Basin-scale Analysis, Synthesis, and INtegration (BASIN) of oceanographic and climate related processes and the dynamics of plankton and fish populations in the North Atlantic Ocean

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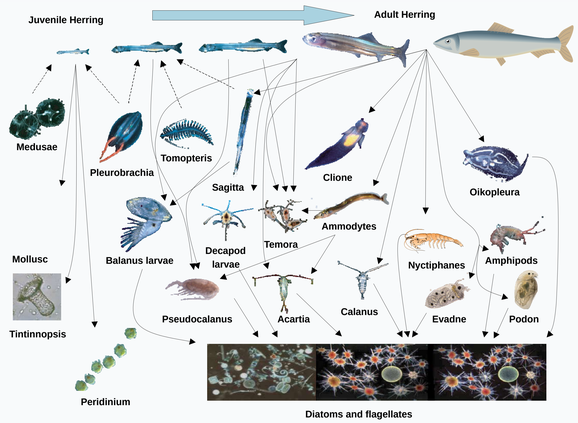
A North Sea food web schematic



Abstract

Integration and synthesis of data sets must be coupled with modeling studies at the basin-scale to elucidate the mechanisms underlying observed changes in physical and biological changes in the North Atlantic Ocean and to predict consequences of climate and environmental change. The dominant physical forcing across the North Atlantic basin is the large-scale atmospheric circulation and the associated coupled air-sea interactions. In addition, the population distributions of key biological organisms, such as *Calanus finmarchicus*, span the ocean basin. As a result, spatial scales of biological events are often larger than national or regional waters, and require an international effort to understand physical-biological coupling at functionally - relevant scales. Such large spatial scales also dictate important time scales requiring study from storm events to the interannual. To launch such an effort, a workshop focusing on the basin scale dynamics of *Calanus* and selected pelagic and demersal fish as target species was held in March 2005 in Reykjavik, Iceland. As defined at the workshop, the specific goals include: integration and synthesis of existing basin-wide data sets; advancement of the current state of the art in bio-physical modeling; development of hindcast modeling studies to understand the observed historical variability of the North Atlantic ecosystem; construction of scenarios of possible ecosystem changes in response to future climate variability; identification of data gaps that limit process understanding and contribute to uncertainty in model results; and specification of new data that will be needed to assess the performance of forecasts and assist management decisions. Achievement of these goals will contribute to an integrated management approach for marine ecosystems and their services. Additional workshops are now planned to promote the development of the BASIN approach.

BASIN Iceland Workshop Aim

To understand and simulate the population structure and dynamics of broadly distributed and trophically important ecosystems, and thereby contribute to ocean management.

Workshop Objectives

- Integration and synthesis of existing basin-wide data sets
- Build on the current state of the art in bio-physical modeling,
- Hindcast modeling studies to understand the observed historical variability of the North Atlantic ecosystem,
- Construction of scenarios of possible ecosystem changes in response to future climate variability.
- Identify data gaps that limit process understanding – and contribute to uncertainty in model results and collect new data to fill the gaps,
- Specify and conduct observation and process studies needed to establish population structure and dynamics across the deep ocean and shelves.

Workshop Conclusions

Continental shelf and marginal sea ecosystems are affected by basin-scale forcing on decadal scales and cannot be studied in isolation.

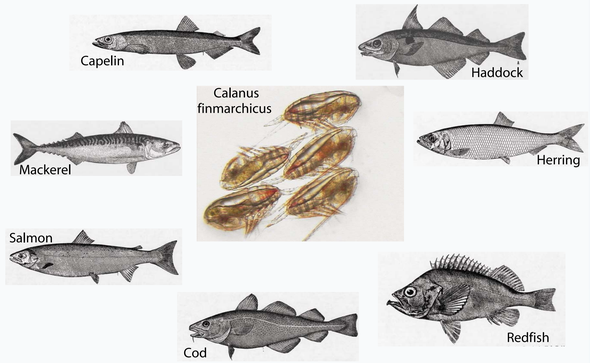
Advances in modeling marine ecosystems will require coupling numerical formulations across trophic levels that have differing degrees of resolution and embedding these in a basin-scale representation of the physics and biogeochemistry.

There is no single, fully integrated model that can simulate all possible ocean ecosystem states.

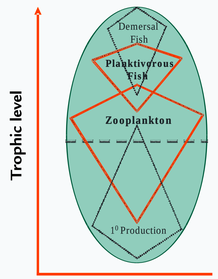
The key steps in representing extended food webs in complex marine systems are:

- To concentrate the biological resolution, or detail of representation, in the main target species, and
- To make increasing simplifications, or decrease the resolution, with distance both up and down the trophic scale from the target species.

Fish species that depend upon *Calanus finmarchicus* in some parts of the North Atlantic



The BASIN Rhomboid Approach



The rhomboids indicate the conceptual characteristics for models with different species and offering areas of primary focus.

Rhomboid is broadest where model has its greatest functional complexity i.e. at the level of the target organism.

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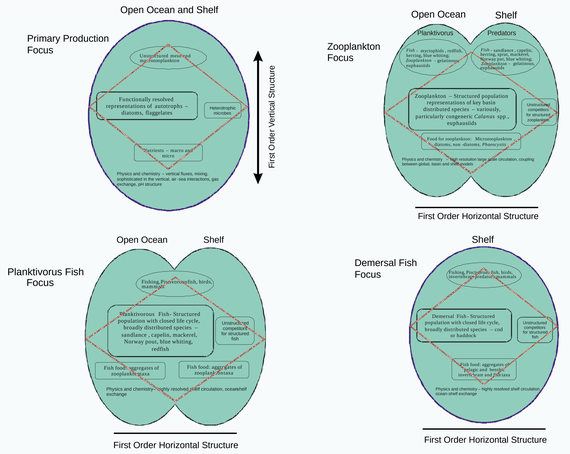
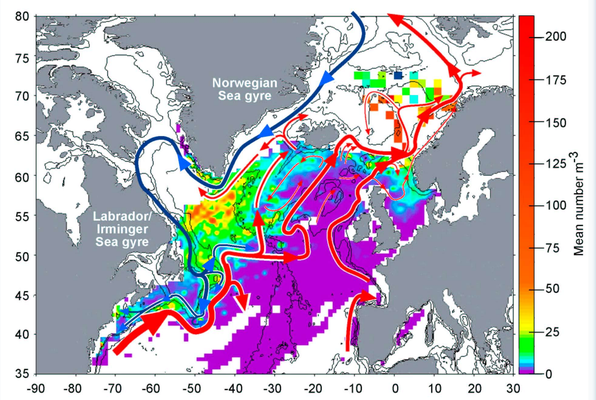
The emphasis of the program will be determined by the ecological requirements to achieve the understanding required to simulate the population dynamics of the selected targeted organisms.

Below, the structural components required for a basin scale study focused on phytoplankton, zooplankton, planktivorus fish, or demersal fish.



Study Area



Next Steps:

A European/North American Collaboration is being developed under the EU Global Change of Ecosystems entitled: "Resolving the impact of climatic processes on ecosystems of the North Atlantic basin and shelf seas: Integrating and advancing observation, monitoring, and prediction: BASIN."

BASIN Initiative Objective & Workshops

The principle objective of this BASIN Initiative is to develop a joint EU-North American research program in the field of ocean ecosystems in support of the Global Earth Observation System of Systems (GEOSS) initiative.

To do so, the BASIN Initiative will support four workshops to:

- Identify and document the state of the art of climate-related ecosystem research in the North Atlantic basin and associated shelf seas,
- Assess the feasibility of developing a joint EU-North American basin-scale research program focusing on the ecosystems of the North Atlantic,
- Seek to develop an implementation plan where by joint research initiatives involving the EU and other nation (e.g. USA, Canada, Japan, China) can be developed and funded.

Workshop Activities

1) Assess and report on the status of climate-related ecosystem research in the North Atlantic basin and associated shelf seas (from Georges Bank to the Barents Sea and the North Sea shelf) conducted intensively over the past decade particularly through national GLOBEC programs (US, Canada, UK, Germany), GLOBEC related projects (ICES, Mare Cognitum), and EU projects, particularly ICOS and TASC.

2) Identify and document gaps in systematic observations and process understanding of atmospheric and oceanic parameters, necessary to improve forecasting of ecosystems in the North Atlantic and associated shelves.

3) Identify via the development of a meta-database the potential for consolidation of long-term observations from EU and international databases for the modeling and in particular prediction of the dynamics of North Atlantic and associated shelf ecosystems and their services (biogeochemical and exploited resources).

4) Determine and report on the feasibly of developing a joint EU-US-Canadian research program in the field of ocean ecosystems focused on the effects of climate processes on the North Atlantic basin and associated shelf sea ecosystems.

5) Develop, in concert with representatives from the EU DG Research (and others as appropriate) and program managers from the US National Science Foundation and the Canadian NSERC, an implementation plan for the development of jointly funded EU-North American research programs.

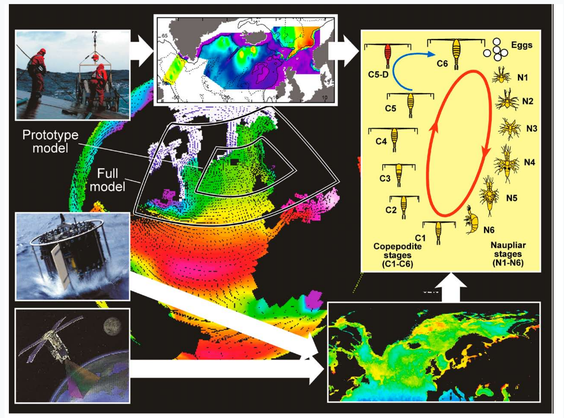
6) Produce a proposal for submission to The EU 7th Framework Program and the US NSF and Canadian NSERC focused on:

- Resolving the natural variability, potential impacts and feedbacks of global change on the structure, function, and dynamics of the ecosystems of the North Atlantic Basin and associated shelf seas;
- Improving the understanding of marine ecosystem functioning in North Atlantic Basin and associated shelf seas;
- Developing ecosystem based management strategies that incorporate the effects of global change and hence contribute to the sustainable use of the marine resources of the North Atlantic Basin and associated shelf seas.

The Collaboration Partners

Michael St. John: U. of Hamburg, Institute of Hydrobiology and Fishery Science, Germany, [Project and coordinator]
Roger Harris: Plymouth Marine Laboratory, United Kingdom
Peter H. Wiebe: Woods Hole Oceanographic Institution, USA
Francisco E. Werner: University of North Carolina at Chapel Hill, USA
Brad de Young: Memorial University, Canada

Tools & Methods



Program Facilitation/Implementation

North Atlantic oceanographic science programs are normally funded nationally or regionally (e.g. by the European Commission) and funding has usually been limited to residents from that country or region. There is a strong motivation and necessity for individual scientists of different nationalities to work together on projects beyond the scale of funding or resources presently available for national or regional programs. The absence of a coherent funding structure is a serious impediment to accomplishing the ultimate goals of Earth System Science and management particularly when addressing geographical areas as large as the entire North Atlantic basin. In order to eliminate such structural impediments two actions are needed:

1) Collaborative international workshops to facilitate exchanges of ideas and to build working partnerships among the scientists involved in or interested in conducting the basin-scale synthesis/modeling research;
2) Definition and implementation of appropriate joint mechanisms to enable the funding of collaborative studies involving international multi-disciplinary teams of researchers.

Conceptual Funding Strategies

Unified Process

EU/NSF Joint Call for Proposals
⇩
Integrated proposals with investigators from both sides of the ocean
⇩
Peer review of proposals by EU/NSF reviewers
⇩
Joint panel review of proposals
⇩
Joint EU/NSF funding decisions by Managers
⇩
Joint funding of accepted proposals

Separate Process

EU/NSF Joint Call for Proposals

EU PIs prepare proposal in relation to text in Framework Program, noting US collaborators
⇩
EU Reviews EU Proposal in the context of the Framework Program
⇩
EU funding decisions By managers
⇩
If both sides have fundable proposals

Funding of EU proposal

NSF PIs prepare separate proposals noting links to aspects of EU proposal
⇩
Peer review of NSF proposals by NSF reviewers
⇩
NSF panel review of proposals
⇩
NSF funding decisions based on panel recommendations and EU decision on EU proposal

Funding of accepted NSF proposals

Acknowledgments

Grants for the Iceland workshop were provided by NSF and the European Union EUR-OCEANS Network of Excellence. New funding for the Next Steps is being sought through the EU Sixth Framework Program (Specific Support Actions), NSF, and NSERC (Canada).