ECODRIVE “Kick-off”Meeting

The ECODRIVE “kick-off” was in the Institute for Hydrobiology and Fisheries Science of Hamburg University from 4-6 May 2009.

Number of participants: 20 (Appendix I).

Agenda: Appendix II

1. Work Packages Overview

Work Package 1

Task 1.1 Time series analysis of climate-related long-term ecosystem changes (Jürgen)

Relevant abiotic and biotic long-term time series will be compiled and analyzed using uni- and multivariate statistics to clarify trends and patterns with respect to climater impact. The task will start with a comparison of the two longest North Sea Plankton time series: CPR data and Helgoland Roads data as a joint enterprise of IOW, AWI and SAHFOS. Data will be discussed and exchanged during visits of involved scientists to Helgoland and Plymouth in August/September.

Task 1.2 Responses of (key) species to abiotic factors (Ecophysiology) (Myron)

A list of relevant abiotic factors was formulated that included water temperature, salinity, oxygen, turbulence, and light. Thermal windows of tolerance and growth (scope for growth) were emphasized as was the need to define key species / groups based upon available field observations, laboratory measurements and model target groups. The impact of abiotic factors on both survival (binary) and growth (scalar) was discussed. A brief summary of data available for small pelagic fish (European anchovy, sprat and European sardine) was provided. Data include tolerable thermal ranges for eggs, larvae, juveniles and adults) and the impacts of temperature on growth rate in larvae and post-larvae. The presentation highlighted the potential role of “critical life stages”. An interspecific analysis of the impacts of temperature on development of eggs and yolksac larvae of 64 marine fish species is available for ECODRIVE.

Task 1.3 Responses of (key) species to biotic factors (trophic coupling) (Myron)

The presentation focused on zooplanktivorous fish species since those can be directly linked to NPZD model ouputs. At the time of the kickoff meeting, University of Hamburg was the in the processes of hiring a PhD student (Dominique Gloe) responsible for diet overlap analysis of European anchovy and European sardine in the North Sea. Historical stomach samples of sprat will be analysed by Alheit (IOW). Time series data on the abundance of top predators are available via the BECAUSE project (Jens Floeter, Hamburg)

It was agreed that a list of physical and biological model outputs should be identified by ECODRIVE researchers involved in WP1. The list should include key factors that could be related to changes in biological time series data. Selected physical and biological factors will then be compared among the hydrodynamic models (HAMSOM, NORWECOM, ECOSMO) and models of lower trophic levels (ECOHAM, NORWECOM, ECOSMO). An initial list of variables was generated (see below) and will be sent to ECODRIVE biologists (and other project members) and discussed via email. If needed, a half day meeting will take place to finalize the list including specific temporal and spatial resolution required for analyses in WP3. Data formats will also be discussed.

A preliminary list of factors included:

Hydrological indices Units	
Stratification indices	
1 Deficit of potential energy (density)	$kg*m^{-1}*s^{-2}$
2 Deficit of potential energy (temperature)	$kg*m^{-1}*s^{-2}$
3 Maximal vertical gradient in density	$kg*m^{-3}*m^{-1}$
4 Maximal vertical gradient in temperature	$°C*m^{-1}$
5 Depth of thermocline	m
6 Depth of pycnocline	m
7 Depth of halocline	m
Frontal indices	
8 Thermal frontal index (potential energy)	$kg*m^{-2}*s^{-2}$
9 Density frontal index (potential energy)	$kg*m^{-2}*s^{-2}$
10 Thermal frontal index (maximal gradient)	$°C.m^{-2}$
11 Density frontal index (maximal gradient)	$kg*m^{-3}*m^{-2}$
Upwelling indices	
12 Vertical speed in σ coordinates	s^{-1}
13 Vertical speed in z coordinates	$m.jr^{-1}$
River plume indices	
14 Salinity at surface	psu
15 Equivalent fresh water height	m
Eddies indices	
16 Vorticity	s^{-1}
17 Okubo-Weiss	s^{-2}
Biological indices (by level of functional group in model)	
18 Weekly Surface chlorophyll (chla) concentration (at 3m)	$mgChla *m^{-3}$
19 Weekly Primary production	$mgC*m^{-2}$
20 Weekly zooplankton production	$mgC*m^{-2}$
21 Weekly zooplankton biomass	$mgC*m^{-2}$
Other indices	
22 Temperature at surface (3m)	°C
23 Temperature at the bottom	°C
24 Current U-component (W-E) at the surface (10m)	$m*s^{-1}$
25 Current V-component (S-N) at the surface (10m)	$m*s^{-1}$
26 Vertical shear	$m*s^{-1}*m^{-1}$

Work Package 2 *(Corinna)*

WP 2 will hindacst modelling of the hydrodynamic and trophodynamic relationships among lower (using coupled NPZD models) and upper trophic levels (using SMS) within the North Sea.
Both the Norwegian and German teams will contribute to WP2.1 and WP2.2. The Norwegian teams work in WP2.1 and WP2.2 will be performed with the coupled ecosystem model ECOSMO (UiB-GFI) and supplemented by earlier model runs compiled within the

RECLAIM project (NORWECOM-IMR and ECOSMO-UiB-GFI). Responsible scientist are Corinna Schrum (UiB-GFI) and Morten Skogen (IMR).
The German team contribution to WP2.1 will be performed with the HAMSOM model (responsible Thomas Pohlmann), the German contribution to WP2.2 will be performed with ECOHAM4, ensured by complementary funding (responsible Johannes Paetsch, Wilfried Kuehn).
WP2.3 is addressed only by the German team with the responsible scientist beeing Axel Temming.

Task 2.1 Hydrodynamic (retrospective) modeling (Thomas)

The following points have been clarified:

Models to be used:

1. HAMSOM,
2. NORWECOM,
3. ECOSMO

Forcing Data:

1. Atmospheric forcing data: NCEP: 1948-2007 (time slices?)
2. Open boundary condition: NW-European Shelf Model

Common validation exercise:

1. Model inter-comparison: S,T, Transport through sections (with focus on decadal variability)
2. Comparison with observational data: ZISCH 1985-1987, NERC 1988-89.

Output parameters:

1. Direct: temperature, salinity, currents, turbulence
2. Indirect: thermocline characteristics (depth, strength and extension), frontal zones and eddy activities (retention areas), flushing times, and heat flux-related indices

Final Product:

1. A multi decadal database of these ecosystem relevant parameters including monthly climatologies will be produced for the North Sea shelf area and regional sub-areas.

A recent study was presented, which will serve as a starting point for WP2.1. The details are given in the paper “Long-term variability and changes of temperature and heat content in the North Sea simulated by a shelf sea model for the period of 1948 – 2007.” by: Elke M. I. Meyer, Thomas Pohlmann, Ralf Weisse submitted to Continental Shelf Research.

Abstract

Long-term changes and variability in water temperature, heat content, and thermocline structure in the North Sea for the period of 1948 to 2007 are investigated by means of a model reconstruction using a baroclinic continental shelf sea model. The model was driven with observed (reanalysed) atmospheric conditions obtained from the NCEP/NCAR global reanalysis. It was found that the model reasonably reproduced observed conditions and variability on time scales from years to decades. In particular, a strong increase in North Sea temperatures and heat content after the early 1980s was obtained that is in good agreement with that obtained from long sea surface temperature (SST) records in the area. A number of sensitivity experiments were carried out to elaborate on the relative contributions of the various atmospheric forcing parameters on the observed increase in SST. It was found that regional changes in atmosphere-ocean heat exchange may account for a considerable fraction of the observed long-term changes and variability.

Task 2.2 Modelling Lower Trophic Levels (??)

Task 2.3 Modelling Upper Trophic Levels (Axel)

Information was provided concerning the new sampling efforts conducted in ECODRIVE to understand niche/competition by Axel Temming (Uni-Hamburg). Stomach data are also partly available from GLOBEC samples and cooperation with IMARES via the EU "RECLAIM" project. Diet data for predators (mackerel, horse mackerel) are also available (taken on IBTS cruises). The presence of 0-group sardine was confirmed in horse mackerel stomachs. Data on predator / prey overlaps will be inputted to the multi-species virtual population analysis (MSVPA) model. A detailed review of the MSVPA model was provided as well as the utilisation of this tool within the "BECAUSE" and "UNCOVER" projects. The objective of previous work focused on stock recovery plans and their viability with respect to changes in North Sea upper trophic levels. Models attempted to evaluate the potential effects of: both decreases in top predators (mackerel and cod stocks) and concomitant huge reduction in fish predation and released prey fish production, and whether the potential recovery of those predators would be supported by available prey resources in terms of competition with prey fisheries, seabirds and marine mammal populations. For ECODRIVE, model updates include additional VPA predators (e.g., mackerel, horse mackerel, western mackerel, gurnard, ray, bird, mammals). Secondly, size-based diet preference appear much less important than issues relating to spatial overlap. Spatial overlap will thus be emphasized in ECODRIVE. Current model limitations were also discussed including the need to extrapolate parameterizations of diet selectivity between years (e.g., 1991) having large-scale stomach sampling efforts.

<u>Work Package 3</u> *(Myron)*

Task 3.1 Identification of ecosystem structural changes

Within the context of Tassk 3.1, *regime shifts* in ecosystem structure (characteristics, timing) were discussed including the appropriate statistical measures / methods to be applied. Links to various ICES working groups were provided including: 1) Working Group on Holistic Assessments of Regional Marine Ecosystems (WGHAME), 2) Working Group on Integrated Assessments of the Baltic Sea (WGIAB) and 3) the Transition Group on on Holistic Ecosystem Assessments and Diagnostics (TGHEAD). Christian Möllmann (ECODRIVE WP3) is a co-chair of the latter two groups. A brief review of the findings of ICES Regional Ecosystem Study Group of the North Sea (REGNS) was provided. REGNS produced standardised anomalies of CPR, oceanographic and fisheries data from 1973 to 2005. An example of similar, ongoing work in the Baltic was given that included disentangling the contribution of abiotic and biotic factors to variability in the time series collected from 1974 to 2005.

Task 3.2 A*nalyses of pressures and processes causing foodweb structural changes*

The presentation provided examples of statistical methods (e.g., direct ordination analyses, GLMs, GAMs, T-GAMs , dynamic factor analysis) that have been previously utilized to find: 1) abiotic drivers associated with the PCs from time series, 2) the biotic / trophic control patterns including the presence of trophic cascades, as well as 3) a comparative analysis of sub-areas of the North Sea. A recent study examining seven different regions within the Baltic Sea was provided as an example.

Task 3.3 Development of informed proxies for future ecosystem change

A discussion ensued regarding the lack of a pithy, one-line definition of an "informed proxy". Myron Peck provided a definition an informed proxy as

"*a function describing the direction of change in abundance or productivity of a species or species assemblage that is based upon knowledge regarding the response(s) to key extrinsic (environmental) and/or intrinsic (physiological) factors*."

An example was provided for herring in the North Sea that included extrinsic factors (west wind intensity/timing, water temperature, abundance of suitable prey) and intrinsic factors (e.g., metabolic requirements and temperature-dependent prey thresholds for larval starvation) correlated with early larval survival. The informed proxies provide the rules by which projected model results obtained after downscaling (i.e., time slice outputs from hydrodynamic, ecosystem (NPZD) and upper trophic level (MSVPA) models) can be applied in a cause-and-effect way to re-structure marine foodwebs.

<u>Work Package 4</u> *(Myron)*

The concept and methods of utilizing MSVPA in forecast mode (WP4) was presented by Axel Temming. The methods included a three-step process: 1) initialization of starting values (utilize latest stock estimates, stock structure and suitability matrix as estimated from historic and modified where possible, based upon external overlap information, 2) incorporation of future level of predator-prey overlap and recruitment levels of predator and prey species based upon hydrographic / lower trophic level model proxies (link to future, time-slice projections here) and 4) apply fishing scenarios.

2. Structure of modeling *(Morten)*

To improve consistency between WP2 and WP4 and to encourage more partners to make simulations (existing and new) available to EcoDrive, it was decided that all model data sets should be analyzed in a similar way by one partner (additional work still to be done by the individual partners). This will make the most out of limited funding. It was decided to share the responsibilities in the following way:

	Responsible for analysis	Simulations
WP2.1	Thomas' post.doc	Thomas, Corinna, Morten
WP2.2	Corinna	Corinna, Morten, Johannes
WP4.1	Bjørn	Bjørn, Thomas
WP4.2	Johannes	Johannes, Morten

Morten's (and Johannes'??) simulations in WP4.2 will use physics from Thomas (and/or Bjørn??) from WP4.1.

3. Model validation *(Björn)*

Here is some text on issue 11) model validation The issue was how to comply to the description in task 2.1 "A common validation exercise will be used ... " The common validation exercise in task 2.1 should not require the participating models to run nearly identical setups (they will not be identical enough anyway). Instead the hindcast simulations should be validated against a common set of data. In view of the planned centralized analysis of model output, this issue will be resolved as part of this common analysis.

4. Recruitment/mortality issues *(Mark)*

Projections of future fish populations are particularly sensitive to assumptions about recruitment, especially in short lived or highly exploited populations. Therefore whilst analysing recruitment care must be taken, and even if informed proxies are found for recruitment, the impacts of these relationships must be carefully considered. It is often best to make assumptions about the underlying properties of the proxy to recruitment relationship, or the stock to recruitment relationship, prior to analysing the data. Using signals from the analysis of purely the recruitment data, may result in very unrealistic projections. Alternative more qualitative approaches, such as traffic light or guild approaches, may result in more realistic and easier to understand projections of future population dynamics.

5. RECLAIM *(Myron)*

Both Norwegian (IMR, Univ. Bergen) and German (IHF, Hamburg) partners within ECODRIVE participate in the RECLAIM project (EU FP6) (http://www.climateandfish.eu/) examines the influence of climate variability and change on fish and shellfish resources within European waters. The ultimate outcome of RECLAIM is the formulation of hypotheses and research needs to be addressed in future EU research on climate impacts in marine systems. The North Sea represents one of the four focus systems. This program has developed a conceptual framework to distinguish between climate-driven processes acting on individual (physiology, behaviour), population (predation, competition) and ecosystem (physical habitat qualities, biological productivity, trophic coupling) levels. RECLAIM utilized time series analyses, spatial statistics and 3-D hydrodynamic, NPZD and individual-based models. A number of ECODRIVE partners (in both Norway and Germany) have been responsible for developing and utilizing the modeling tools within RECLAIM. In this manner, RECLAIM is quite complimentary to ECODRIVE; the latter builds upon the former. For example, RECLAIM utilizes a limited number of hindcasts and scenario modelling to examine the effects of climate change on the productivity and distribution of fish and shellfish stocks. Unlike ECODRIVE, RECLAIM will not employ downscaling of global climate models. Beyond model development, other synergistic activities include compilation of long-term data sets (comprised of both modeled and observed / fisheries data). Data sets generated via RECLAIM are available for ECODRIVE. RECLAIM project synthesis activities will be completed by December 31, 2009.

6. Ensembles *(Susanne)*

In the context of the EU FP6 project ENSEMBLES (www.ensembles-eu.org <http://www.ensembles-eu.org/>), an ensemble of regional climate change simulations for Europe has been accomplished. To assess the possible climate changes as well as the associated uncertainties, a matrix of different global climate models and different regional climate models has been set up. Data of the regional climate model simulations is/will be available for scientific purposes on a daily basis for a broad number of model parameters. The

ENSEMBLES climate simulations cover entire Europe with a horizontal grid resolution of 25 x 25 km. From the regional model REMO developed at the Max Planck Institute for Meteorology in Hamburg (MPI-M), data of an ENSEMBLES IPCC-A1B simulation (driven by the MPI-M global coupled climate model ECHAM5/MPI-OM) can be provided directly by MPI-M (hourly time resolution for many parameters). The data are available for the period of 1950 to 2000 (control period) and 2001 to 2100 (scenario period).

7. UNCOVER *(Myron)*

Both Norwegian (IMR) and German (IHF, Hamburg) participate within the "UNCOVER" project (EU FP6). UNderstanding the Mechanisms of Stock ReCOVERy **(**http://www.uncover.eu/**).** UNCOVER is designed to identify various changes experienced during the decline of fish stocks in order to understand the prospects for their recovery, to enhance the scientific understanding of the mechanisms of fish stock recovery, and to formulate recommendations for fisheries managers how to best implement stock recovery plans. Modelling activities combine biological, ecological and economic information. Biological process knowledge stems from workpackages examining changes in stock structure (reproductive potential), environment / recruitment (bottom-up) relationships, and trophodynamic (top-down) influences. The North Sea is one of four focus regions. UNCOVER utilizes similar modeling tools as ECODRIVE (e.g., hydrodynamic, NPZD, IBM, multi-species VPA) but with different research aims. The work in the North Sea revolves around hindcasts and does not include future projections of fish stocks based upon climate models. Research efforts within the North Sea focus on a few commercially-important species including Atlantic herring (*Clupea harengus*) and Atlantic cod (*Gadus morhua*). North Sea-wide trophodynamic models (SMS) are also utilized to explore how observed changes in the structure of upper trophic levels may impact the future development of specific stocks (particularly Atlantic cod) via scenario testing. There are no perceived overlaps of UNOCVER and ECODRIVE. The former has compiled data and advanced models that will be utilized / enhanced in the latter. UNCOVER has entered its synthesis phase. A symposium is planned in November 2009 and final reporting is due a few months later**.**

8. Climate studies in Irish waters *(Glenn)*

The Irish Marine Institute is engaged in marine climate change research activity in Irish and adjacent waters. The main focus of the work is on understanding processes at work within the marine ecosystem, producing an ocean and ecosystem status report and building capacity in future scenario ocean modelling. There are 3 specific areas where Irish marine climate change researchers aspire to work with the ECODRIVE project consortium:

1: Disentangling the various signals that contribute to ocean climate in the NE Atlantic (eg. Atlantic Multidecadal Oscillation(AMO), NAO, EA pattern and anthropogenic contribution). Ireland is particularly interested in looking at water mass interactions with the Shelf Edge Current, gyre scale circulation and the position of the sub-polar front and the mechanism(s) that drive the AMO.

2: Comparison of ecosystem model data in regions of model domain overlap. Specifically to compare NPZD model outputs in the regions that overlap with HAMSOM and ECOHAM4 (eg. NW shelf up to Scotland and the English Channel).

Comparison with Irish ROMS model for both the hindcast period and agreed future scenarios.

3: Work with the ECODRIVE consortium to build Irish capacity in IBM modelling and multi-species modelling. Could include transfer of PhD and postdoctoral researchers to interact with Axel Temming and other key ECODRIVE modellers.

9. Next Meeting

11-14 January 2010, Bergen

10. Miscellaneous

Carola volunteered to establish a project web site. Myron will create the project logo.

Appendix I

List of Participants

Alheit, Jürgen	IOW	juergen.alheit@io-warnemuende.de
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Appendix II

Agenda ECODRIVE – Kick-off

Monday, May 4

Time Series group (Chair: J. Alheit):

11:00-12:00 Impact of climate variability on North Sea (J. Alheit)
12:00-13:00 North Sea CPR survey: available data and results (M. Edwards)
13:00-14.00 Lunch
14:00-15:00 Helgoland Roads series: available data and results (M. Boersma)
15:00-16:00 Discussion
16:00-16:30 Coffee break
16:30-17:30 Discussion
18:00 Wine Tasting 1

Modeling Group (Chair: M. Skogen,)

11:45-12:00 Introduction (M. Skogen)
12:00-12:30 Hindcast modelling of physics and lower trophic levels (C. Schrum)
12:30-13:00 Discussion
13:00-14:00 Lunch
14:00-14:30 Dynamic downscaling of the North Sea future climate (B. Ådlandsvik)
14:30-15:00 Discussion
15:00-15:30 Upper trophic level modelling (A. Temming)
15:30-16:00 Discussion
16:00-16:30 Coffee break
16:30-17.30 Discussion

Tuesday, May 5

Short Presentations on Related Projects
The list of projects should be lengthened to include all projects dealing with important elements of ECODRIVE (time series compilations/analyses; modelling activities - hydrodynamic/biophysical/trophic, etc.).

09:30-09:40 Reclaim (M. Peck)
09:40-09:50 Ensemble (S. Pfeifer)
09:50-10:00 Uncover (J. Flöter)
10:10-10:20 MEECE (S. Sundby)
10:20-10:40 Climate studies in Irish waters (G. Nolan)
10:40-11:00 other projects
11:00-11:30 Coffee break

11:30-12:10 Workpackage 1 (overview) and summary of Time Series Group (J. Alheit)
12:10-12:30 WP 1.2 and 1.3 (M. Peck)
12:30-13:10 WP 2 (overview, incl. overview over available models such as HAMSON/ECOHAM, ROMS/NORVECOM, ECOSMO, etc.) (C. Schrum)
13:10-14:10 Lunch

14:10-14:25	WP 2.1 (T. Pohlmann)
14:25-14:40	WP 2.2 (W. Kühn)
14:40-14:55	WP 2.3 (A. Temming)
14:55-15:35	WP 3 (overview) (C. Möllmann)
15:35-16:15	WP 4 (overview) (B. Aadlandsvik)
16:15-16:40	Coffee break
16:40-17:30	WP 5, Coordination (J. Alheit, M. Skogen)
18:00	Wine tasting 2

Wednesday, May 6

09:30-11:00	Workpackages, discussion
11:00-11:30	Coffee break
11:00-12:30	Workpackages, discussion
12:30-13:30	Lunch
13:30-15:30	Wrap up
15:30	End