BONUS BIO-C3

Biodiversity changes: causes, consequences and management implications

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BIO-C3 overview

The importance of biodiversity for ecosystems on land has long been acknowledged. In contrast, its role for marine ecosystems has gained less research attention. The overarching aim of BIO-C3 is to address biodiversity changes, their causes, consequences and possible management implications for the Baltic Sea. Scientists from 7 European countries and 13 partner institutes are involved. Project coordinator is the GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany, assisted by DTU Aqua, National Institute of Aquatic Resources, Technical University of Denmark.

Why is Biodiversity important?

An estimated 130 animal and plant species go extinct every day. In 1992 the United Nations tried countering this process with the "Biodiversity Convention". It labeled biodiversity as worthy of preservation – at land as well as at sea. Biological variety should not only be preserved for ethical reasons: It also fulfils key ecosystem functions and provides ecosystem services. In the sea this includes healthy fish stocks, clear water without algal blooms but also the absorption of nutrients from agriculture.

Biodiversity and BIO-C3

To assess the role of biodiversity in marine ecosystems, BIO-C3 uses a natural laboratory: the Baltic Sea. The Baltic is perfectly suited since its species composition is very young, with current salt level persisting for only a few thousand years. It is also relatively species poor, and extinctions of residents or invasions of new species is therefore expected to have a more dramatic effect compared to species rich and presumably more stable ecosystems.

Moreover, human impacts on the Baltic ecosystem are larger than in most other sea regions, as this marginal sea is surrounded by densely populated areas. A further BIO-C3 focus is to predict and assess future anthropogenic impacts such as fishing and eutrophication, as well as changes related to global (climate) change using a suite of models.

If talking about biological variety, it is important to consider genetic diversity as well, a largely neglected issue. A central question is whether important organisms such as zooplankton and fish can cope or even adapt on contemporary time scales to changed environmental conditions anticipated under different global change scenarios.

BIO-C3 aims to increase understanding of both temporal changes in biodiversity - on all levels from genetic diversity to ecosystem composition - and of the environmental and anthropogenic pressures driving this change. For this purpose, we are able to exploit numerous long term data sets available from the project partners, including on fish stocks, plankton and benthos organisms as well as abiotic environmental conditions. Data series are extended and expanded through a network of Baltic cruises with the research vessels linked to the consortium, and complemented by extensive experimental, laboratory, and modeling work.

From science to management

The ultimate BIO-C3 goal is to use understanding of what happened in the past to predict what will happen in the future, under different climate projections and management scenarios: essential information for resource managers and politicians to decide on the course of actions to maintain and improve the biodiversity status of the Baltic Sea for future generations.

Concept:

The aim of the short movies was to include different social media in our outreach strategy via the internet e.g. facebook, youtube. This gives an additional chance to distribute the project results and goals a wider audience independently from classical dissemination by publications and written reports. With the short movie we try to address the public, non-specialist audience and some stakeholders to give a first introduction to BONUS BIO-C3 and to make them curious about the topic Baltic biodiversity .

Publication strategy:

In cooperation with several Bio-C3consortium partners the Bio-C3 short movie and task descriptions were published on the Bio-C3 homepage www.bio-c3.eu, institutional webpages, and national funding agency webpages. The movie was also promoted via the BONUS webpage and the BIO-C3 consortium.

Links:

Bio-C3 short movie: **https://vimeo.com/222642663**

Task topics:

- **Indicators and tools:** **https://vimeo.com/194346578**
- **Foodwebs:** **https://vimeo.com/194344259**
- **Genetics:** **https://vimeo.com/194342879**
- **Modelling:** **https://vimeo.com/194340263**
- **Functional Biodiversity:** **https://vimeo.com/194337458**

Promotion example:

- German BMBF webpage: https://www.fona.de/en/how-will-climate-change-eutrophication-fishing-and-species-invasions-influence-the-biodiversity-in-the-baltic-sea-22415.html

Short summary (based on the movie script):

What is biodiversity?

Erik Bonsdorff: '*Species diversity can be defined as the number of species that you would encounter or find at any given moment in time in any given habitat or environment.*'

Jan Dierking: '*Essentially the diversity of habitats is the number of different habitats that you find in a certain area, to put it most simply*.'

Thorsten Reusch: *'Within species we have different individuals and those individuals they differ form one another in genetic terms and very often we see that also in their appearance in their phenotype. Those differences are biodiversity at the level within species*.'

The BONUS project Bio-C^3 covers all these definitions and examines the changes of biodiversity within the Baltic Sea. The reasons and consequences of this change in

biodiversity are discussed. At last the project proposes management tools with the aim to preserve the biodiversity.

As example, Daniel Oesterwind catches round gobies with a beach seine. He and his colleagues want to examine if the invasive round goby has a negative impact on native fish species.
The stomach analysis shows what the round gobies eat. Are they competing for food with native species? Do they eat eggs and larvae of herring?

The round goby was genetically tested like many native fish species. The result is clear. The introduced round gobies are able to survive and reproduce in large parts of the Baltic Sea without genetic adaptations. By comparison, herring and cod are genetically adapted to specific areas of the Baltic Sea. Both species are divided into different stocks with clearly different DNAs.
To cover the whole Baltic ecosystem, scientists examine all kind of species; from zooplankton to marine mammals, from phytoplankton to macrophytes.
The Stockholm University examines models and experiments to find out what happens with the foodwebs of the Baltic Sea when native species fall away or new species are added. The collected data is also used to model possible scenarios for the future of the Baltic Sea.

But not only the plants and animals of the Baltic Sea are changing. A declining salinity, less oxygen, higher temperatures, increased nitrate and phosphate levels in the Baltic Sea are visible evidence of the influence of humans and climate change.

Helen Andersson: '*The combination of different pressures like climate change, nutrients loads and fishing for example, all this have impact on the marine ecosystem and with models we try to understand what are the impacts, what will the variability and the environment be and how can that impact the ecosystems*.'

Thorsten Reusch: '*The results of Bio-C3, in particular the genetic differences between the baltic cod stocks, they will be incorporated into fisheries management, both stocks has to be dealt as completely separate units. Our genetic investigations show that they will not mix.*'

Erik Bonsdorff: '*So in Bio-C3, what we have been doing is, that we have been analyzing biodiversity from many many perspectives. And one of course are species that don´t really belong here, that are invasive. And if we want to somehow manage them, we need to do it in two ends. One is where they come from, in other words prevent them from being spread here in the first place which would be controlling ballast water. And the other end is, that if we keep our own local environment healthy and clean, then there will be no ecological space for non-native species.*
So if you have a system which has been disturbed or destroyed then non-natives have an easy change to get in. The practical advice one could give then to the general public is, that if you find a species that you know you have never seen before, is to report it straight away, because if it's a new invasion then you mind be able to stop it by taking away the individuals that first came. But once they have established it's virtually impossible to kind of pick them all out.'