Bergen Summer Research School

› Global Development Challenges

Climate, Environment and Energy
22 June- 3 July 2009

Course 5: Impact of Climate Change on Marine and Terrestrial Resources

Course Leaders

- Ass. prof. John-Arvid Grytnes and Prof. Vigdis Vandvik and, Department of Biology, UiB
- Hjalmar Hatun, Research scientist, Faroese Fisheries Laboratory
- Tore Furevik, Professor, Geophysical Institute, UiB

Guest lecturers

- Anne Bjune, Researcher, Bjerknes Centre for Climate Research, UiB
- Helge Drange, Professor, Geophysical Institute, UiB and Bjerknes Centre for Climate Research
- Jan Helge Fosså, Senior scientist, PhD, Institute of Marine Research, Bergen
- Einar Heegaard, Researcher, Bjerknes Centre for Climate Research, UiB
- Kari Klanderud, Researcher, postdoc, Dept of Ecology and Natural Resource Management, Norwegian University of Life Sciences, Ås
- Svein Sundby, Professor, Institute of Marine Research, Bergen
- Gaute Velle, Researcher, postdoc, Bergen Museum, UiB
- Gian-Reto Walther, Senior Academic Advisor, University of Bayreuth, Germany

Synopsis

Man-induced climate change is affecting a number of natural resources, both on land and in the marine realm, and will have important consequences onto the ecosystems that they operate on as well as on human societies and communities that are depending on them. This course will through a series of overview lectures make the participants familiar with the basics of the climate system, and how the marine and terrestrial ecosystems are tightly linked to the range of climate variables.

The topic of climate change, both natural variability and man-induced, will be introduced in light of the latest assessment report of the Intergovernmental Panel on Climate Change (IPCC), and several lectures will then focus on effects of past, present and future climate change on marine and terrestrial ecosystems and biodiversity.

In the terrestrial part, we will present five perspectives of climate change effects differing in 1) time scale; past, present and future, 2) empirical approaches; from long-term ecology via observations and experiments to modelling of future responses, and 3) in the responses studied; from species distributions via ecological processes to evolutionary processes.

In the marine part we will first give a core lecture on the relationships between physics and ecology in the ocean, and in particular how changes in the physical properties (temperature, salinity, currents, turbulence, light conditions etc) will influence on the oceanic food chain at all levels. Thereafter, impacts of climate change on the marine resources will be discussed in three more specialized lectures. Focus will be the influence of the sub polar oceanic gyre circulation on the commercial species in the North Atlantic – Nordic Seas region; the influence of climate variations on the fisheries along the African coasts, and the influence of global warming and increased CO2 levels on oceanic acidification and marine organisms.

Objectives:

The course aims at providing the student with (i) a working knowledge of the past, present, and future climate change, (ii) examples of how climate change affects natural resources and biodiversity in the terrestrial and marine realms, and (iii) on how climate change impacts will interact with major global change drivers.

Course blocks

1. Climate change: the natural sciences
The topic of climate change (both natural variability and man-induced) will be introduced in light of the latest assessment report of the Intergovernmental Panel on Climate Change (IPCC). *Lecturer: Helge Drange*

2. Terrestrial ecosystems: Lessons from the past
What effects has climate change had on ecology, evolution, diversity and function of terrestrial organisms in the past – ecosystem changes on temporal scales from decennia to millennia? What methods and approaches are available for studying these changes? *Lecturers: Anne Bjune & Gaute Velle*

3. Terrestrial ecosystems: Evidence of effects of recent climate change
Recent studies indicate that ongoing climatic warming is causing changes in species phenology or population dynamics, poleward movement of species ranges , upward migration of treeline position or species distributions, or changes in local species composition, abundance, and diversity. What are the patterns and trends? *Lecturer: Gian-Reto Walther*

4. Terrestrial ecosystems: Observations and experiments in climate change effect research
Observational studies are important sources of information on long-term and large-scale changes, but experimental approaches are needed to test hypotheses about the underlying ecological processes. Twenty years ago, a unique experiment (The International Tundra Experiment, ITEX) was set up across the arctic-alpine biome world wide to examine the

effects of climate warming on tundra plant communities. One weakness of most climate change experiments is that they are performed on small plots and on a short time scale. One approach to scale up climate change studies both in time and space is to combine experiments with studies along natural environmental gradients. This lecture will summarise the experiences and results from ITEX, and present examples of observational studies and how observations and experiments can be combined. *Lecturer: Kari Klanderud*

5. Terrestrial ecosystems: Predictions and future challenges
In light of climatic changes a considerable effort has been put down to describe what to expect in the future of biological changes. How can we predict such responses to future climatic conditions? What types of procedures have been used for providing biological predictions? *Lecturer*: *Einar Heegaard*

6. Marine ecosystems: Physical influence on the marine ecology – influence on changed physical condition
The physics have a particularly important role in marine compared to terrestrial ecosystems because the understanding of plankton populations is naturally much more integrated with the ocean physics. Especially, over the recent decade the integration of biology and physics has developed in marine ecology. It is now possible to add an extra dimension to marine ecology. Instead of putting the organisms at the center of the picture and considering them in relationship to other organisms and the environment, it is possible to work with marine ecosystems in which physical, chemical and biological components are equally important in defining the total system properties. *Lecturer: Svein Sundby*

7. Marine ecosystems: Marine climate and blue whiting in the northeastern North Atlantic
The dynamics of the subpolar gyre shifts the boundaries between the main faunistic zones – the Lusitanean, the Boreal and the Arctic - in the north-eastern Atlantic Ocean. This strong and persistent bottom-up bio-physical link is illustrated with four trophically connected levels in the food chain - phytoplankton, zooplankton, pelagic fish, and pilot whales. We will focus on the huge stock of the pelagic gadoid, blue whiting (*Micromesistius poutassou*). The potential of predicting recruitment of young fish to this commercially important stock will be discussed. *Lecturer*: *Hjalmar Hatun*

8. Marine ecosystems: Marine Climate and fisheries in African coastal waters
The Benguela upwelling ecosystem at the southwestern African coast is one of the big five upwelling ecosystems of the world's oceans (together with the Canary, Chile-Peru, Californian and Somalian systems). Such ecosystems are characterised by very high phytoplankton production which sustains through the year, and extended spawning period of the fish species .It will be shown that spawning behaviour and recruitment dynamics of fishes in such system are particularly adapted to circulation features of such regions. *Lecturer: Svein Sundby*

9. Marine ecosystems: Consequences of ocean acidification on fisheries
The threat from increasing CO2 levels and subsequent a lowering of the ocean pH will be illuminated, and the uncertainties that still exist with respect to physiological, species and ecosystem impacts of global warming discussed. The key parameters determining stock dynamics such as recruitment and growth, or collapses of big fisheries such as anchovy and herring, will be identified. *Lecturer: Jan Helge Fosså*

Target Students and Prerequisites

The course is targeted primarily to PhD students and junior faculty. Participants are required to be registered in a PhD program or hold a university or research centre position. Course 5 targets marine and terrestrial ecologists and environmental scientists, and requires background in these or other relevant disciplines at the graduate level. They must be fluent in English.

Students will be awarded 10 ECTS upon completion of all requirements, which include: attendance to all Bergen Summer Research School activities, completing the required reading prior arrival to Bergen, presentation of a paper outline during the sessions, and submission of the paper within 4 weeks after the course. The preliminary title and abstract of the student's paper is to be submitted by June 15th (see information on student assignments below).

Student assignments

Paper: Each student is to deliver a 5 – 15 page paper on an agreed topic, within four weeks after the end of the course. This can be a review paper, opinion article, or outline for a scientific article, and it can be based either on the required reading or on the applicant's own research, as long as the topic falls within the theme of the course. Students will give presentations of their paper outline during the summer school, and written feedback will be provided on draft papers before the deadline.

The activities of this course will be interspersed with Summer School Plenary Sessions and Plenary Panel Debates. All lectures in course 5 and plenary activities are mandatory.

Miscellaneous

The overall program of the BSRS includes exhibitions, tours, sightseeing, etc, that all Summer School participants and faculty members are free to engage in. Please visit the web pages regarding practicalities and program for further information.

Required Reading: *(under compilation)*