



## BONUS BIO-C3/BAMBI/INSPIRE 2015 Summer School

*“The Baltic Sea: a model for the global future ocean?”*

Status 5 July 2015

### Lecturers

Thorsten Reusch, GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany; BIO-C3

Kerstin Johannesson, CeMEB, Sweden; BAMBI

Helen Andersson, Swedish Meteorological and Hydrological Institute; BIO-C3

Piotr Margonski, NMFRI, Poland; BIO-C3

Andreas Lehmann, GEOMAR, Germany; INSPIRE

Christian Möllmann, IHF, Hamburg University, Germany; INSPIRE

Anders Nissling, Uppsala University, Sweden; INSPIRE

Michele Casini, Swedish Agricultural University; INSPIRE

Elizabeta Briski, GEOMAR

Frank Melzner, GEOMAR

Isabel Casties, GEOMAR

Christoph Petereit, GEOMAR; BIO-C3

Jan Dierking, GEOMAR; BIO-C3

### Topics, preliminary program

#### Sunday, July 5

14:00 - Tour of GEOMAR experimental facilities (for participants traveling via Kiel)

16:45 - Joint departure by bus to Summer school location in Glücksburg.

19:00 - BBQ and brainstorming

## Monday, July 6

08:30 - *Welcome and Introduction to the summer school* (1/2 h)  
(Jan Dierking)

09:00 - Focus topic: *Baltic environmental dynamics*:  
(Helen Andersson and Andreas Lehmann)

*Past, present and future marine environment of the Baltic Sea.* – 1.5 – 2 h Lecture.  
(Helen Andersson)

Focus: Baltic Sea dynamics concerning the large freshwater input, restricted exchange with North Sea, horizontal and vertical salinity gradients (mixing, inflows), stagnation periods and hypoxia, the basics in the biogeochemical cycles (nutrient inputs, eutrophication).

- *Major Baltic inflow events (MBIs), using the case study of the 2014 MBI.* – 1 h Lecture.  
(Andreas Lehmann)

What are the atmospheric conditions that are necessary for large volume changes in the Baltic Sea? Which influence do MBIs have on the deep water salinity and oxygen conditions in the Baltic, and on the reproductive volume of cod? We will show output of model runs of the Baltic Sea model at GEOMAR for the period the period 1979-early 2015 including the December 2014 event. The highly saline water which entered the Arkona Basin during December has propagated further into the Bornholm Basin and has probably reached now the Bay of Gdansk and the eastern Gotland Basin.

13:30 - *Climate change modeling and future environmental projections for the Baltic Sea*  
(Helen Andersson)

- *Climate-change modelling of the Baltic.* – Lecture 1.5 h lecture.  
What are IPCC scenarios, how are they constructed? What do the current projections of global changes of the oceans and the specific scenarios for the Baltic Sea (ice, temperature, salinity, oxygen, primary production etc.) show?

*How do climate change models work, and do we need them?* – 1 h Lecture/Exercise.

Participants use a simple climate model (in an excel sheet) in order to understand the sort of assumptions, parameters, sensitivities and uncertainties that go into climate modeling.

16:30 - *Baltic fish reproduction*

- *Reproduction of marine fishes in the Baltic Sea and adaptations to brackish water.* – 1 h lecture. (Anders Nissling)

I will focus on salinity requirements for successful reproduction of marine fishes inhabiting the Baltic Sea, effects of inflow events vs. stagnation with implications for variability in species abundance and distribution. In this context I will also focus on

maternal effects, i.e. the viable egg production and effects of fishing. Further, I will bring up the question whether fish in the Baltic Sea are more fecund, and discuss the trade-off between somatic growth and investment in reproduction. Examples will be based on my studies on cod and flatfishes, and comparisons made with populations at marine conditions to reveal adaptations to brackish water.

- *Density columns and the principle of egg buoyancy measurements/experiments.* – 1 h Practical demonstration including 20 min lecture. (Christoph Petereit)

I will shortly introduce the basic experimental approach, the setup and necessary equipment we are using to assess and calculate spatial distribution of Baltic Sea fish eggs. I will demonstrate how to create density columns and what needs to be considered to avoid pitfalls in the methodological approach. The experimental outcomes are of special interest if the results are used as input parameters and coupled to hydrodynamic modelling. Some key results related to selected Baltic Sea fish are presented.

## **Tuesday, July 7: Baltic species distributions, ecophysiology and adaptation**

08:30 - *Changes in spatio-temporal distribution of Baltic fish populations: patterns, explanations and consequences.* – 1.5 h Lecture.  
(Michele Casini)

The lecture will address the spatial and temporal changes in the commercially and ecologically most important fish populations in the open Baltic Sea. These changes will be put in relation to hydro-climate changes, biotic variations and anthropogenic pressures, such as (over-)fishing. The concepts of top-down and bottom-up trophic control on ecosystem functioning will be treated in particular detail, together with the theory of alternative stable states and resilience.

*Ecophysiology of marine animals in the Baltic Sea: how will species distribution be constrained by ongoing climate change?* 1.5-2 h Lecture.  
(Frank Melzner)

In my lecture, I will discuss how marine animals cope with variability in abiotic parameters (salinity, carbon dioxide, temperature and oxygen) in the Baltic Sea. I will describe basic mechanisms of acid-base and ionic regulation that render some taxa more vulnerable to expected environmental changes. A special focus will be placed on discussing impacts of multiple stressors and on the importance of long-term and transgenerational experimental approaches.

13:30 - Focus topic: “*Adaptation*”  
(Kerstin Johannesson)

- Lecture 1 (1.5 h): *Adaptation*. What is adaptation, and how can it be measured using ecological and genetic approaches.  
I will give examples using common-garden analysis, reciprocal transplantation, but also genetic/genomic approaches (outlier analysis, admixture analysis, time-series analysis). I will use examples from the Baltic Sea as much as possible to illustrate methods and for discussion of results.
- Lecture 2 (1.5 h): *Not adaptation*. Patterns and processes that may look similar to adaptation but that are the result of stochastic processes.  
Here I will present some ideas of Excoffier and others on "allelic surfing" and a modeling example of sex ratios following colonization of a new area. I will compare the results with data on two species of Baltic Sea seaweeds (*Fucus*). This lecture may actually end with a discussion on the role of genetic drift versus the role of selection in natural ecosystems, together with students and other lecturers of the summer school.

*Guided tour of artefact renewable energy exposition ca. 1.5 h*  
(Werner Kiwitt, artefact)

### **Wednesday, July 8: Invasion biology; ecosystem based management**

08:30 - Focus topic: *Ecosystem based management*.

- *What are EBM and EBFM? The basic principles of ecosystem-based management.* – 1.5 h Lecture. (Christian Möllmann)

Ecosystem-based management (EBM) is now the agreed paradigm for a modern and sustainable management of marine resources. However, the basic principles of EBM and the ways to implement it are often unclear to scientists not directly involved in applied management questions. Here I review the basic EBM terminology and discuss the different implementation levels from sectorial approaches such as Ecosystem based fisheries management (EBFM) to a full multi-sector approach. I further review the ways to implement EBM in European policy and compare it to approaches conducted in Northern America.

- *Implementation of the EU Marine Strategy Framework Directive from the marine ecologist perspective* 1 h Lecture + 20 min discussion.  
(Piotr Margonski)

The aim of the EU Marine Strategy Framework Directive (MSFD) is to protect more effectively the marine environment across Europe. Lots of our recent scientific and management activities focuses on subsequent steps of its implementation. I will summarize the basic assumptions and goals, steps in the process, role of EU Member States and Regional Conventions, descriptors, concept of GES, indicators and pressures, reference condition, (integrated) monitoring programmes, and programmes of measures. MSFD might be presented and discussed from different perspectives of e.g. politicians,

environmental administration, and researchers. I will focus on the latter. My lecture will be a “logical” addition to the morning Ecosystem Based Management panel.

13:30 – Continuation of focus topic *Ecosystem based management*

- *Ecosystem based management applied to the Baltic Sea.* 1.5 - 2 h Exercise.

(Christian Möllmann and Piotr Margonski)

We will conduct an exercise with the students outlining an EBM approach for the Baltic Sea.

15:30 – Focus topic: *Invasion biology*

(Elizabeta Briski and Isabel Castis)

- *Basic principles of invasion biology* – 20 min Lecture.  
I will provide an introduction to the history and important terms of invasion ecology (e.g., propagule pressure and colonization pressure), and impacts of introduced species.
- *Vectors of species introductions.* – 20 min Lecture.  
Here, I will introduce students to different vectors that transport species and current management strategies to prevent new introduction of species.
- *Invasions in the Great Lakes and the Baltic Sea – same same but different?* – 20 min Lecture.

This lecture will address the following questions: Is there a similar number of non-indigenous species (NIS) in the North and Baltic Seas compared to the Great Lakes-St. Lawrence River region? Are the taxonomic composition and the geographic origin of NIS different due to an opposing salinity pattern of the two systems? Do species from a certain region have inherent advantages in colonizing new areas?

16:30 – *Invasion biology and the Baltic Sea.* – Discussion forum

(students please study the papers provided for this session for preparation)

### **Thursday, July 9 – Fieldtrip**

08:30 - *Fieldtrip “Coastal ecosystems”*, Flensburg Fjord (half day, return to artefact around 14:00)

ca. 16:00 - *Discussion of young scientists about knowledge gaps and ideas for projects/collaborations, discuss potential for young scientist network BIO-C3/BAMBI/INSPIRE*

19:00 BBQ

## **Friday, July 10 - Synthesis**

08:30 - “*The Baltic Sea – a model for the global future ocean?*” – Lecture.  
(Thorsten Reusch)

Biology and ecology are comparative sciences. Hence, although several features of the Baltic Sea, such as its age and geomorphology are very distinct from the world ocean, we can nevertheless learn a lot about the possible fate of as yet more pristine ocean areas from a look at the Baltic Sea. In this synthesis lecture I will compare causes and effects of some major anthropogenic pressures that threaten both the world ocean and the Baltic Sea. I will highlight where the Baltic may serve as negative time machine into the future, but also, where management measures have sometimes reverted negative trends in ecological services. Wherever possible, I will try to refer to previous lectures within the summer school to synthesize the current state-of-the art.

10:30 - “*The Baltic Sea – a model for the global future ocean?*” – Sum up, discussion.

ca. 13:30 - Departure for second fieldtrip – *Hike Geltinger Birk nature reserve with guided tour of wetlands and bird fauna* 4 h  
(led by Nils Kobarg, LLUR)

ca. 19:00 – Summer school dinner, restaurant “Möwe Jonathan”

## **Saturday, July 11**

9:30 - Bus for Kiel leaves after breakfast, arrival no later than 12 noon.