ICES/GLOBEC Newsletter

Number 6, September 2000

Editorial

by Keith Brander

First, my apologies that a year has passed since the last ICES/GLOBEC Newsletter appeared. I had hoped that I would be able to produce one when the uncertainty over the future of the ICES/GLOBEC office was finally resolved, but this has not yet come to pass.

The news in other respects is mostly positive. The International programme is picking up speed with the appointment of Manuel Barange (Director) and Hester Willson (Data Manager) to the International Programme Office. The second (bigger) phase of UK GLOBEC has been agreed and is underway and the German GLOBEC programme is poised for the green light. Phase 2 of Canada GLOBEC unfortunately did not gain sufficient industry support to be awarded more NSERC funding, but DFO continue to provide some funds.

The ICES Council will be discussing whether and how to support GLOBEC and the "environment - fisheries" area of work in general at the meeting in Bruges. Depending on the outcome, this may be the last Newsletter from me, so I'd like to thank everyone who helped to make this an enjoyable and stimulating job. My current contract is to wind up the office by the end of the year, but....

there is a possibility that it will be extended and some of the funding to pay for this is already in place. If this should happen then one of the first actions must be to revive the Regional Co-ordinating Group and/or the Steering Group for the GLOBEC office and to reconsider the priorities and scope of the programme. At present I must be one of the few employees whose contract specifies that their work is directed by two committees, neither of which exists.

GLOBEC in the North Atlantic: A perspective for European and North American research co-operation?

Report from the EurOCEAN 2000 meeting in Hamburg on 30 August 2000

Introduction

The purpose of this session was to consider how to foster GLOBEC studies at the basin scale (the North Atlantic) - the scientific rationale for conducting basin-scale studies and the institutional framework for doing so. The intent is to develop practical steps for linking, integrating and synchronising basin-wide research. If a coherent and well supported case can be made then the next step is to consider how to organise joint funding among all the bordering states.

The session was chaired by **Dr Roger Harris** (chairman of International GLOBEC programme) who also opened and introduced it. The first talk by **Dr Peter Wiebe** was on **"Basin-wide studies of zooplankton through observation and modelling: Synthesis of North Atlantic GLOBEC data sets."** His message was that ocean basin scale analysis will produce a fundamentally new understanding of ecosystem dynamics and will allow prediction of basin scale responses to climatic variation.

Calanus finmarchicus is the dominant zooplankton species over much of the North Atlantic. Thanks to the time series of over fifty year of basin scale sampling from the Continuous Plankton Record, we know how the populations of *Calanus* have fluctuated and what the geographic variability in their distribution is. The dynamics of *Calanus* is important because they are the main link in the trophic chain which leads from primary production to fish.

Although we still have a lot to learn about the processes involved, it is evident that the abundance of *Calanus* influences the growth and recruitment of many fish species around the North Atlantic. For example fluctuations of the capelin stocks around Icelandic are related to the abundance of *Calanus*, which is their main prey. Capelin in turn are preyed on by cod, but cod also feed directly on *Calanus* during their early life. The dynamics of cod is therefore diectly and indirectly influenced by *Calanus*.

A recent analysis of a time series of the total quantity of zooplankton on Georges Bank indicated that it can be related to changes in the North Atlantic Oscillation (NAO). A "cod index" also appears to be related, but we do not yet know what the processes are. The detection of relationships between environmental variables and populations requires long time series. For example at least 28 years are required to establish the relationship between *Calanus* and the NAO.

Dr Wiebe provided a detailed scientific and practical rationale for a co-operative synthesis in order to increase our understanding of (i) the dynamics of plankton, (ii) impacts of environmental perturbations and (iii) linkage with fish stocks. Such a basin scale GLOBEC synthesis would require collaborative workshops, which in addition to bringing together existing knowledge about the life-history of Calanus, would develop coupled physical and biological models, identify gaps in our knowledge and design co-operative fieldwork to deal with such gaps in a cost-effective way.

Co-ordinated, synchronised joint funding is essential if a large pan-Atlantic programme such as this is to succeed.

Dr Mark Ohman from Scripps Institution of Oceanography, USA responded as **provocateur**, but began by declaring himself a dedicated believer in international co-operation in science. He stressed three elements:

1. GLOBEC is addressing large scale issues
2. there are existing frameworks for international co-operation and we should try to use what exists rather than creating new institutions
3. almost all new ideas in science come from individual scientists

On the first, there is good evidence that fluctuations in the abundance and catches of some major fish stocks is strongly influenced by basin-scale process, which are almost certainly linked to long term (atmospheric) physical factors. This is particularly well shown by coherent changes in abundance of Japanese sardine, California sardine and North Pacific salmon since 1920, which appear to be linked to North Pacific atmospheric circulation. There is evidence that the dynamics of fish stocks in the North Atlantic is also related to basin-scale physical forcing.

On the second, the principles are agreed and some of the institutions and mechanisms are already in place. It would be valuable to encourage more travelling fellowships, university sabbatical arrangements and other means of encouraging mobility of research workers. The necessary funding arrangements need to be used more fully and improved.

On the third, Dr Ohman quoted Henry Stommel who said that: "breaking new ground in science is such a difficult process that it can only be done by an individual mind". This led him to argue against "mission-oriented" research programmes and in favour of individual, discovery-based research. We should retain flexibility, maintain open solicitation and be willing to change priorities in mid stream. We should give highest priority to young investigators and fund directly competing ideas and methodologies.

Dr Ohman cited TASC (Trans-Atlantic Study of Calanus) as an example of how a programme can arise "bottom-up". Individual scientists shared ideas about the programme, but then had to find their own sources of funding. This created problems, because the different parts of the programme were not in phase with each other and resources for collective work were limited.

Dr Wiebe pointed out that the discussion and development of the ideas which led to the common ground between several programmes (Mare Cognitum, US GLOBEC etc) and thence to the TASC programme took place at the ICES Working Group on Zooplankton Ecology, which is an existing institutional arrangement for this type of coordination. Those attending its meetings have to find their own funding and therefore many who might wish to attend are excluded. It would be helpful to have some pooled resources to invite such people.

Dr Ohman added that he had found the TASC Symposium in August 1999 extremely stimulating, but it lacked a true integrated nature and he would

like to see further analysis and synthesis of the findings. This should be carried forward using existing structures as much as possible.

Dr Kurt Tande, University of Tromsø spoke as a representative EU scientist about experience gained during the TASC (Trans-Atlantic Study of Calanus) programme, for which he co-ordinated the European component.

Building and organising the team was the main requisite and took a great deal of organisational effort. There was very substantial trans-Atlantic co-operation during all phases of the programme from planning through to the final Symposium, which in addition to ICES, was financially supported by the EU, NSF and several Norwegian funders. A Newsletter with European and North American editors helped to keep the whole community informed. Much of the international co-operation was carried forward through ICES, including discussions at Working Groups, Theme Sessions at the Annual Science Conference, links with the Cod and Climate Change programme and assistance by the ICES/GLOBEC co-ordinator in funding arrangements, organising an annual conference and production and distribution of the Newsletter.

There remain considerable scientific problems in studying, understanding and finally integrating across the huge range of time and space scales from the ambit of an individual *Calanus* to the dynamics of the North Atlantic. New technology is helping to extend our capabilities at all scales, but improved instrumentation also mean that methodologies have little time to mature and generate consistent data series before being replaced by newer ones.

We have made great progress in investigating of growth, mortality and life history patterns, which are essential for modelling population dynamics. The challenge of relating what we have learned about this major component of the plankton to fish population dynamics remains wide open.

Dr **Ken Drinkwater** Bedford Institute of Oceanography, Canada, and Chairman of the ICES/GLOBEC Cod and Climate Change Programme spoke as a representative Canadian scientist. He outlined the work of the Canadian GLOBEC programmes and some additional GLOBEC related work which was funded by other programmes. A range of projects on oceanography, fish and plankton had been carried out and there had been close co-operation with the US programme on Georges Bank in the past. The proposal for renewed funding for the second phase of the Canadian GLOBEC was turned down recently in spite of being highly graded for its science content. It did not have strong industry support. The international dimension could be a supportive factor in further attempts to secure Canadian funding.

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SAHFOS's data policy is compliant with the developing data policy for the Global Ocean Observation System (GOOS). The data are freely available, provided that the recipient has signed a 'Data Licence Agreement', available from the SAHFOS Data Manager.

Limited data are currently available on a number of samples in a given area via the SAHFOS web site. It is planned to allow more detailed data searches via the web in the future. Currently all data requests are dealt with by the Data Manager to ensure the integrity of the data. Contact him on

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Dr Drinkwater gave a short outline of progress to date with the Cod and Climate Change (CCC) programme, which has been running now for ten years and has produced a large number reports from the Working Group and from a series of workshops dealing with retrospective analysis (Ocean Climate of the NW Atlantic ; The gadoid outburst in the North Sea; Causes and effects of extreme cold periods in the marine environment of the Barents Sea and the Baltic), climate variability, dynamics of growth in cod, data issues and application of environmental data in fish stock assessments.

The recent CCC Working Group meeting had 26 participants from nine countries. It reviewed and updated the work programme up to 2004. During this period the main emphasis will be on synthesis of results to date, including a symposium and book. There will also be new research initiatives which will require substantial co-operative work by scientists all around the North Atlantic. The funding for maintaining the level of co-operative activity, which the ICES/GLOBEC office has helped to bring about over the past four years, is not yet secure and an equitable pan-Atlantic solution to this issue would be very welcome.

Dr Keith Brander - gave the final summary. Existing structures are being used to encourage further analysis of the findings from the TASC Symposium. For example, a Theme Session convened by Drs Wiebe, Tande, Drinkwater and Runge, will be held at the ICES Annual Science Conference in Bruges in September 2000 to further our understanding of: (1) the linkages between climate changes and plankton variability and (2) the relative importance of zooplankton fluctuations in controlling changes in fish abundance and production.

ICES exists in order to provide various different fora for co-operation between scientists from North Atlantic countries and beyond and also to promote the application of science to the problems of resource management and sustainability. Additional funding would certainly help to carry this out more effectively.

There is a strong scientific rationale for conducting basin-scale studies and for co-operating on the design, implementation and analysis of marine ecosystem studies around the North Atlantic. The European GLOBEC Science plan was drafted by a group which included US and Canadian scientists. A healthy level of international co-operation has been a feature of GLOBEC studies since they began over a decade ago. The institutional structure is largely in place, particularly through ICES, which hosts the ICES/GLOBEC programme office.

Evidence of the value added by planning and co-ordinating research internationally can be seen from the published products of programmes such as TASC and Cod and Climate Change. Many papers have appeared already and they are being digested and integrated in order to consolidate and apply the knowledge gained. This process also reveals where further investigation is needed and helps us to design studies which will fill the gaps in our understanding. However, it would be quite wrong to conclude that all is rosy and that the current momentum will be maintained without further effort.

In addition to the formidable scientific complexity, other difficulties to be addressed include:

Linking different areas of science - The GLOBEC programme relies on data, models and ideas from many other programmes and areas of science (JGOFS, CLIVAR, PAGES, basin scale physical models etc.) It is difficult to keep track of the acronyms, let alone the content of such programmes. If we are to do more "joined-up" science at the programme level then individual scientists will need to rely more on regional nodes (such as ICES) which try to keep track and disseminate the information.

Linking science to applications - Bringing new knowledge generated in a programme such as GLOBEC to bear on the policy issues which they are intended to address (ecosystem health and sustainability, fisheries fluctuations) is a long, difficult task. Communicating the relevant information to policy makers and stakeholders is a highly skilled job. Even communicating to other scientists (such as colleagues in fisheries assessment) is a long term undertaking.

Scope of the programme - The meeting heard mainly about co-operative work on Calanus and on Cod and Climate Change. Although these are areas in which pan-Atlantic co-operation has played a large part, there are many other GLOBEC programmes at national and regional level which have not been mentioned. There are major topics, such as comparisons between different ecosystems around the North Atlantic, which are mentioned in GLOBEC plans, but which have barely been addressed. How can the programme be open to all scientists carrying out relevant research and at the same time retain coherence and a tractable scope?

Funding - This has created difficulties because the programmes in different countries have not been funded at the same time or for the same periods of time. The funding for the international collaborative elements, including the ICES/GLOBEC office comes from several countries and sometimes more than one agency within a country. Equitable international funding agreements for programmes of common interest (including for example the Continuous Plankton Recorder Survey and GOOS), could save a large amount of time and scientific energy.

Finally, in the light of Dr Huntley's remarks and as someone whose job title includes the word "co-ordinator" Dr Brander was very conscious of Peter Larkin's trenchant observation that achievement is a positive linear function of perspiration, a positive exponential function of inspiration and a negative exponential function of co-ordination. If we do not find inspiration in the idea of co-ordinating our efforts in order to tackle the very difficult issues of how marine ecosystems behave, then we should probably go back to solitary pleasures.....♋

Dynamics of growth in cod

The three day workshop in May this year was co-convened by Doug Swain, Niels Andersen and Geir Ottersen and attracted 28 participants from nine countries. It was preceded by a long period of active co-operative work using the ICES web site, which included a bulletin board for web discussion, a dedicated database of size at age and population information for 23 cod stocks, over 1400 web searchable references and 21 working documents. In addition to the participants at the meeting, a number of scientists, including several assessment groups, contributed via e-mail and the web.

The report (**ICES CM 2000/C:12**) is long, detailed and therefore difficult to summarise briefly. Conclusions relating to the five terms of reference can be paraphrased as follows:

1. Several kinds of model will help to improve the quality of stock forecasts, including correlation models, bioenergetic models and others using individual and life history based approaches. Progress with all of these is currently limited by the type and quality of field data available on both the fish and their environment. The recommendations concerning improvement in data collection during surveys and sampling address this, as does a proposal to reconstruct individual growth histories from otoliths.
2. Factors affecting potential growth and realised growth need to be considered. The former are genotypic or phenotypic, but the limited information to date indicates that genotypic differences are relatively small for cod. Realised growth is determined by ambient temperature, food availability, light, maturation schedule, oxygen etc. Temperature governs rates of physiological and behavioural processes. Since the information on ambient temperature is rarely very good, it is difficult to investigate any of the other factors properly. The results from experiments are particularly helpful here because temperature is known.
   Prediction of growth can be improved by collecting more complete data on individual fish (including field and lab sources). New technology (data storage tags) and methodology is already helping to do so. Existing and new models can then be tested against the improved data. In some stocks much of the variability in size at age arises during early life, but in others this may subsequently be reduced or even reversed by density dependent processes.
3. Growth rate variability contributes very substantially to observed variability in stock biomass, particularly in cold-water stocks, such as the Gulf of St Lawrence and the NE Arctic. Furthermore growth and reproduction are intimately related, so that the reproductive output may be affected by reduced growth far more than the stock biomass, because fish maintain lean soma at the expense of maturation or gonad development. Survival during early life is probably also related to growth rate.

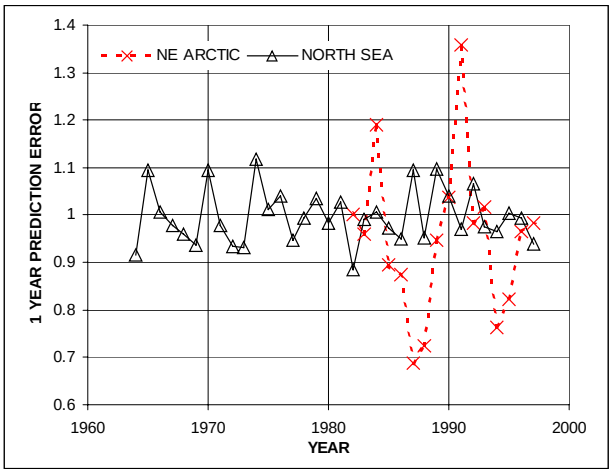

Figure 6.4 Error in prediction of stock biomass due to using weight at age for the previous year

4. Growth can be expressed in many different ways which may be relevant for specific purposes. The workshop nevertheless recommended a standard way of expressing specific growth rate, when making comparisons. Specific growth rate is primarily a function of size (small fish grow faster than big fish).

5. The workshop assembled data for 23 North Atlantic cod stocks and carried out joint analysis on many of these. More detailed and specific case studies were developed for the NE Arctic cod, for which models to forecast weight and maturity at age from temperature and prey biomass are being developed. This will lead to biological reference points which incorporate environmental and ecological factors and management strategies that are sensitive to variation in growth and condition.

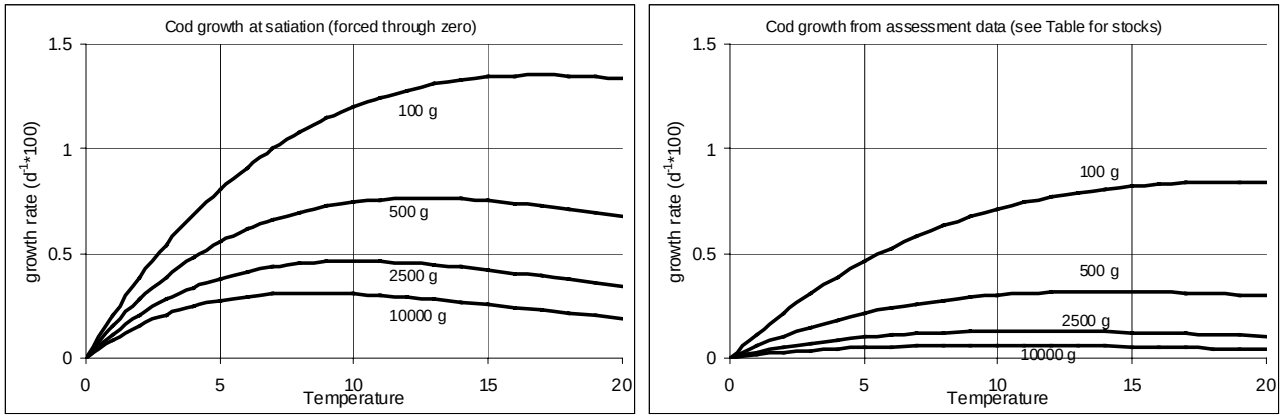

Figure 3.3 Three parameter growth model fitted to Bjornsson's satiation reared cod and to assessment data.

My personal selection of the most significant new information from a very rich choice comes from the experimental results presented by Bjőrn Bjőrnsson. As well as showing more clearly a number of things which we already knew (i) the effect of temperature on growth rate is not linear (ii) temperature has a bigger effect on the growth rate of small fish than big fish, they also show (iii) how much the optimal temperature for growth (at satiation feeding) declines as fish get bigger. Anyone who chose the site for a fish farm based on the optimal temperature for growth of small fish would be in for a nasty surprise - no doubt the industry have been aware of this for years.

Fitting the same three parameter model to field data from ten cod stocks shows that fish in the wild grow far slower than those fed to satiation in experiments. Although the obvious conclusion is that wild fish are short of food, I remain sceptical for two reasons. First, there are situations in the wild in which food is not limiting, yet the hepato-somatic index (i.e. the liver size) in the wild never remotely approaches the values which experiments produce. Second fish in the wild behave differently - they migrate, avoid predators, chase prey and in general have a higher activity level (for which a large liver would probably be fatal). The experimental results are immensely valuable in indicating a suitable functional form for modelling growth, but probably less useful for estimating the parameters. ☋

Working Group on Cod and Climate Change

The group met immediately after the workshop on cod growth and over a three day period carried out reviews and evaluations of much of the work on the programme to date, before going on to plan the future synthesis phase.

The group noted that a review of the future of the ICES/GLOBEC Office had been carried out for the ICES Bureau, but had not contacted anyone involved in the CCC programme. It was considered unacceptable that key CCC participants and funding countries had not been consulted. It was decided that a communiqué be sent to the ICES General Secretary and the Chair of the review panel, stressing the importance of maintaining the Office during the synthesis phase of the programme.

The scheduled activities specified in the Group's five-year plan have been completed through to the spring of 2000, including the Workshop on the Dynamics of Cod Growth. There was a discussion about publishing the workshop proceedings as a CRR, but a decision about this and other future activities related to the Workshop was deferred. An exception is that funding will be sought from the EU

for a pan-Atlantic study to determine the growth history of individual cod using otolith back-calculations. The co-ordinator has contacted Dr Erlend Moksness, who runs the European Fish Ageing Network to inform him and seek his views (which are positive).

It was decided not to continue with the proposals to hold follow-up workshops to BFIII and BFIV and a Theme Session related to these Workshops. Instead scientists working on research, especially related to BFIII, are encouraged to present this at other sessions during the ICES ASC or as a primary papers.

The Group endorsed the idea of preparing a book synthesising the Cod and Climate Change work to date. Multi-year funding would be needed in order to carry out such an endeavour and it was decided to apply for EU Concerted Action Funding.

A workshop on transport of cod across stock boundaries during pelagic life is planned. It will include the Iceland/West Greenland example, but also other known or suspected links, which may be intermittent. Such transport can have very big consequences for the dynamics of cod in the areas involved, because it may play an important role in re-colonisation and because the subsequent migration of a large proportion of mature fish back to their original spawning site (spawning fidelity) affects the stock levels in both areas. There will therefore be a serious effort to involve assessment biologists in the Workshop, which will probably be held in spring 2002. The workshop will seek close collaboration with physical modellers in order to develop the ability to track larvae, with active vertical behaviour from their original water masses (which are often coastal) across oceanic areas. We hope to re-establish the fruitful collaboration with Bob Marsh, who published two excellent papers arising from the BF1 tilefish investigation. He is a partner in the EU TRACMASS project, one of whose primary interests is to model the transport and dispersion of fish larvae from spawning grounds.
www.misu.su.se/~doos/tracmass/tracmass.html

Plans for a workshop on Long-Term Climate Change and Prediction (ca 2004) were discussed but will be revisited after consultation with the Working Group on Oceanic Hydrography.

The Working Group and its workshops make much use of the ICES web site, however more fisheries information should be available. The Living Marine Resource Committee will be approached to help bring this about. ♋

Progress report for the ICES/GLOBEC office 1999/2000

The year since the 1999 ASC has been overshadowed by uncertainty concerning the future of the ICES/GLOBEC office. The recommendation from the Oceanography Committee in 1999, that the work begun under the GLOBEC regional office should continue as part of the core-funded Secretariat workplan, was passed over and instead a further review was set up, which reported to the Bureau in June. The contract of the co-ordinator, which was due to expire in July, was renewed in June for a further five months.

The main Cod and Climate Change activities were the workshop on Dynamics of Growth in Cod and the working group meeting which preceded it. Preparations for the workshop had been ongoing since it was first mooted. These included the assembly of data for 23 cod stocks; compiling a large, web accessible reference list; corresponding with chairs and members of assessment working groups and with participants about their interests and contributions; developing and maintaining the discussion area on the web site; carrying out preliminary analyses and assembling and disseminating the many working documents which were prepared before the meeting.

Other jobs undertaken during the year included:

Writing reports and research proposals to NSF (US), NRC (Norway), MAFF (UK), EU.

Chairing or convening sessions at:

- The Climatic Challenge Conference, Cornwall
- ASLO , Copenhagen
- EurOCEAN 2000, Hamburg

Talks at:

- Greenwich Forum (and EU Parliament Fisheries Committee), Brussels
- ICES Young Scientists Conference, Gilleleje
- Spatial Modelling Workshop, Bergen
- EuroGOOS, The Hague
- Fisheries Ecology course, University of Arhus
- ASLO, Copenhagen

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