**Advisory Committee on the Marine Environment** **ICES CM 2001/ACME:06**
**Ref.: ACE**

**REPORT OF THE**

# PLANNING GROUP FOR A WORKSHOP ON ECOSYSTEM MODELS

**ICES Headquarters**
**6–8 March 2001**



International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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# 1 INTRODUCTION

## 1.1 Venue and Attendance

The Planning Group for a Workshop on Ecosystem Models (PGEM) met from 6 to 8 March 2001 at ICES Headquarters in Copenhagen. The meeting was opened at 09:30 hrs by the Chair, Dr Chris Frid, and PGEM was welcomed by Janet Pawlak, the ICES Environment Adviser. Members attending the meeting were:

| | |
|---|---|
| Bjarte Bogstad | Norway |
| Geoff Evans | Canada |
| Chris Frid (Chair) | UK |
| Henrik Gislason | Denmark |
| Sture Hansson | Sweden |
| Peter Lewy | Denmark |
| Leonie Robinson | UK |
| Verena Trenkel | France |

Contact information for the participants is attached as Annex 1.

## 1.2 Terms of Reference

The terms of reference for the meeting are contained in ICES C.Res. 2000/2ACME06, as follows:

The **Planning Group for a Workshop on Ecosystem Models [PGEM]** (Chair: Dr Chris Frid, UK) will meet at ICES Headquarters from 6–8 March 2001 to:

a) specify the ecosystem models whose performance would be evaluated at a proposed Workshop to be held in 2002;

b) specify the data sets that need to be available for the Workshop, to allow the performance of the ecosystem models to be evaluated in usefully rigorous ways;

c) specify the properties of the ecosystems whose status will be "monitored" and contrasted across models;

d) develop a workplan, with specific tasks and deadlines, that, if implemented, will maximise the likelihood that the items specified in a) to c) will be available at the start of the Workshop.

PGEM will report by 30 March 2001 for the attention of ACME, the Marine Habitat Committee, and ACE.

# 2 OVERVIEW AND GUIDE TO THE REPORT (PREPARED BY THE CHAIR OF PGEM)

The meeting was attended by a small but very hard working group of participants. The task PGEM had been set is an important one that has the potential to influence the development of policy and the task of implementing ecosystem-level fisheries management. At times, PGEM felt frustration about the size of the task but also excitement about the intellectual challenges presented.

PGEM initially agreed on a criterion for an ecosystem effect (Section 3). We kept this broad so as not to exclude any effects that might be of interest to any group. PGEM then developed a set of what it hopes are achievable aims for the workshop. These form the basis of the workplan. At this point, it must be noted that PGEM separated the ecosystem-level effects from the ecosystem, i.e., we can predict an ecosystem effect without necessarily knowing all the ecosystem interactions. However, in this case we have no way of knowing the relative magnitudes of the predicted effects or any other effects.

PGEM then attacked Term of Reference (c) (see Section 4), which provides a checklist of the ecosystem effects PGEM would expect its tested models to yield information on.

The review of the available models for Term of Reference (a) provided the opportunity for some lively discussions. However, PGEM quickly settled on a limited number of models (or model architectures) to examine in more detail (Section 5). This was based on the availability of both a working model formulation and personnel familiar with it. Alongside this, we considered the data needs and testing procedures for our proposed comparisons (Section 6). It must be noted that the number of models available is limited and the differences in their architecture render it impossible to make a number of the comparisons one would normally deem desirable, for example challenging different models with the same data/parameter sets. It is possible to derive predictions of ecosystem effects from each model and so comparisons of the scale and nature of the effects predicted can be made and to some extent these can be contrasted with data from the real world. The group felt very strongly that the persons who initiated this proposed workshop appreciate that the limits to what it can achieve are set by the number and types of models actually available at this time.

PGEM has developed a work programme based on comparisons of three model families (Section 7). PGEM has also identified personnel that can allow comparisons of these models in three sea areas. In addition, comparisons could be made in Icelandic waters, but at the time of the meeting it had proved impossible to have any expert from Iceland to make the necessary commitment. It was the hope of the group that between the Planning Group meeting and the workshop this situation may change and comparisons could be made for a fourth area.

PGEM also identified the OSMOSE model as potentially being useful in generating null models systems for testing purposes. The lack of expertise amongst the group prevented it from being able to fully evaluate this possibility.

PGEM would appeal to anybody with other models they feel should be included to contact the Chair and, if possible, to take part in the workshop. A similar call goes out to anybody with other case studies of the models presented for evaluation. However, if this is not possible in the time available before the workshop, then the framework developed at the workshop for model evaluation will at least allow other experts to carry out comparative trials later.

PGEM remains optimistic that the proposed workshop will lead to significant advances, but again cautions that they will be less than many would hope for. Advances will only be made, however, if the appropriate individuals are brought together and the preparatory work detailed in Section 7 has been adequately carried out.

## 3 FORMULATION OF WORKSHOP AIMS

The proposed workshop, for which PGEM is developing plans, arose in response to the progress made by 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 Planning Group has taken the 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 proposed workshop will be entitled *Modelling ecosystem dynamics to explore the ecosystem effects of fisheries*. Its aims are to:

a) make rigorous comparisons between:
   - different families of dynamic models varying in their complexity and architecture;
   - model outputs and reality.

   These comparisons will include the ecosystem effects they estimate to have occurred and their ability to provide predictions.

b) examine the way models deal with and respond to uncertainty in their parameters and in data;
c) provide a “framework” that can be employed in the future for comparisons of other ecosystem models.

## 4 ECOSYSTEM EFFECTS OF FISHERIES WHICH MODELS NEED TO BE ABLE TO PREDICT (TOR (C))

In order to establish which ecological models can be used to examine the ecosystem impacts of fishing, it is first necessary to establish what the properties altered might be. A lot of attention has recently been directed at assessing the impacts of fisheries on the ecosystem (ICES, 1998, 2000; Frid *et al.*, 1999; Hall, 1999a, 1999b). This has in part been driven by the need to ensure conservation of biological diversity and sustainable use of the biosphere, key provisions of the convention agreed at the UN Rio summit (Tasker *et al.*, 2000).

Fishing activities influence marine ecosystems in a number of ways (for reviews see Gislason, 1994; Dayton *et al.*, 1995; Hall, 1999b; Gislason *et al.*, 2000). These include:

1) direct removal of target species;
2) direct changes in size structure of target populations;
3) alterations in non-target populations of fish and benthos (Rumohr and Krost, 1991; Camphuysen *et al.*, 1995; Tuck *et al.*, 1998);
4) alteration of the physical environment (Churchill, 1989; Messieh, 1991; Riemann and Hoffmann, 1991; Auster *et al.*, 1995; Schwinghamer *et al.*, 1996; Collie *et al.*, 1997);
5) alterations in the chemical environment, including nutrient availability (ICES, 1998);
6) altered predation pressure (Frid *et al.*, 1999) and trophic cascades (Carpenter *et al.*, 1985).

The ecological effects of fishing extend over multi-decadal time scales (Frid and Clark, 2000) and operate at spatial scales ranging from processes within the trawl tracks (Kaiser and Spencer, 1994) to changes at the scale of the coastal sea (Frid *et al.*, 2000). We can also infer changes across the full spectrum of trophic levels. The phytoplankton, through altered nutrient fluxes. The benthos, both by direct mortality and indirectly through altered predation pressure and competition. The fish as a result of direct fishing mortality and indirectly by provisioning from discards and altered competitive regimes. The top predators by both provisioning and direct mortality of birds (Camphuysen, *et al.*, 1995; Hall, 1999b) and altered food resources for marine mammals (Kaiser and de Groot, 2000). The need to conserve biodiversity, and to manage in a precautionary manner, are requirements of international conventions. The extensive changes wrought by fishing on the aquatic ecosystems would, therefore, suggest an urgent need to explicitly incorporate ecosystem considerations into fisheries management (ICES, 2000).

We consider those properties of ecosystems of most concern to the public that might be influenced by fishing activities (Table 4.1). These changes result from both the direct and indirect ecosystem impacts that fishing might have on ecological processes (Table 4.2).

Fishing effects clearly have the potential to ramify through the ecosystem. Any model that will offer insights into the direct and indirect effects of fishing at the ecosystem level should provide the ability to follow these ramifications through the ecosystem or in aggregate emergent properties of the system.

**Table 4.1.** Properties of ecosystems potentially altered by fishing and of general concern to the public.

| |
|---|
| Abundance changes in commercial stocks |
| Temporal variability in commercial stocks |
| Geographic range of commercial stocks |
| Size/age distribution of commercial stocks |
| Loss of charismatic species |
| Geographic range of charismatic species |
| Increase in “nuisance” species |
| Altered “biodiversity” |
| Altered productivity |
| Loss of habitat features |
| Increased vulnerability to perturbations |

**Table 4.2.** Direct and indirect impacts of fishing on ecosystem rates.

| Impact | Direct effects on rates | Indirect effects on rates | References |
|---|---|---|---|
| Removal of target species and incidental catch | Mortality of target species and other fish and invertebrate species incidental to catch | Changes in trophic interactions such as predator-prey dynamics, trophic cascades, changes in nutrient and carbon cycling | Andersen & Ursin, 1977; Carpenter *et al*., 1985; Hall, 1999b |
| | Altered life history parameters resulting from density dependence | Prey decreases for top predators such as marine mammals, seabirds and sharks | Hall, 1999b; Kaiser and de Groot, 2000 |
| By-catch and discards | Mortality of undersized target fish | Increases in scavengers including species of benthos, demersal fish and seabirds | Frid *et al*., 1999; Hall, 1999b |
| | Mortality of non-target species including fish, marine mammals and seabirds | Changes in trophic interactions such as predator-prey dynamics, trophic cascades | Brothers, 1991; Heessen & Daan, 1996; Hall, 1999b |
| Seabed disturbance due to trawling and dredging | Mortality of benthic assemblages, in particular vulnerable, fragile species | Changes in food-web dynamics (bottom-up control?) | Kaiser & Spencer, 1995; Hall, 1999b |
| | | Increases in scavengers including species of benthos, demersal fish | Kaiser & Spencer, 1994; Frid *et al*., 1999; Hall, 1999b |
| | Resuspension of nutrients and particulates | Knock-on effects of resuspension of nutrients including temporary phytoplankton and nutrient cycling changes | ICES, 1998; Hall, 1999b |
| | Habitat disturbance and modification | | Hall, 1999b |
| Lost gear and litter | Incidental mortality (ghost fishing) of seabirds, marine mammals and fish | | Hall, 1999b |

# 5 MODELS WHICH CLAIM TO BE ABLE TO EXPLORE THE ECOSYSTEM EFFECTS OF FISHING (TOR (A))

A list was compiled of models that compute the ecosystem effects (as defined in Section 3) of fishing. In Working Paper 1, Frid and Robinson scored a selection of models on their ability to give useful insights into the ecosystem effects of fishing and selected eight as giving the best coverage of ecosystem components. These eight models were six from the ECOPATH with Ecosim family, the European Regional Seas Ecosystem Model (ERSEM), and the Andersen and Ursin multispecies extension to the Beverton and Holt model. To this list PGEM added MSVPA/MSFOR, BORMICON, and OSMOSE.

The Andersen and Ursin multispecies extension to the Beverton and Holt model was not considered further as it has been succeeded by other models of the age/size-structured class of ecosystem models such as ERSEM (Baretta *et al.*, 1995).

## ERSEM

ERSEM is currently being extended to cover the entire “European shelf”. It is a model based on biogeochemical fluxes and the bulk biomass of functional groups. As such it is suitable for simulating rapid turnover taxa but fails to capture the richness of the dynamics of longer-lived groups such as fish, benthos, birds and mammals (Mike Heath, FRS, Aberdeen, pers. comm.).

## ECOPATH with Ecosim

The base for Ecosim analyses is a food web model (ECOPATH) (Christensen and Pauly, in prep.; Walters *et al.*, 1997). This model holds data on biomasses, production/biomass, consumption/biomass, production/consumption, and diet composition for each component in the food web. The production of each component must meet the consumption demands of all "species" that "eat" it (i.e., the food web model must be balanced). This means that the model ideally should be parameterised with data from periods when fish stocks were in equilibrium, or at least not overexploited. The fishery is handled as a "species" that "eats" target species. Parameters that are computed in ECOPATH are exported to Ecosim, where responses to variations in production or consumption (e.g., fishing pressure) are explored through simulation. The model can also be fitted to time series.

The ECOPATH model requires inputs of food web structure and for each individual web component (box of the model) a complete diet composition and the input of three of the variables biomass, production/biomass, consumption/biomass, production/consumption and ecotrophic efficiency. The model then calculates the remainder of the terms. Although no further data are required for the running of Ecosim, a more comprehensive understanding of the ecology of concerned groups allows modifications of the character of the trophic interactions, for example the degree of top-down/bottom-up control for each web component and the division of web components into juveniles and adults. Effects of external forcing factors (e.g., eutrophication-induced changes in the primary production) can also be added at this stage before responses to variations in production or consumption are simulated.

**MSVPA/MSFOR**

Multispecies virtual population analysis (MSVPA) (Gislason and Sparre, 1987) is a deterministic, age-structured model. The model is a virtual population analysis (VPA) where predation mortality by age over time for the prey species is calculated from food preference parameters—the so-called suitability parameters. Stomach contents data can be used for one or several years. The suitability parameters are assumed constant over time. Three categories of species can be included: species dynamically treated in the model, "other predators" and "other prey". The biomass of the last two categories is input to the model and is included in interactions between species. Growth can be either modelled as a function of food availability or treated as a known constant. Outputs from the model are stock numbers, predation mortality and fishing mortality by species, time and age. Expected catch and stomach contents will also be available.

A prediction model MSFOR including a stock-recruitment function is also available (Vinther *et al.,* 2001). The model is implemented on a quarterly basis. It has been applied to the North Sea and the Baltic Sea. The data requirements to run MSVPA/MSFOR for the species dynamically treated in the model are numbers-at-age and mean weight-at-age for catches included by year and quarter; mean weight-at-age in the sea by year, quarter and species; proportion mature by year, species and age; total consumption of the predators by species and age and mean proportion in the stomach of predator species by age, of prey species by age. For "other predators" and "other prey", biomass and natural mortality excluding predation are included, by species and age.

**BORMICON**

BORMICON is a multi-species/multi-area/multi-fleet forward simulation, modelling framework, where the stocks are structured by length/age/area. Choices of functional forms for population dynamics processes (growth, maturity, spawning, predation, fishing mortality, migration) need to be made. These functional forms are mainly length-based. The parameters in the specific model are estimated using a maximum likelihood approach. For model applicability, some parameters, e.g., migration parameters, may have to be fixed based on knowledge or external data analysis. In this framework, different model formulations can be compared statistically based on their goodness-of-fit.

The data sources that may be used for parameter estimation include data from commercial catches, scientific surveys, stomach content and tagging experiments. The level of resolution of the data may vary between species, areas, fleets and surveys. For commercial catch data, numbers by species/time/area/fleet/age/length and/or tonnes by species/time/area/fleet are used. Abundance indices by species/survey-type/time/area/age/length are derived from scientific surveys. For stomach contents, weight/number and length group of each prey species are recorded by predator species/time/area/age/length. A stomach evacuation rate model or a bio-energetic model is needed to convert stomach content to consumption rate. Finally from tagging experiments, the numbers of tagged and recaptured fish by species/time/area/age/length are utilised. Model outputs include number and biomass of the stocks, as well as catches and consumption (absolute values and rates) at any time and at any model level of detail.

Existing implementations include a three-species model (cod, capelin, shrimp) for Icelandic waters (Stefánsson and Pálsson, 1997; Stefánsson, 1998; Björnsson, 1998). The philosophy behind the choice of BORMICON-type models for boreal ecosystems is described in Stefánsson and Pálsson (1998). A single-species implementation of BORMICON as an assessment tool for Northeast Arctic cod is described in Frøysa *et al.* (2001). The BORMICON modelling framework is also used within the EU project DST2 (Developing structurally detailed statistically testable models of marine populations). It is utilised to build a multispecies, multi-area, multi-fleet model for the Celtic Sea. The work is carried out jointly by IFREMER (France) and CEFAS (England). The collection and compilation of data started in 2000 and is due to be completed by mid-2001. It is expected to have an initial model running by the end of 2002. In parallel, an ECOPATH model for the Celtic Sea is being implemented by the English partner. The intention is to use the ECOPATH framework to explore food web dynamics and then, for the chosen model realisations, to compare the results of the two models.

Simulations with MULTSPEC (a predecessor to BORMICON) including the species minke whale, harp seal, cod, herring and capelin have been performed for the Barents Sea (Bogstad *et al.*, 1997). The model realisation demonstrated a number of indirect effects of fishing.

**OSMOSE**

OSMOSE is an individual-based simulation model that has been developed for investigating the dynamics of exploited fish communities (Shin and Cury, in press). It allows the representation of age- and size-structured populations that interact within a spatially resolved food web. Individuals belonging to the same species have similar biological parameters and follow similar behaviour rules. Somatic growth, reproduction, predation and starvation processes are modelled. Predation depends on size only independent of species. Using simulated communities, emergent properties such as community stability have been investigated. To date the model has not been applied to any real system.

# 6 DATA REQUIREMENTS, DATA AVAILABILITY AND MODEL TESTING PROCEDURES (TOR (B))

## 6.1 Testing Procedures

Using any candidate model to compute an ecosystem effect of fishing entails running it at different levels of fishing, with otherwise identical parameters. An effect, whether direct or "ecosystem", is then the difference between some characteristic indicator for the different levels. This in turn entails a need to run the model with a set of parameters chosen by the user, independent of any data set it might have been fitted to.

Although it is convenient to refer to ECOPATH with Ecosim, BORMICON and MSVPA/MSFOR as models, they are better seen as model schemata; what we actually have to compare is individual realisations of a model – choices of species, linkages, functional forms, etc. – within each schema. So even after we have decided to apply both ECOPATH with Ecosim and BORMICON to the Celtic Sea, it will be valuable for the people making the applications to talk to each other well before the workshop, with the idea of working with compatible realisations to the extent this makes sense. This is a large component of the pre-workshop workload. Available at the workshop, and ideally distributed among participants well in advance, will be a comparative description of the detailed assumptions and restrictions of each schema, including places where they are compatible and places where they are irreducibly different. It may be possible and desirable during the workshop to experiment with minor modifications of a realisation within a schema.

Each of the three prime candidate models comes with its own scheme for determining parameters. BORMICON and (indirectly) MSFOR/MSVPA choose parameters that minimise a misfit between model predictions and observations; ECOSIM with ECOPATH requires a large number of parameters to be asserted, and chooses others to maintain internal consistency. PGEM felt that it would not be profitable to look for a common, model-independent parameter-setting procedure. The data used in the three schemata are so different that deciding which model can best fit the data is scarcely an issue. This would seem to imply that we cannot rank the models according to accuracy; the workshop will be restricted to reporting the similarities and differences in the effects they predict. We can of course, even before the workshop, compare the models according to which effects of interest they even purport to be able to predict. It is also probably true that we will not have fished and un-fished data sets for different periods from the same area, to see whether any prediction of an effect had been correct. The outcomes of the workshop will inevitably be modest.

It is part of good modelling practice to determine how well the model parameters are known, and how wide a range of results (of ecosystem effects of fishing, for example) is consistent with the available data.

## 6.2 Models to be Tested

Three model schemata were chosen as appropriate for exploring at the workshop, based on their ability to compute many relevant characteristics and the availability of a "champion" to coordinate the work needed before and during the workshop. These were ECOPATH with Ecosim, MSVPA/MSFOR, and BORMICON. In addition PGEM would also strongly support the involvement of ERSEM if an updated version is available. The possible use of OSMOSE as a simulation tool for use during the workshop in providing null models should also be explored.

The three schemata differ in their ability to distinguish the various types of ecosystem effect (Table 6.2.1). All have the ability to predict changes in the abundance of species that are not the principal target of the fishery and hence some measure of the biodiversity of the system. They can all make predictions about the degree of variability in the system (if the models are given suitable variable forcing) and hence its vulnerability to perturbations, both anthropogenic and natural. All three models provide only a limited ability to predict changes in carbon and nutrient flows. The models differ in the degree to which they can resolve changes in charismatic/nuisance species, size/age spectra and the geographical ranges. (PGEM is aware of the implementation in the near future of Ecospace, a module which will allow the ECOPATH with Ecosim family to provide spatially resolved output.)

**Table 6.2.1**. Ecosystem effects categories predictable (fully * or partially ?) by each class of model.

| | Altered size/age spectra | Temporal variability/ Vulnerability to perturbations | Changes pop. sizes | Altered biodiv-ersity | Changed nutrient or carbon cycling | Altered abundance of charismatic/ nuisance spp. | Altered geographical range |
|---|---|---|---|---|---|---|---|
| ECOPATH with Ecosim | | * | * | * | ? | * | (? Ecospace ) |
| MSVPA/MSFOR | ? | * | * | * | ? | | |
| BORMICON | ? | * | * | * | ? | ? | ? |

## 6.3 Data Set Requirements

Term of Reference (b) requires PGEM to discuss the availability of data sets for the workshop. Stepping right back from the workshop, the ultimate question is whether we can make correct predictions of ecosystem effects of fishing. Is there a data set that would enable us to determine if we had made a correct prediction? Probably not. Beyond that, there is literally no requirement for data in order to run a model and make predictions with it; all you need is parameter values. Each model schema carries with it a procedure for determining parameter values from a set of data and/or prejudices.

There appears to be a difference in the sorts of data that different models can use. BORMICON fits its parameters to a time series, and one might expect that high-contrast data, where the state changes a lot during the series, would be especially informative. ECOPATH gets its parameters for Ecosim from a data set in which ideally there is no contrast over time. Does this create problems in applying both models to the same area?

One potential way to test a model is to run a different, “target” model which for these purposes will be taken to be the “truth”, and whose structure and parameters are known. The model under test can then be presented with data generated by the target model, to see how well it recovers the “true” history and parameters. There was, however, no good candidate for a target model, and the task of developing one was greater than anyone felt able to undertake either before or during the workshop.

Four sea areas of interest to ICES have two of the three model schemata implemented (Table 6.3.1). It should also be feasible to develop an MSVPA/MSFOR model for the Celtic Sea and possibly for Iceland. It may also be feasible to develop a BORMICON model for the Baltic Sea. If two of these go ahead, then this would provide a basis for three-way model comparisons in multiple sea areas.

**Table 6.3.1**. Sea areas for which there are, or will be by late 2002, realisations of the three types of ecosystem models.

| | **North Sea** | **Celtic Sea** | **Baltic Sea** | **Iceland** |
|---|---|---|---|---|
| ECOPATH with Ecosim | ✓ | ✓ | ✓ | ✓ |
| MSVPA/MSFOR | ✓ | | ✓ | |
| BORMICON | | ✓ | | ✓ |

### 6.4 Model Comparisons

There is a set of interesting, relevant ecosystem characteristics (quantities, changes in which constitute ecosystem effects of fishing) as the default list of quantities to compare. Many of these are described in Working Paper 2 (Trenkel and Rochet). Another suggestion was to take the output from each model as data from which to fit the parameters of a multispecies Schaefer model, and use these parameters as a low-dimensional representation of the whole behaviour of the model rather than just its "ecosystem" properties. It is expected that additional quantities to compare will be suggested and implemented during the workshop.

## 7 WORKSHOP PREPARATION WORKPLAN (TOR (D))

### 7.1 Model (and Personnel) Availability

The proposed workshop will only yield useful results if the models are available and in a form where they can be readily used and manipulated by the workshop participants. It will be of no use having models that include "black boxes" the processes within which are not transparent.

This therefore requires the models to be physically available at the workshop, and also personnel familiar with them and able to manipulate them – the workshop is not the place for learning how to run a model.

Each model realisation needs to have an identified champion (Table 7.1.1). PGEM feels that these individuals need to take the lead in assembling the group of people and the data/parameter sets necessary prior to the workshop. In most cases, this will require a small meeting to test procedures and resolve details.

**Table 7.1.1.** Proposed champions for each model realisation. NB. ? indicates that at the time of the PGEM meeting an individual had not been identified for this role but preliminary contacts had been made.

| **Model framework** | **Realisation** | **Champion** |
|---|---|---|
| ECOPATH with Ecosim | North Sea | V. Christiansen |
| | Baltic Sea | S. Hansson |
| | Celtic Sea | J. Pinnegar |
| | Iceland | ?? |
| MSVPA/MSFOR | North Sea | M. Vinther/H. Gislason |
| | Baltic Sea | P . Lewy |
| | Celtic Sea | V. Trenkel |
| BORMICON | Iceland | ?? |
| | Baltic Sea | ?/H. Gislason |
| | Celtic Sea | V. Trenkel |

The success of this workshop is highly dependent on getting the right people together in a productive environment. This means that the necessary preparatory work must be completed so that the workshop can focus on making comparisons and developing syntheses. It is the opinion of the Planning Group that the likely success of the workshop will be greatly increased through it having a dedicated budget that is managed at a distance from normal members' commitments to ICES activities. This budget would support the necessary preparatory meetings and key personnel at the workshop.

### 7.2 Dates and Venue for Workshop

The infrastructure requirements of the workshop meeting will be fully met by hosting the workshop at ICES Headquarters in Copenhagen.

It was the feeling of PGEM that a five-day programme would serve the needs of the workshop provided that the necessary preparations and regional trials had been completed. This would allow a programme such as that described in Table 7.2.1 to be implemented. PGEM would expect the workshop to include other models or realisations (case studies) of the models proposed here if they can be made available. While PGEM has outlined a number of approaches to testing/comparing models, the participants are likely to develop further comparisons during the workshop. In particular, PGEM feels that it is important that some consideration be given to what the models can add to the consideration of appropriate metrics of, and reference points for, ecosystem health. This will involve consideration of the work of the Study Group on Ecosystem Assessment and Monitoring (SGEAM) and the material presented in Theme Session T at ASC2001.

**Table 7.2.1.** Outline programme for the proposed Workshop on Ecosystem Models.

| Day | Programme |
|---|---|
| Day 1 | Introductions, terms of reference and reporting of comparisons made at "regional seas" meetings |
| Day 2 | Running revised/new scenarios as decided on Day 1 |
| Day 3 | Preliminary reporting and calculation of metrics |
| Day 4 | Consideration of models, metrics and proposed ecosystem reference points |
| Day 5 | Final report production and agreement |

PGEM has identified a number of comparative exercises that will be carried out in the near future. These will not be completed until late 2002, implying that the workshop will be best run in the latter part of the year (early December 2002 was suggested). However, it is impossible to set a date for the workshop at this time as it will be crucial that certain individuals are able to attend.

## 7.3 Workplan

Completion dates are given in months prior to the workshop.

| Task | Completion date prior to Workshop | Lead person |
|---|---|---|
| 1) Contact individual model champions and invite their involvement | 12 months | C.L.J. Frid |
| 2) Seek clarification from each champion about the underlying assumptions made in their realisations and seek to achieve a consistency | 6 months | G.T. Evans |
| 3) Ensure that all the components represented in the realisations are sufficient to maximise the range of effects that can be assessed | 6 months | Champions |
| 4) Hold meetings of champions for each sea area to review | 2 months | Champions |
| 5) Review with champions their progress on tasks (3) and (4) | 6 and 2 months, respectively | C.L.J. Frid |
| 6) Confirm date and set up local arrangements for Workshop | 6 months | C.L.J. Frid and ICES Secretariat |

# 8 ACKNOWLEDGEMENTS

The work of PGEM was assisted by the considerable support received from the ICES Secretariat. PGEM would also like to thank Yunne-Jai Shin (IRD, France) who has kindly provided information on the modelling framework OSMOSE, Gunnar Stefánsson (University of Iceland) on the state of the BORMICON and ECOPATH applications to the Icelandic ecosystem and Mike Heath (FRS, Aberdeen) who provided comments on the current status of the ERSEM.

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## ANNEX 2: LIST OF WORKING PAPERS

PGEM01/01 Frid, C.L.J. and Robinson, L.A. Dynamic ecosystem models and the evaluation of ecosystem effects of fishing: Can we make meaningful predictions.

PGEM01/02 Trenkel, V. and Rochet, M-J. Metrics for comparing the results of different multispecies/ecosystem models: A proposal to the Planning Group for a Workshop on Ecosystem Models.