outcome of the Twelfth Dialogue Meeting and has developed some ideas for a follow-up Dialogue Meeting on the ecosystem approach.

ACE reviewed the proposal for a Second Environmental Dialogue Meeting. This proposed that the overall topic should concern the development of ecosystem-based advice in ICES. Proposals were given for three workshops to take place during the Dialogue Meeting, along with nominations for several members of the Steering Group for this meeting.

This was felt to be a useful proposal. Comments were made concerning having parallel workshops on topics 2 and 3; it was felt that these two topics should be discussed together instead. It was also felt that the paper prepared by the sub-group for items 4 and 8 could serve as a useful discussion document for one of the workshops.



### **13 ANY OTHER BUSINESS**

Ole Misund provided some material from the Fishing Technology Committee. It was agreed that members should consider this material and provide comments to the Chair and to O. Misund concerning whether they feel that this material could be included in the ACE report. This will be considered again at the Consultations Meeting in Oslo.

### **14 ADOPTION OF THE 2001 ACE REPORT AND REVIEW OF DRAFT MINUTES**

The style of the report was discussed, as the style of the ACFM report does not use references while the ACME report does use them. The Chair stated that he would prefer the use of references when handling topics of a broad nature.

The Chair noted that there are two types of requests being handled by ACE: management advice, such as that requested by the EC, and information and advice to develop a topic further, such as the requests for EcoQOs by OSPAR, that provides material of a more general nature. In addition, ACE is responding to the nineteen ICES Member Countries in the development of concepts on an ecosystem approach and integrated assessments, and some of the material developed on this topic may be ready for the report.

On this latter topic, it was pointed out that when ACFM developed the basis for its advice, two meetings were held to develop these concepts that were thereafter considered and adopted by ACFM, after much discussion and these concepts are still under discussion. The basis for the ACE work could also be developed in greater detail by an ACE working or study group convened for this purpose.

It was noted that there will be two types of ACE reports: 1) the report containing the responses to the requests for information and advice, that will ultimately be published in the *ICES Cooperative Research Report* series, and 2) the minutes, which can contain as annexes all the materials that are under work in the development of concepts and issues.

As there was no other business, the Chair thanked the members for their work, and closed the meeting at 13.00 hrs on 30 August.

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**ANNEX 2: AGENDA**  
**ADVISORY COMMITTEE ON ECOSYSTEMS**  
27–30 August 2001

1. Opening of the meeting
2. Adoption of the agenda and schedule of the meeting; description of procedures
3. Checklist of requests from regulatory commissions and member governments
  - a. OSPAR Commission (see Items 5.2 and 5.3, below)
  - b. Fifth North Sea Conference (see Item 6, below)
  - c. European Commission (see Item 7, below)
4. Development of a framework for an ecosystem approach to ocean management (conceptual and operational aspects, including linkages between fish stocks and the environment)
  - a. Conceptual framework **KEIZER**
  - b. Operational aspects, including ecosystem inventory **COLIJN**
5. Ecological Quality Objectives (EcoQOs) **COLIJN**
  - a. General consideration of concept **TASKER**
  - b. EcoQOs for marine mammals in the North Sea [OSPAR 2001/2.2] **KOCK**
  - c. EcoQOs for seabirds in the North Sea [OSPAR 2001/2.3] **McMAHON**
  - d. Consideration of possible EcoQOs for fish communities and benthos communities **JENNINGS**
6. Fisheries document for the Fifth North Sea Conference **DEGNBOL/HEESSEN**
7. EU request on by-catch of small cetaceans **RICE**
8. Integration of environmental and fisheries considerations in an ecosystem context
  - a. Operational fisheries oceanography: concepts and applications **HEESSEN**
  - b. Framework for ecosystem assessment: integration of information on the marine environment and living marine resources **MISUND**
  - c. Data management for integrated assessments
9. Marine habitat classification and mapping **JANSSEN**
10. Plans for a Workshop on Ecosystem Modelling **JENNINGS**
11. Biodiversity issues **VINTHER**
12. Proposal for a Dialogue Meeting on Marine Ecosystems **NOJI**
13. Any other business
14. Adoption of the 2001 ACE report and review of draft minutes
15. Closing of meeting

**ANNEX 3: INITIAL CONSIDERATIONS OF A SCIENTIFIC FRAMEWORK FOR ICES ECOSYSTEM ADVICE, INCLUDING AN ECOSYSTEM APPROACH FOR THE SUSTAINABLE USE AND PROTECTION OF THE MARINE ENVIRONMENT**

*Request*

ICES has requested an examination of how to provide advice to its customers on fisheries and environmental issues in an integrated fashion, using an ecosystem approach as a basis. This topic is also of interest to many ICES customers such as the Nordic Council of Ministers and the North Sea Secretariat as well as to Commissions like OSPAR in relation to the development of Ecological Quality Objectives.

*Source of the information presented*

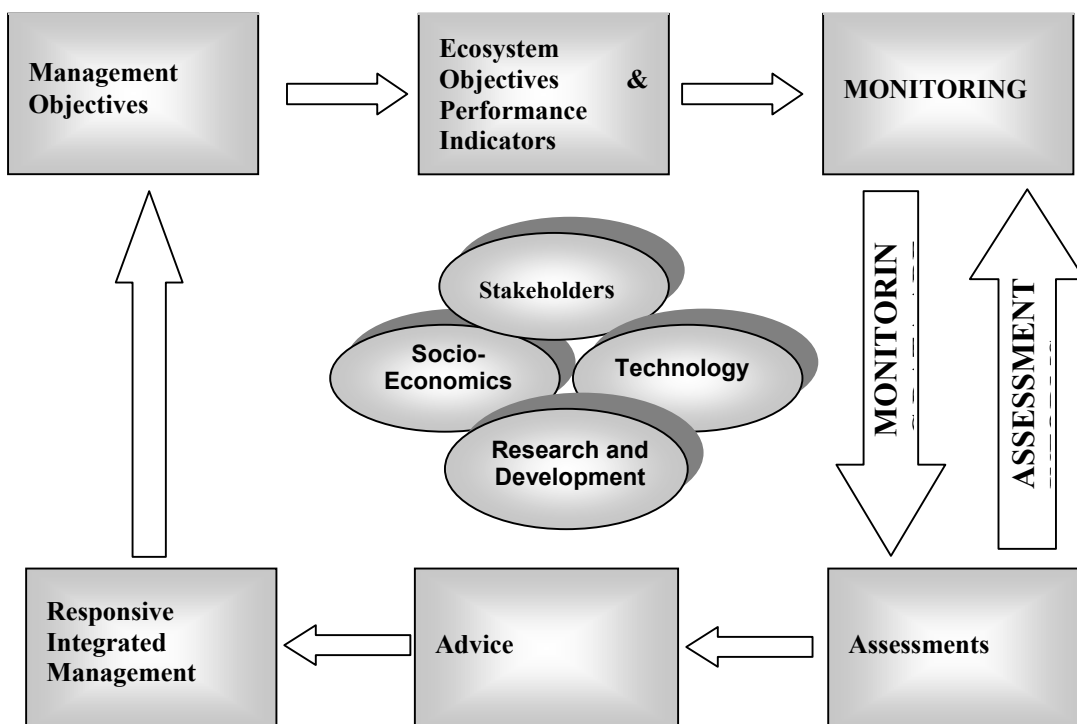
The 2000 report of ACME, the 2000 and 2001 report of the Study Group on Ecosystem Assessment and Monitoring (SGEAM), the 1999 report of the Working Group on Ecosystem Effects of Fishing Activities (WGECO), and ACME deliberations.

*Status/background information*

The ACME considered four aspects related to an ecosystem approach to ocean management: (A) terminology and definitions; (B) a framework for an ecosystem approach; (C) desirable general properties of ICES ecosystem advice; and (D) the scientific elements of an ecosystem approach. The ACME 2000 discussed and agreed upon a definition and a conceptual framework for an ecosystem approach to ocean management. This framework was proposed by SGAEM building on work done by SGAEM and WGECO and the development of specific proposals for seabirds and marine mammals by WGSEA and WGMMPH respectively. The conceptual framework embodies 5 elements

- Objectives
- Monitoring
- Assessment
- Advice, and
- Management Actions

**Figure 0.1 The flow of information required in an responsive integrated management system (adapted from Figure 5.2.2.2 in the SGEAM 2001 report.)**



ACME identified (ACME minutes, June 2000) the importance of the clear definition of the terminology used and SGEAM was tasked with WHAT FROM SGEAM TOR from SGEAM 2000 “There was agreement between the members of SGEAM that there is a need to define key terms used in an ecosystem approach to management. The main reason for this is that there are a number of confusing (sometimes synonymous) terms used in the broad context of environmental management (see SGEAM 5/1/00 and 5/2/00). These terms often lack clear definition, which leads to a lack of consistency in their use among different countries or among different organizations within a country.” It is recommended that the two following definitions be modified to make them simpler and clearer.

1. Ecosystem - “*An ecosystem is a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.*” It is recommended that the final phrase be deleted.
2. Ecosystem management - “*Integrated management of human activities based on knowledge of ecosystem dynamics to achieve sustainable use of ecosystem goods and services, and maintenance of ecosystem integrity.*” It is recommended that the underlined words be changed to *conservation of ecosystem structure and function.*

The essence of this framework is the application of a responsive management approach to a suite of ocean management areas or large marine ecosystems. Figure 1, is a modified version of Fig. 5.2.2.2 from SGAEM 2001 report. It has been modified to make the terminology more consistent with the terminology and definitions provided in the SGEAM report and the ACME 2000 report and minutes. Figure 1 demonstrates the interactive linkage between monitoring and the ecosystem-based assessment with the subsequent provision of ecosystem-based advice. Each one of the boxes in this figure is critical and each box is dependent upon the others. For example, it should be noted that if the management objective is not defined then it is difficult to identify potential ecosystem objectives and performance indicators. Without a defined management objective it is not possible to set limits for the performance indicators. However managers also need scientific advice in order to be informed about the consequences of management decisions.

While the documents referenced here are directed mostly at the provision of advice on fisheries management, it is clear from the request that the application of an ecosystem based approach to all ICES advice is to be considered.

#### 4.1.1. Ecosystem Objectives

(To be considered under Agenda item 5)

#### 4.1.2. Monitoring

Monitoring is essential to determine whether the ecosystem objectives are being met. This is accomplished through assessment of the state of the identified performance indicators. These performance indicators may be single determinants or indices of varying complexity. Research will be required in instances where performance indicators for an ecosystem objective are not readily available. The applicability of these indicators to the assessment process and their scientific validity will have to be confirmed.

The assessment of fisheries resources has a long tradition of the application of analytical models to evaluate the condition of fish stocks. The assessment of the environment does not have a similar tradition. Such assessments have been descriptive reports of the value of numerous determinants compared to either pristine or historical data. There has been no organised attempt to determine the cumulative impact of all of the environmental stresses. Recently fish stock assessments have included ocean climate as a factor. The challenge is to include in these assessments other environmental factors such as the status and availability of critical habitat for various life stages. In order to do this we need to understand the functioning of ecosystems so that we can determine the important interactions and determine what needs to be monitored. Realistic ecosystem models that embody these interactions need to be developed so that the temporal and spatial scales for monitoring can be determined. Ongoing scientific research will be needed to validate the sensitivity and reliability of the model outputs, to determine potential performance indicators, and to evaluate their usefulness.

In this respect SGEAM recommended that, in order to evaluate the consequences of various management scenarios, realistic ecosystem models coupled to useable management tools need to be developed.

SGEAM also specifically recommended that, as a first step towards implementing the overarching management framework, a strategic integration of national monitoring programmes is required. This has implications for the way in which data are managed and reported for integrated appraisal and assessment. To facilitate this:

SGEAM also recommended that a GIS approach be developed to enable the flexible interrogation of data held in the ICES database.

The implication in these latter two recommendations is that existing monitoring programs will, wholly or in part, address the ecosystem objectives and associated performance indicators identified in the proposed responsive management process. It will be necessary to evaluate and modify existing monitoring programs to fulfil the identified monitoring needs while preserving continuity of important time series. This process will be ongoing since management objectives will sometimes change as a result of the advice received. Consequently it may then be necessary to change either the performance indicators and/or the monitoring protocols. As recommended, the national monitoring programs should be integrated and data management should be based on geo-referenced data.

#### 4.1.3. Framework for ecosystem-based assessments: integration of information on the marine environment and living marine resources

From the very first draft of the new Strategic Plan for ICES released by the Bureau Working Group on the Strategic Plan (BWGSTRAT 1999), it was clear that an ecosystem approach should be the guiding principle both for the scientific development and the advisory process within the organisation. After the Open Forum during the ICES ASC 2000 in Brugge, Belgium, the Strategic Plan have been redrafted, but still with the ecosystem approach as the basic principal.

The Study Group on Ecosystem Advice and Management (SGEAM) discussed a conceptual framework for ecosystem based assessments in which the ecosystem approach is the fundament for the monitoring, assessment, advisory and management part of the framework (SGEAM 2000, 2001). Further consideration about this framework has been conducted by WGECO 2001 and by ACME 2000, 2001. An underlying basis for the framework is that the advisory process of ICES has taken an ecosystem approach both in the advice for managing fish stocks and for the environmental assessments. This implies that where appropriate fisheries assessments take environmental information into account and environmental assessment also includes fisheries information or assessments.

A schematic framework for producing environmental assessments or quality status reports (QSR's) has been outlined by ACME 2000, and would therefore not be further considered here. This framework elaborate on the need for clear objectives for an environmental assessment, and outline the report structure according to scientific disciplines or categories, suggest solutions for data gathering, archiving, processing and transmission, comment on the environmental assessment process, and discuss the limitations of marine environmental assessments. Finally ACME 2000 put forward specific recommendations for further development of marine environmental assessments.

The fish stock assessments have been a major focus in ICES the last decades, both on the scientific and advisory level. Possibly this is because clients of ICES have been asking for quantitative advice on the status and harvest potential of specific fish stocks. In Europe is the sole independent organisation of fishery scientists annually assessing and providing advice on status and potential yield of major commercial fish stocks in the North Eastern Atlantic, North Sea and in the Baltic. On the environmental side there are several organisations and agency that provide environmental assessments including the marine systems. In several occasions, ICES have contributed to such environmental assessments.

In the fishery assessments of ICES there is little tradition of using environmental information in the analytical models. Classical theory of fish population dynamics do not include quantitative functional relationships between fish population parameters like recruitment, natural mortality and growth and environmental characteristics. The functional forms of these relationships are generally not known and correlational relationships have often been found to break down over time. Instead, stock assessments generally treat natural mortality as a constant, use average weights at age over the most recent years, and estimate incoming recruitments from survey catches (and sometimes commercial catches of small fish). Exceptions exist including stock specific population models that take into account cannibalism within the stock itself and/or predator-prey relationships to other fish stocks are applied, and considerations of the impact of these anomalous oceanographic conditions in the North Sea in the winter of 1996 on growth and survivorship in the advice on several fish stocks. In the eighties, there were substantial effort towards developing applicable multi-species fish population dynamic models, and one of these models is used as the source of the natural mortality parameter used in a number of ICES single species assessments.

It is an intuitively appealing concept that, as fish stock dynamics are dependent on marine environmental conditions, improved knowledge of external factors (environment and other species) should lead to improved advice in fish stock assessments. However, despite many studies and many attempts to use such external factors, practical experience has not been positive. Some of the reasons are :



- a. Relationships between fish stock parameters and extrinsic parameters are typically very noisy and difficult to identify. This means that (in addition to low predictive power of “noisy” processes) there is a high probability of error in selecting an appropriate structural model. It has often happened that addition of new data has not conformed to the expectations derived from previous data: there is a strong tendency to overestimate the predictive power of observed historic trends.
- b. It is usually easier and simpler to measure a fish stock population parameter (e.g. abundance or growth rate) than to measure some extrinsic parameter and to derive the fish stock parameter from it. Realised growth and year-class strength can be measured using standard methods, for which long time-series of data exist.
- c. Even if reliable parameter correlations can be identified, making forecasts still depends on being able to forecast the value of the extrinsic variable. This is rarely possible.
- d. Compared with the effects of fisheries, extrinsic parameters have a relatively small effect on recruited year classes. Variability of recruitment (so long as spawning stock is at a high level) is not amenable to management action and there.

In this context a conceptual framework for the ecosystem approach to be used in fish stock assessments of ICES requires careful consideration. Incorporating environmental information directly into analytical assessment models requires reliable functional forms and parameters for the relationships (or comparable analytical formulations). Although there is active work on these analytical questions, these relationships are not likely to be available for most stocks in the short term. Moreover, unless these relationships are fairly tight and the parameters are well estimated, they may result in a substantial increase in uncertainty in assessment results and advice. This may more accurately reflect the true situation, but because ICES advice on fisheries is provided in a precautionary framework, maintaining the current level of risk aversion in the advice will lead to much lower advised harvests. These may not be welcomed by clients. Hence, in the near term, alternative ways to include environmental considerations in fisheries advice are necessary.

An important step towards an ecosystem approach (see chapter 4.1) will be to provide fishery assessment working groups within ICES with status reports on the marine environment inhabited by the fish stocks considered. Such status reports should provide information on physical (ocean climate), chemical and biological characteristics of the relevant ecosystem. Scientific effort is being given to develop prognostic models for specific environmental characteristics (temperature, oxygen) which enable forecasting of marine environmental conditions, and as these come available the forecasts should also be available to assessment working groups. Where data are available, models and analyses are also exploring population and food web interactions, population structure and dynamics of geographic distribution. When this wider range of information is available to fish stock assessment working groups, potential consequences of the environment can be considered much more directly in the evaluation of the current status of stocks, and in forecasting the possible consequences of management options. Particularly when the environment is changing rapidly, the results of such considerations may figure prominently in the advice.

Status reports of environmental information have been taken into account for some time already in the Northern Pelagic and Blue Whiting Working Group (WGNPBW). This working group has the responsibility for stock assessments of some of the major pelagic species in the northeastern Atlantic. The report from WGNPBW now contains an introductory chapter on the environmental status in the northeastern Atlantic. In this chapter the temperature, salinity, and zooplankton biomass conditions are considered. Of special relevance to the stock assessment of Norwegian Spring Spawning herring is a functional relationship between the condition index of herring and the zooplankton biomass which in turn is related to the NOA index. These relationships are sufficiently robust that it is possible on the basis of the NOA index in a given year to predict the zooplankton biomass and thereby the condition index of the Norwegian Spring Spawning herring. But there is a development in the group towards an ecosystem approach where the examples of the relationships between environmental parameters and some of the stock characteristics mentioned will be considered in the assessment. The forecast condition index is not used in the quantitative advice on harvest at present.

For the fisheries in the Baltic ecosystem the environmental conditions are key factors in regulating spawning habitats, overall distribution, and recruitment and growth conditions. Several environmental parameters like oxygen content, temperature and salinity have functional influence on population characteristics of important fish stocks in the Baltic. According to the Study Group on the Scientific Basis for Ecosystem Advice in the Baltic (SGBEAB 2000) there are possibilities to further develop the existing fishery assessment models in such a way that information on the state of the environment could be taken into account. For instance one could model the growth of fish as dependent on food resources by parameterization of the growth equation as a function of food quality and quantity. Similarly, in production models intrinsic rate of growth and/or carrying capacity could be a function of food resources. At present, however, the only interaction with the environment is modelled when assessing the state of herring and sprat stocks.

The natural mortality of these species is decomposed into predation mortality (dependent on the state of cod stock) and residual natural mortality. There are attempts to develop the model of cod recruitment in relation to cannibalism and the environment (STORE Project). Promising attempts have been done to include age structure of mature females in assessment models. In such models, age-specific variation in egg quality and development has been shown to have significant effect on recruitment success.

The Study Group on the Scientific Basis for Ecosystem Advice in the Baltic (SGBEAB 2000) conclude that fisheries models are based on statistics and knowledge of fish-biology in conjunction with data from landings, surveys, etc. Though the models do not represent the lower part of the food chain dynamically, they are forced by observed data on productivity from below. Those models apply in particular to those cases where variations in the prey field play a minor role and where physical or chemical forcing, e.g. oxygen deficiencies, act directly on the trophic level of the fish. It is at present uncertain how much of the major physical and chemical forcing is directly on the physiology and trophic level of the fish, and how much is through redistribution of predators and prey in the sea.

Ecological models are better able to deal with slow changes that propagate up from below. An ecosystem approach will require further model development and data collection (monitoring and research data) to support the decision making process. The transition from the 'bottom-up' and 'to-down' modelling to the models used in fishery management and stock assessment is still difficult to implement and is an important field of future research.

For short term predictions (1 – 3 years) from stock assessments there is doubt that inclusion of environmental information into the stock assessment models will enhance to reliability of the predictions and reduce the uncertainty. This means that addition of environmental information for short-term predictions from stock assessments will not necessarily improve the scientific basis, strength and quality of the predictions.

For long term predictions (> 3 years) inclusion of correctly quantified relationships between environmental variables and stock characteristics may enhance the reliability of the predictions. Depending on the nature of the relationships, uncertainty may or may not be reduced, but in any case it will be better represented in the forecasts. These forecasts will be particularly important for evaluating the sustainability of alternative harvesting strategies. In cases where major changes in environmental conditions may occur (e.g regime shifts) reliability of long-term projections will require particular care in interpretation. Where biological responses to regime shifts are being studied, some results suggest basic biological relationships, including tropho-dynamic relationships and geographic distribution of species may change substantially. Hence the analytical relationships used in the long term forecasts would have to be at least reparameterized, and possibly changed in form. However, under conditions of regime shifts long term forecasts using environmental information will at the very least call attention to the dramatic increase in uncertainty associated with stock status and future trajectories. Such information may be very valuable in preventing increases in fishing mortality at a time when a stock may be especially vulnerable.

An approach that can be useful to incorporating multispecies effects and environmental effects may be in :

(i) Characterisation of long-term variability, and identification of appropriate management strategies in response to such variability;

(ii) Choice of appropriate balance in harvesting various species;

(iii) Advice on fishing gear design with respect to harvesting various species in accordance with (ii)

A number of initiatives in respect of this topic has been initiated by ICES recently (e.g. SGPRISM, cod and climate workshop).

#### 4.1.4. Ecosystem-based Advice

ICES provides advice that can be categorized into three types to its clients. Advice on techniques, protocols, etc., i.e. the requests for "how to do something" will rarely be directly impacted by the adoption of an ecosystem-based approach to providing advice. The other two types of advice, i.e. assessments and management recommendations, will be impacted. It is important to recognize that the proposed recommendations would be implemented over a period of time. For example, with respect to fish stock assessments and provision of advice, few ecosystem-based stock assessment models presently exist and they have not been fully verified for their application to fisheries management.

In order to implement the ecosystem-based approach to assessment and the provision of advice, the SGEAM 2000 report recommended that Regional Ecosystem Groups (REGs) should be established within ICES. It was recommended that the REGs should focus on the following tasks:

- 1) Consider the general issue of integration of pertinent assessment information on the changing states of large marine ecosystems in the region, based on regional expertise;
- 2) Prepare periodic assessments of the status and trends in fish stocks and environmental conditions of the LMEs in the region with emphasis on:
  - a) climatic/physical forces, and
  - b) biological (e.g. multispecies) interactions;
- 3) Contribute to environmental assessments and preparation of Quality Status Reports (QSRs) in cooperation with stakeholders, academic institutions, the public, and other organisations (e.g. EEA, OSPAR, AMAP, HELCOM).

The details of this recommendation need to be carefully considered with respect for the workload of the various working and study groups and the advisory committees. For the REGs to succeed, member states will have to make and deliver on a commitment to support the groups with adequate numbers of scientists, from a sufficiently broad range of disciplines, while continuing to support the other working groups of ICES, on which REGs will depend for important inputs. There also needs to be a clear statement of the functional relationship among the various committees and groups.

Under recommendation 1, the REGs would be responsible for collecting relevant information from various ICES WG/SGs and conducting a comprehensive ecosystem-based assessment of that information. The recommendation needs to be strengthened and the REGs should undertake this assessment and provide that assessment and recommendations regarding quantity, quality and type of monitoring information. The REGs would report to ACE who would disseminate this information through ACFM and ACME to the relevant WG/SGs.

Under recommendation 2, the REGs would prepare periodic assessments of the status and trends in fish stocks and environmental conditions and under recommendation 3, they would prepare environmental assessments. It is suggested that these two recommendations should eventually be combined. Periodic assessments of the status and trends in fish stock and environmental conditions should be more comprehensive and contain information of environmental quality and other users of marine resources. Similarly, environmental assessments and QSRs should contain comprehensive information on the status and trends in fish stocks and environmental conditions. It may not be possible to obtain this integration immediately but the REGs, with the assistance of the advisory committees should work towards this goal.

While these recommendations will not have a direct impact on the existing WG/SGs or advisory committees it will impact the details of the Terms of Reference for these groups. The WG/SGs will have to provide information to the REGs and will have to consider the REG assessments and recommendations in their deliberations.

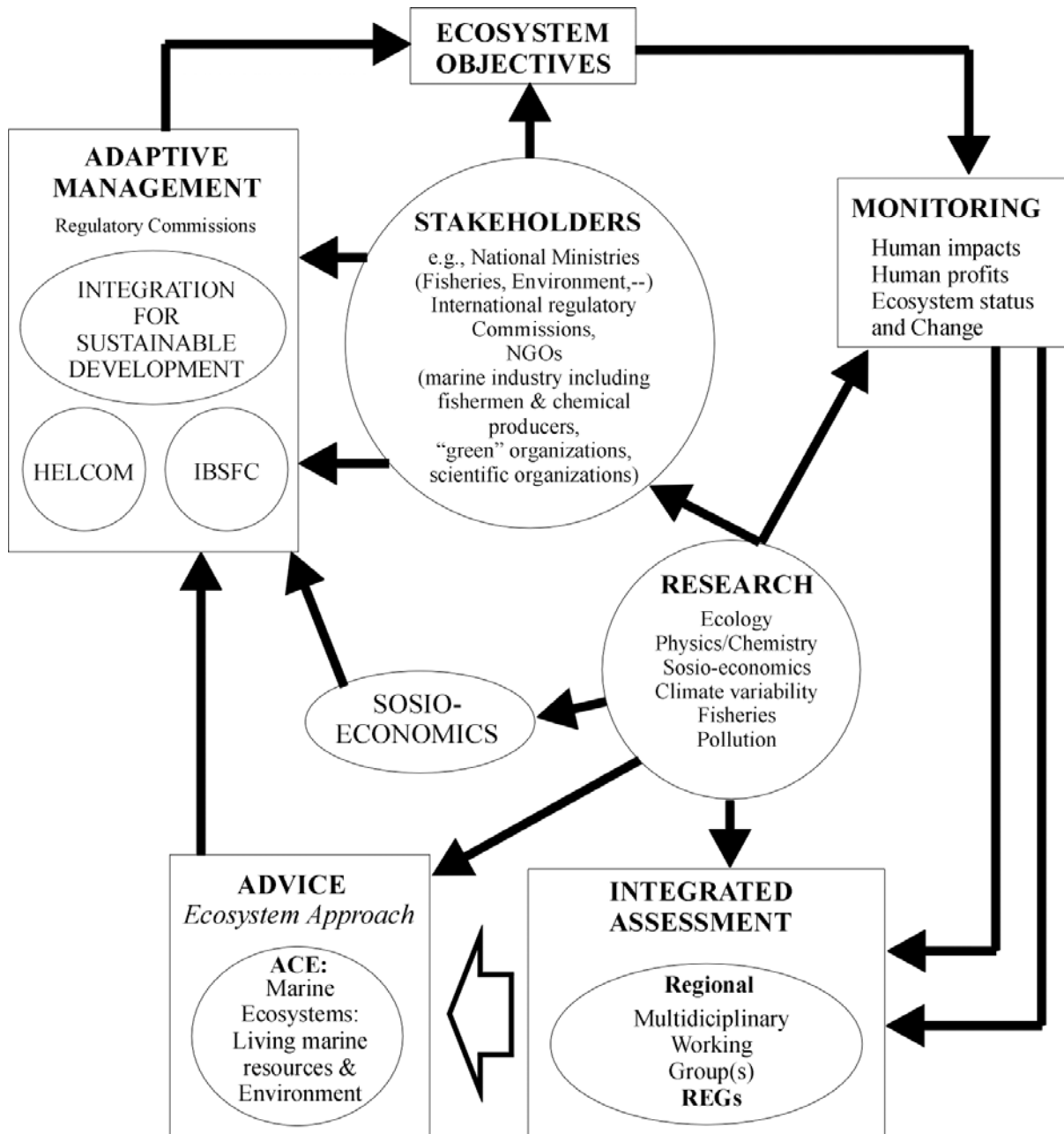
A major implication in these recommendations is that ICES through ACE would take some responsibility for the preparation of the comprehensive environmental assessments and QSRs. This is a departure from its present role as a reviewer of these documents.

Inherent in this recommendation is the need to identify the management areas. These should be selected so that the boundaries are consistent with present ocean management units, i.e. fisheries management areas.

It is important to note that while these recommendations identify only the traditional fishing industry as a marine resource user and stakeholder, the application is much broader.

The 2001 report of SGAEM also provides an example (Figure 4.1.4.1) of an ecosystem based management framework for the Baltic Sea (SGAEM 2001, Fig. 5.2.2.3). In fact the approach described is mostly generic in its application. The ecosystem-based scientific advice is provided to management through ACE based on assessments conducted by the REG as well as advice received from other ICES WGs and SGs.

**Figure 0.2.** An example of an ecosystem based management framework for the Baltic Sea, where ICES is making a substantial contribution through ACE and a proposed Regional Ecosystem Group (REG). (Figure 5.2.2.3 in the SGEAM 2001 report.)



This figure requires some clarification and expansion in some areas. For example, starting at the top of the figure with the “ECOSYSTEMS OBJECTIVES” box.

- while stakeholders and managers make a decision on the management objectives, it is mainly a scientific exercise that expresses these management objectives as ecosystem objectives with associated performance indicators.
- monitoring data go to the existing ICES WG/SGs for quality assurance and control, site specific assessment, and the production of data products. One of the data products is a report to the REGs who then undertake the integrated ecosystem-based assessment of the information (the INTEGRATED ASSESSMENT box).
- data products, other than those requiring an ecosystem-based approach, would be provided using the existing approach.

#### 4.1.5. Responsive management

The responsibility for the development of an integrated adaptive management approach lies with ICES clients who request advice from ICES. ICES has a role in promoting this approach but ICES support cannot solely ensure the acceptance of any particular management framework. The adoption of an appropriate framework is obviously essential

to the overall process. Nonetheless, the ICES initiative to adopt an ecosystem-based approach to assessment and the provision of advice is not dependent upon the adoption of an integrated management approach.

#### **4.2. DEVELOPMENT OF A FRAMEWORK FOR AN ECOSYSTEM APPROACH TO OCEAN MANAGEMENT (CONCEPTUAL AND OPERATIONAL ASPECTS, INCLUDING LINKAGES BETWEEN FISH STOCKS AND THE ENVIRONMENT)**

##### *Request*

ICES has requested ACE to develop a framework for an ecosystem approach to ocean management. The operational aspects, including ecosystem inventories, are discussed here.

##### *Source of information presented*

The Annex 3 to the minutes of the June 2000 ACME meeting, Annex 9 to the 2000 Report of the ACME, the 2000 and 2001 reports of the Study Group on Ecosystem Assessment and Monitoring (SGEAM).

##### *Status/background information*

Within the new advice structure of ICES now being developed the ecosystem approach has become a major item to enable the assessment of human activities on the ecosystem. During the last few years ICES has tried to develop so called environmental status reports and has been involved in assuring the quality of international environmental quality status reports (OSPAR, HELCOM). To date these assessment reports do not have the character of an ecosystem approach.

One of the successful ICES products is the Ocean Climate Status Report produced by the Working Group on Oceanic Hydrography (WGOH). Other activities presently underway are the mapping of Harmful Algal Blooms (WGHABD) and a zooplankton overview (WGZE). All these products can be seen as results from operational monitoring activities as well as parts of ecosystem inventories.

##### 4.2.1. Future developments

To support integrated assessments, monitoring programmes provide updated information on status and trends. There is a need to move towards integrated monitoring in an ecosystem context. Thus, all elements in existing national and international monitoring programmes in a given ecosystem should be reviewed with the aim to incorporate them into an integrated ecosystem monitoring programme following appropriate adjustments. There is a considerable potential for a more comprehensive and efficient utilisation of monitoring results in integrated assessments.

Many commercial fish stocks are monitored regularly through research vessel surveys. In many instances, environmental data are collected during fish stock surveys. An example is provided by the ICES-co-ordinated IBTS (International Bottom Trawl Survey) in the North Sea. During this survey, hydrographic data are collected which provide semi-synoptic descriptions of the distribution of water masses and density fields. This has been accepted as a component in the international GOOS programme. Many laboratories also monitor nutrients during the winter IBTS. This has provided some of the most comprehensive data on winter nutrient distribution in the North Sea and was used in the 1993 North Sea QSR. With small additional costs it would be possible to extend this nutrient monitoring as a component of a systemic nutrient budget, productivity and eutrophication-monitoring programme.

Other elements, which could be included in the ecosystem inventory, are available on benthos communities from the BEWG, on ocean climate and modelling from WGOH, on zooplankton from WGZE and on Harmful Algal Blooms from WGHABD.

A more complete compilation of available information from WGs within ICES has been prepared by the Consultative Committee as Annex 1 to the 2000 ASC report.

Another important step in the monitoring of biota, of contaminants in organisms and on fish stocks will be the adoption of the EcoQO's. This will facilitate the monitoring effort to reasonable levels, because it is impossible to monitor complete and complex ecosystems.

#### 4.2.2. Framework for monitoring, assessment, advice and management

In the 2000 SGEAM report a simplified framework was presented for an ecosystem approach to the management of marine ecosystems to achieve sustainable use of ecosystem goods and services and conservation of ecosystem integrity. At the 2001 SGEAM meeting, the group further considered elaborating more specific aspects of the framework of particular relevance to the further development of ICES.

ICES has been involved in a framework for the provision of scientific information and advice for many decades together with various stakeholders operating within the areas of fisheries and environment via the advisory committees (e.g., Advisory Committee on Fishery Management, ACFM and Advisory Committee on the Marine Environment, ACME) and their subsidiary entities. With a few exceptions—these being requests for advice between these areas—the process has been primarily separate for fisheries and for environment, as illustrated in Figure 4.2.2.1. At the end of 2000, the Council of ICES established an additional advisory committee, the Advisory Committee on Ecosystems (ACE), to handle the provision of ecosystem-related advice as described in the new Rules of Procedure (Rule 26). In essence, the new system recognizes the ongoing commitment to the long-standing types of requests from environmental and fisheries commissions via ACME and ACFM, respectively, whilst also developing a more integrated approach to crosscutting issues via the new ACE.

Up to the end of 2000, the need for integrated advice was either dealt with by

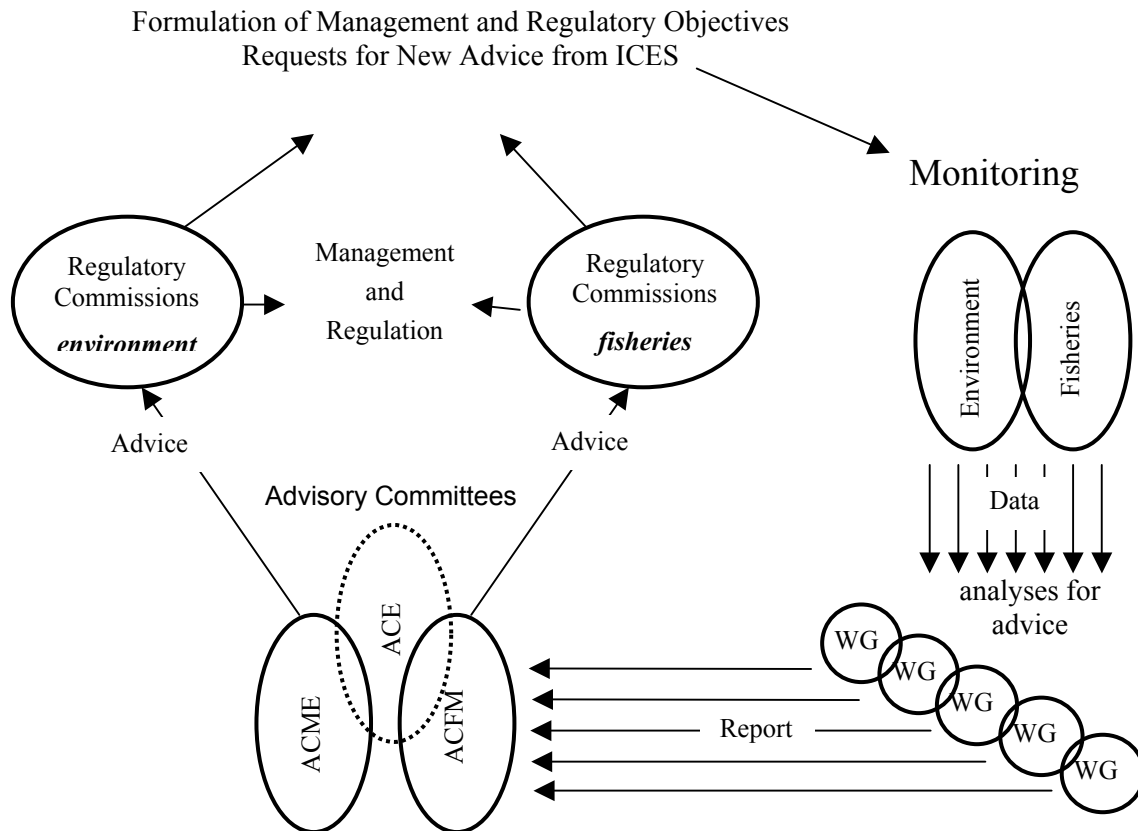
- integration “bottom up” via the novel WGECO approach with multidisciplinary experts involved in a single Working Group with peer-review by one or more of the existing advisory committees,
- or by tasking several individuals working on a sectoral basis and applying the integration of information and knowledge submitted via the advisory committees themselves.

There is a belief based on experience that it is very difficult to achieve successful integrated advice if this is not already happening at the assessment stage.

ACE now has begun a process of establishing a portfolio of working groups and a relevant quality assurance framework for ecosystem-related assessments. It is pertinent to note that ACE does not have an immediate externally driven client basis although it is expected that this will increase over the medium to long term. The question is raised as to what legitimate tasks ACE will address from the ICES viewpoint. Further, for the shorter term, ecosystem-based advice will still be requested by the existing regulatory commissions and the Member Countries, e.g., delivery of products to sectoral commissions, etc.

The SGEAM 2000 report and its framework figure recognises that managing the marine environment covers a wide variety of issues. The integrated management of these issues requires a coherent and transparent approach, and as a step towards delivering this within ICES Member Countries there are plans (for example, at a national level within the UK) to consider the integration of various monitoring and assessment programmes. An example of an overarching framework to implement such an approach was described in SGEAM 2000 and is schematically shown in Figure 4.1.4.

**Figure 4.2.2.1.** Present ICES advisory structure.



This describes a number of “key” thematic areas at a national level which, when linked (via the production of reports, consultation and the development of computer-based management tools), provides a transparent and auditable account of the scientific and regulatory decision-making process required to sustain marine ecosystem stakeholder values.

The main operational development task for ACE appears to be to supervise the exploration and establishment of ecosystem assessment methods at an appropriate regional scale, which in the medium and longer term can support an ecosystem advisory role.

Taking the Baltic Sea as an example, a key benefit of establishing a multidisciplinary regional working group approach is the provision of integrated assessments. ( cf. Fig. 4.1.2 in section 4.1.)

The assessments should be underpinned by appropriate monitoring of ecosystem status and change, involving human impacts and human profits (economics); this requires full access to the necessary knowledge and information base. Connected with this is the need to develop and enhance the research basis of scientific disciplines in line with a number of the “outreach” arguments of the ICES Strategic Plan; this can only be facilitated by broader-based stakeholder participation in the overall framework.

ACE will also be expected to provide particular advice connected with parts of the wider “ecosystem status” assessment(s). This is the practical operational product outside of ICES. However, although integration of the advisory product can be achieved, the question arises as to what mechanisms can be brought about at the current sectoral management levels that are represented via regulatory commissions for fisheries and for the environment in the form of HELCOM and IBSFC. The Baltic Sea has been highlighted by the GEF for the establishment and substantial funding of the BSRP as outlined earlier in this report, where a key aspect is the great potential for socio-economic benefits resulting from applying a Large Marine Ecosystem approach to science, advice and management. An important element in this is institutional strengthening and capacity building for valuing ecosystem goods and services as well as the capacity for local and regional integrated management. This also implies improved adaptive management for achieving sustainable development that integrates the environmental and living marine resources (e.g., fisheries and aquaculture) sectors. In order to achieve acceptance for the eventual outcome of the advisory and management process, a wider representation of stakeholders within ICES for building consensus is needed.

ICES makes a substantial contribution through ACE and a proposed Regional Ecosystem Group in the Integrated assessment and advice Groups in an ecosystem based management framework for the Baltic. The monitoring activities are strongly regulated by setting the ecosystem objectives (EcoQO's). The monitoring activities are organised through the HELCOM organisation. ICES supports with database facilities and QA of the data.

As stated by the SGEAM (2000, Annex 4) "The present monitoring of the North Sea is often insufficient to reveal human impacts on the ecosystem. There is a need for improved, integrated monitoring through co-ordination and harmonisation of existing national and international monitoring activities, as well as through implementation of new methods and technology." This statement clearly shows that there is a need for more integration that fits into the current ecosystem based concept for an improved advice.

Moreover monitoring requirements for performance indicators need to be developed.

#### 4.2.3. Chances for operational monitoring (e.g. section 4.3.)

Due to its long-term tradition ICES has many aspects of operational monitoring at hand. Several activities like the IBTS, measurement of nutrient concentrations along the European coasts, annual updates of HABs and several oceanographic standard transects are operational activities. To improve the use of this data there is a need for better products based on these activities. Instead of annual reports seasonal updates might be possible where relevant. Events occurring within ecosystems should be documented more rapidly and published through the ICES website or other adequate ways.

This would certainly improve the status of the organisation within society. Many of the activities depicted would also be part of future GOOS activities, especially within the Living Marine Resources module.

#### 4.2.4. Challenges

14.1.1 To improve the current advice on the basis of an ecosystem approach, e.g. to make integrated or ecosystem based assessments, a profound and intimate linkage between current distinct information e.g. on fish stocks and environmental information should be established. One manner of obtaining this linkage is the adoption of the Regional Ecosystem Groups as suggested by the SGEAM in 2001. Within these REG's information from the thematic WGs and SGs, from the Stock assessment WGs and other relevant information from ACME and ACFM should be combined. A control on the use of the concept of ecosystem approach should be made by ACE.

### 4.3. OPERATIONAL FISHERIES OCEANOGRAPHY: CONCEPTS AND APPLICATIONS

#### *Source of information presented*

SGGOOS 2000 Report, SGGOOS 1998 Report and ACME 1998 annual report (ICES Coop. Res. Rep. 233)

#### *Status / Background Information*

Operational oceanography, as used here, was defined (SGGOOS 1998) as:

**“OPERATIONAL OCEANOGRAPHY IS THE ACTIVITY OF ROUTINELY MAKING, DISSEMINATING, AND INTERPRETING MEASUREMENTS OF THE SEAS AND OCEANS AND ATMOSPHERE SO AS TO**

- Provide continuous forecasts of the future condition of the sea for as far ahead as possible(*Forecast*)
- Provide the most usefully accurate description of the present state of the sea including living resources(*Nowcast*)
- Assemble climatic long term data set which will provide data for description of past states, and time series showing trends and changes(*Hindcast*).”

The term, operational fisheries oceanography as used by ICES is defined here as “operational oceanography with particular application to understanding population fish dynamics”. Thus operational fisheries oceanography addresses long-term historical changes, present as well as predicted status of fish stocks.

In a poll conducted and reported by SGGOOS 98, it was indicated that ICES should “take the responsibility to establish and run a centre for operational fisheries oceanography on non-meteorological time scale (i.e. more than two weeks) or



on the time scale of fish stock assessment (some months) for the whole North Atlantic or parts thereof, i.e. the North Sea. The centre should co-ordinate national and international data collection, the rapid transmission of data to computerised data assembly centres for processing through numerical and statistical models to produce:

- regular climatic predictions (time scale season to some years);
- regular environmental status reports; and
- time series for identifying trends or changes.”

#### 4.3.1. Fisheries and operational oceanography

With acknowledgement of the utility of an ecosystem approach to ocean management, the relevance of operational oceanography (including living resources) for fisheries is clear. Integration of fisheries and environmental protection conservation and management measures should draw upon the development and application of an ecosystem approach, emphasising critical ecosystem processes and food web interactions.

With regard to *environmental assessments*, data from research activities contribute substantially as a supplement to monitoring results in describing the status and trends in the environmental situation. There is a considerable potential for improved collection and utilization of data through coordination and harmonisation of ongoing national and international monitoring activities.

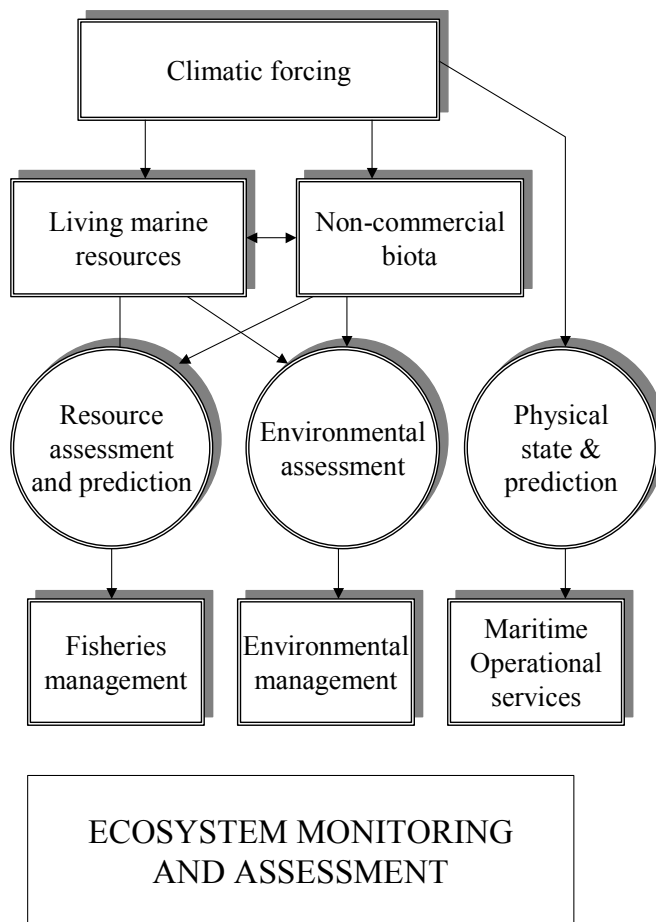
Updated information from monitoring is used at regular intervals along with general knowledge from research, to produce assessments. Assessments of fish stocks are generally produced on an annual basis, while comprehensive environmental assessments (e.g., Quality Status Report) are prepared at several years intervals. There is a need to improve integration of these assessments. More information on environmental variability could be used to improve assessments and forecasts of fish stocks. Similarly, information and expertise on fish stocks and fisheries could improve environmental assessments.

It follows from the interlinked nature of components of marine ecosystems that there is a large common element in the data and information required to assess the impacts of various (human) activities. SGG00S 2000 listed the following environmental variables to be of relevance for fisheries:

<b>Physical</b>	<b>Chemical</b>	<b>Biological</b>
Topography	Nutrients	Plankton
Hydrodynamics	Oxygen	Benthos
Hydrography	Seston	Fish
	Contaminants	Mammals
		Seabirds

The sectors of fisheries management, environmental management, and maritime operational services have to a considerable degree the same need for data and information although on different time scales. Assessments of living marine resources, environmental conditions and ecosystem state are most appropriately done on the scale of Large Marine Ecosystems (LMES). The effects of climate variability and change as ecological driving force are assessed through downscaling from global or large regional scale. The effects of multiple human uses and impacts on local scale in the coastal and inshore environment are assessed through integration for their summed and combined effects on populations and habitats at the scale of the larger ecosystem.

**Figure 4.3.1** Common need for data and information on climatic and meteorological variability, living marine resources, and non-commercial biota for the purposes of the sectors of fisheries management, environmental management, and maritime operation services (SGGOOS)



Recommendations from the EuroGOOS/ICES Workshop on Bio-ecological Observations in Operational Oceanography (Den Haag, April 2000) were made with respect actions needed to support ecosystem models. The bulk of these recommendations are applicable here for operational fisheries oceanography, and they are adopted here and listed below:

*User involvement* - user surveys needed, along with improved interaction with stakeholders.

*Biological Monitoring Technology* - biosensors need to be developed and improved. Methods require standardisation, and *in situ* time series are needed for the calibration of remote sensing.

*Fish Stock Assessment* - variables and models needed to describe and predict fish distribution and abundance should be identified, and a relevant monitoring strategy determined. Spawning areas should be monitored, and more attention should be paid to non-commercial fish.

*Sampling Strategy* - an integrated sampling strategy is needed, using operational bio-ecological models to determine type and resolution of variables required. The frequency and accuracy of biochemical measurements must be balanced against user needs. Existing data bases should be better used, as should smart moorings and ship of opportunity automatic sampling.

*Long-term Databases* - long-term databases are needed.. The systematic collection of biological data by national and international agencies is required, and data access should be facilitated. A repository for data analysis software is needed.

*Data Analysis* - Virtual data analyses centres should be established, along with quality criteria for parameters, methods, processes and model results.

*Modelling Requirements* - Models need to be standardised. Shared models should be developed, with better cooperation amongst modellers. Models require high frequency data for calibration and validation, and new models are needed to meet user needs. Nested models can be used at different scales. Benthic processes and benthos-pelagic interactions require an improved understanding.

*Products* - The visualisation of data analysis and model results should be emphasised, and possible products listed.

#### *Recommendations*

Review the environmental variables of relevance for operational fisheries oceanography and specify suitable parameters of measurement for each category.

ICES should consider which existing WGs may function best under ACE.

#### *References*

## ANNEX 4: PLANS FOR THE WORKSHOP ON ECOSYSTEM MODELLING- DRAFT 3

### *Request*

There is a request from the chair to consider plans for a Workshop on Ecosystem Modelling. This is a general request for information based on the role of ACE as the primary source of scientific information on the status and outlook for marine ecosystems as agreed at the 2000 Statutory Meeting of ICES. However, ACE agreed that it was not within the remit of the meeting to offer ICES funding.

Review the plans for holding a Workshop on Ecosystem Modelling, as prepared by the Planning Group for a Workshop on Ecosystem Modelling (PGEM), and propose means to assist in the further conduct of the preparations for this Workshop (including funding support, if possible)

### *Background*

The proposed workshop, for which the PGEM has developed plans, was arranged in response to the progress made by the Working Group on the Ecosystem Effects of Fishing Activities (WGECO, 1999) on its term of reference "to commence a review of the principal models of ecosystem dynamics and develop specific predictions based on them for the ecosystem effects of fishing". The PGEM took a broad definition of an ecosystem effect, essentially considering any effect on one species caused by the exploitation of another as being an ecosystem effect.

The aims of the proposed workshop were 1. to make rigorous comparisons between different families of dynamic models that vary in their complexity/ architecture and between model outputs and reality, 2. to examine the way models deal with and respond to uncertainty in their parameters and in data and 3. to provide a "framework" that can be employed in the future for comparisons of other ecosystem models.

ACE recognises that it is desirable to complete comparison exercises between ecosystem models, and consider that such comparisons will yield information that can usefully inform an ecosystem approach to management and working groups such as WGECO.

The models which the PGEM considered suitable for comparison were ECOPATH, MSVPA and BORMICON. ACE regard a workshop for the comparison of ecosystem models as desirable and the aims of the proposed workshop were relevant to the ecosystem approach to fisheries management. However, ACE have three concerns.

- 1) 1. The proposed workshop should not replicate work that is currently in progress. PGEM note that a number of similar comparisons of ecosystem models are already in progress and will replicate some of the comparisons they propose. PGEM do not specify the projects, but ACE are aware that components of the EC funded Framework V project 'Development of Structurally Detailed Statistically Testable models of marine populations' (DST) and others address some of these comparisons. DST involves 8 institutions, and the group will be collecting relevant data before developing and testing BORMICON/ GADGET/ MULTSPEC models and MSVPA and using them to evaluate reference points for safe exploitation. There are also national and bilateral projects that include a collaborations between the Institute of Marine Research (IMR), Bergen, University of British Columbia, Canada (UBC) and the Norwegian College of Fisheries Sciences where Ecopath and MULTSPEC models for the Barents/Norwegian Sea will be compared. UBC and the Danish Institute of Fisheries Research (DIFR) are comparing MSVPA and Ecosim models for the North Sea, there is a NATO funded ecosystem modelling project that involves Istanbul Technical University and the US Fish and Wildlife service and there are other relevant initiatives in progress in the Baltic.
- 2) 2. The aims of the workshop as stated were considered to be too ambitious for a single workshop and would more easily be addressed within the framework of long-term projects.
- 3) 3. Representatives of a number of the key modelling studies currently in progress were not present at the PGEM.

ACE also noted that extensive comparisons have already been made between ecosystem models which emphasise processes at the lowest trophic levels and the effects of nutrient inputs (ERSEM etc). Effects on higher trophic levels are not widely incorporated in these 'ecosystem' models because the complexity of feeding relationships at higher trophic levels is often difficult to deal with on the same scales. However, the modellers consider that these ecosystem models could usefully be developed to incorporate higher trophic levels and trophodynamics. Any modelling initiatives that are supported by ICES should be used as a forum to encourage interaction between modellers working on the lowest and highest trophic levels.

### *Advice*

ACE considers that the comparison of ecosystem models can usefully inform the development of an ecosystem approach to management.

ACE recommends that the existing plans for a workshop on ecosystem models (PGEM, 2001) need to be developed and strengthened to account for the model comparisons that are currently in progress, to reflect the period available to do the proposed work, and to include representatives of all the key groups involved in relevant modelling work.

ACE recommends that a second Planning Group for a Workshop on Ecosystem Models should be held, ideally in early 2002, to develop revised plans for the workshop. These plans will be considered at the next meeting of ACE. The recommended Terms of Reference for this group are:

- 1) To compile a comprehensive list of ecosystem modelling work in progress within ICES member states;
- 2) To establish which comparisons between ecosystem models have already been completed;
- 3) To determine the requirements for additional comparisons between models;
- 4) Subject to a need for additional comparisons between models, develop plans for a workshop at which models will be compared.

ACE could not advise on sources of funding, but the chair noted that delegates attending ICES meetings were usually funded by their supporting national institutions.

### **Reference:**

ICES. 2001. Report of the planning group for a workshop on ecosystem models. ICES CM 2001/ ACME:06

## ANNEX 5: PROPOSAL FOR THE 2<sup>ND</sup> ENVIRONMENTAL DIALOGUE MEETING

### *Request*

The Consultative Committee has asked ACE to develop a proposal for a Dialogue Meeting to focus on advice relevant to marine ecosystems. The proposal should consider issues and questions to be addressed at such a meeting and further planning beyond the meeting. Each ICES Member Country shall be invited to send three participants in addition to participants from partner commissions and other relevant organisations.

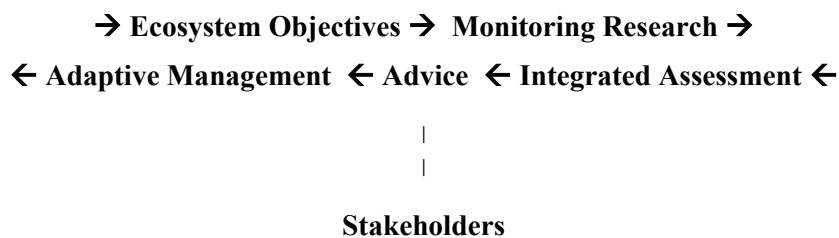
### *Status/background information*

The 12<sup>th</sup> Dialogue Meeting was held in Bonn in September 2000 and was the first Environmental Dialogue Meeting. The following comments (ICES Coop. Res. Rep, No. 243) were made during the meeting:

“The biological couplings and the multiple human impacts in open marine ecosystems are the main reasons why we need a holistic and integrated approach to our studies and management of marine ecosystems. The integration involves two different aspects or levels. The first level is the ecosystem, where we need to take into full account the integrated nature of marine ecosystems with their biological couplings and climatic driving forces. The second level is the management system where there is need for integration through close cooperation between the various sectorial management branches. These two levels of integration are the main principles and pillars of an Ecosystem Approach....

The ACME has proposed the following definition for an Ecosystem Approach to Ocean Management: “Integrated management of human activities based on knowledge of ecosystem dynamics to achieve sustainable use of ecosystem goods and services, and maintenance of ecosystem integrity.”.....

**Figure 1.** Framework for an ECOSYSTEM APPROACH to Ocean Management (modified from ICES Coop. Res. Rep, No. 243).



[A] key recommendation should relate to the role of ICES in the development of ecosystem advice....ICES should work with the Commissions to draft the questions more precisely and to provide a response as soon as possible.....”

Much has been written about the principles that should underlie an ecosystem approach to fisheries management. These principles apply also for the most part to the broader concept of providing advice on ocean management. Sissenwine and Mace (2001) suggest that the key elements of the approach should include (amongst others) decision-making that is participatory and transparent, as well as management support including scientific information, enforcement, and performance evaluation. The authors suggest that (Fisheries) Ecosystem Plans are a useful vehicle for designing and implementing (fisheries) management systems. Such Plans should highlight a hierarchy of management entities from the ecosystem scale to the local scale of communities.

**PROPOSED AGENDA FOR THE  
ICES 2<sup>ND</sup> ENVIRONMENTAL DIALOGUE MEETING**

**THE ROLE OF ICES TO PROVIDE SCIENTIFIC ADVICE  
IN AN ECOSYSTEM APPROACH TO OCEAN MANAGEMENT**

**Steering Committee**

Stig Carlberg  
Tore Jakobsen  
Michael Sissenwine  
Hein Rune Skjoldal  
??

**PLENARY SESSION 1 - The evolution from single-species to ecosystem-based management**

Lecture topics may include:

- a) Introductory lecture - Hein-Rune SKJOLDAL (Chair, ICES Advisory Committee on Ecosystems)
- b) Governance for responsible management of marine resources: an ecosystem approach - Mike SISSEWINE or Pam MACE (U.S. National Marine Fisheries Service)
- c) one more

**SIMULTANEOUS WORKSHOPS in the afternoon**

Each workshop to begin with two lectures followed by discussion.

**Workshop 1: The roles of ICES Advisory Committees in the Ecosystem Approach to Ocean Management**

As ocean-management principles evolve with the growing acceptance of an ecosystem approach, the advisory process must keep pace. Traditionally the Advisory Committees on Marine Environment (ACME) and also on Fisheries Management (ACFM) have gathered information necessary for the formulation of advice via Work Groups and Study Groups focusing on single disciplines. It was acknowledged by ICES that the structure of these Committees was not especially conducive to the ecosystem-based approach to resource management. This led to the creation of the Advisory Committee on Ecosystems (ACE), which employs not only Work and Study Groups on specific disciplines but also Regional Ecosystem Groups (REGs) to address broader interdisciplinary issues. REGs are compatible with the scientific concept of Large Marine Ecosystems (LMEs) and management concepts of Fishery Ecosystem Programs (FEPs) and Ocean Management Areas (OMAs). Relative to ACME and ACFM, the new ACE and REGs may be in a better position to provide advice on new, less traditional strategies for ocean management. Further, for the ecosystem approach to ocean management, ICES may play an important role to provide independent and transnational advice on LME-scale issues for particular resources with reference to a suite of environmental factors and cumulative effects of these.

How can ICES, using the ecosystem approach, facilitate the formulation of large-scale or new ocean-management policies? For example, is the multidisciplinary ecosystem approach appropriate for addressing alternative incentives for habitat conservation via implementation of a system to license rights for the common use of habitat, e.g. aggregate extraction, fisheries, bioprospecting, seabed engineering including petroleum activities, etc.. How can ICES, particularly ACE and the use of REGs, serve to provide advice useful for the development new progressive management practices? Is the ICES infrastructure compatible with these needs?

**Workshop 2: The importance of participation and transparency in the advisory process: implications for stakeholders and resource managers.**

Scientific advice on management of marine resources requires that managers and stakeholders appreciate the complexity of ecosystems and appreciate the effects of management actions. For this reason, it may be appropriate for

stakeholders and managers to have the opportunity to participate in the advisory process. Stakeholders include the industries, environmentalists with concerns about the effects of management actions on ecosystems, and anyone who is interested in the distribution of benefits. There are many different types of arrangements for stakeholders to participate in decision-making, ranging from having the opportunity to comment before final decisions are made, to having input into the initial stages of decision-making where options are being formulated, to delegation of management authority to some stakeholders to make some of their own decisions. The advisory process may require as much participation in decision-making as is practical, recognizing that ultimately, a management authority (e.g., government officials or a council of stakeholders) must be charged with weighing the options and making a decision.

One important reason for this is to focus on potential points of contention with respect to advice and implementation by management. For example, it has become common in the United States for participants in the fisheries management decision-making process to seek to overturn decisions using litigation. This probably could have been avoided in many cases, if the stakeholders had been involved at an early stage in raising issues demanding attention during the advisory process.

What can ICES do to promote participation and transparency of the process? How can this be helpful in the interpretation of advice and implementation by management? How can this promote acceptance by stakeholders? What are particular issues of concern, for which this would apply?

### **Workshop 3: Management support of scientific objectivity, enforcement, and performance evaluation**

Management of marine resources depends on collecting objective scientific information and providing objective scientific advice. Compliance with management rules requires either rules that the industry believes in, such that most of the industry willingly, or it requires enforcement capability and sufficiently severe penalties to force compliance. Obviously, the former is preferable, and Workshop 2 shall discuss one way to promote this belief. Further, performance evaluation is a valuable element of a management system because it is a way to monitor the implementation of rules and research as well as a way of learning from experience so that management can be improved and is adaptive. It is important to recognize that separating or shielding scientific institutions from management may facilitate objectivity of performance evaluation.

Providing advice to any one governing body on management measures to promote scientific objectivity and to permit the monitoring and evaluation of performance is difficult. Providing this advice on an ecosystem-wide scale, typically of transnational nature, is a great challenge. Is ICES in the position to advise on the means to implement this support? How? What is the danger of political bias in the advisory procedure?

### **References**

ICES Cooperative Research Report No. 243.

NRC 1997. Striking a balance: Improving stewardship of marine areas. National Academy Press. Washington, DC. 177pp.

Sissenwine, Michael P., and Pamela M. Mace, 2001. Governance for responsible fisheries: an ecosystem approach. To be presented at FAO Conference on Responsible Fisheries in the Marine Ecosystem, 1–4 October 2001, Reykjavik, Iceland.