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BONUS
SCIENCE FOR A BETTER FUTURE OF THE BALTIC SEA REGION

briefing
number 31

JUNE 2019

Outcomes of BONUS Viable ecosystem call:

Widespread impact on Baltic Sea management action

The BONUS call 2012: Viable ecosystem (VE) of over EUR 26 million in volume, engaged nearly 600 research staff across implementation of seven projects funded in years 2014–2018. The projects generated substantial impact on science, society, policy and management of the Baltic Sea region. The research partners from 39 institutes of all nine Baltic Sea coastal countries (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden as BONUS member countries, and Russia through bilateral agreements), facilitated Baltic-wide research integration both within and beyond the VE call.

To date, the VE projects have published 343 scientific papers, out of which nearly half as open access and 44 % with authors from at least 2 different BONUS participating states. Furthermore, over 150 suggestions have been made to shape Baltic policy and management measures. These projects have reported on at least 900 events of stakeholder engagement and nearly 1600 instances of dissemination, e.g. nearly 120 popular science contributions and 300 media interviews. The projects have supported 66 doctoral studies and more than 80 PostDoc positions over the course of their implementation. The gender balance has been well aligned with the overall BONUS approach as half of all scientific staff have been women.

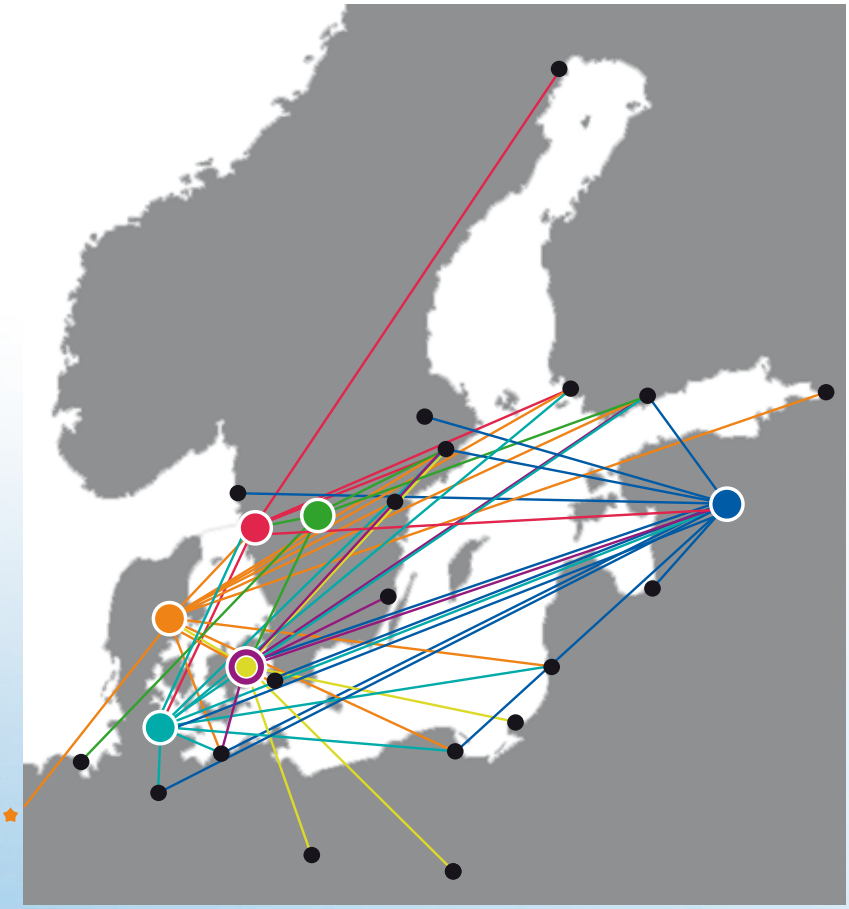
Broad array of performance statistics data collected from BONUS projects

Since opening the first project call in 2012, the BONUS Secretariat has continuously collected performance statistics data of the projects' periodic reporting. These statistics comprise 19 categories on the projects´ contributions to regulatory management, development and implementation of policy, stakeholder engagement, cross-border research integration, links to academia, and public dissemination, resulting in an extensive database: a unique information source for evaluating the impact of research carried out by the BONUS projects.

■ ***Collaboration within, across and beyond project calls and EU states:*** The VE projects organised five joint symposia and workshops and authored 35 joint scientific publications (10 % of all VE publications). Additional three events and 11 publications were cross-call joint efforts with projects of the BONUS calls 'Sustainable Ecosystem Services' and 'Blue Baltic'. The VE projects also established more than 100 links to non-Baltic research actors from within and outside the EU, including researchers from Australia, Canada, Chile, New Zealand, Russia and the USA.

■ ***Tight links to academia:*** The VE projects supported 66 doctoral and more than 80 PostDoc positions, and organized two summer schools and 13 post graduate courses. So far, 343 peer-reviewed scientific publications have been released, roughly half as open access and 44 % with authors from at least two different BONUS participating states; more than 70 publications are still to come.

■ ***Broad dissemination of project results:*** The VE projects engaged in nearly 1600 events of public dissemination, including around 300 interviews to media, 50 multi-media productions (e.g. movie "Reducing Nutrient Loadings into the Baltic Sea" by BONUS SOILS2SEA), and 120 popular science contributions (e.g. books "Have you seen the fish?" by BONUS INSPIRE, or "Changing leisure boat antifouling practices in the Baltic Sea" by BONUS CHANGE).



BONUS BAMBI - Baltic Sea marine biodiversity
Kerstin Johannesson, University of Gothenburg, Sweden

BONUS BIO-C3 - Biodiversity changes – causes, consequences and management implications
Thorsten Reusch, GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany

BONUS BLUEPRINT - Biological lenses using gene prints
Lasse Riemann, University of Copenhagen, Denmark

BONUS CHANGE - Changing antifouling practices for leisure boats in the Baltic Sea
Mia Dahlström, Research Institute of Sweden Borås, Sweden

BONUS COCOA - Nutrient cocktails in coastal zones of the Baltic Sea
Jacob Carstensen, University of Aarhus, Denmark

BONUS INSPIRE - Integrating spatial processes into ecosystem models for sustainable utilization of fish resources
Henn Ojaveer, University of Tartu, Estonia

BONUS SOILS2SEA - Reducing nutrient loadings from agricultural soils to the Baltic Sea via groundwater and streams
Jens Christian Refsgaard, Geological Survey of Denmark and Greenland in Copenhagen, Denmark

The Baltic-wide network of the seven VE projects, including 39 different project partner institutes in all nine countries of the Baltic Sea region, as well as in the Netherlands.

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IMPACT OF BONUS VE PROJECTS ON MANAGEMENT, POLICY AND SOCIETY

The seven BONUS VE projects contributed more than 150 times to the development and implementation of 'fit-to-purpose' regulations, policies and management practices aimed at safeguarding the sustainable use of Baltic Sea ecosystem's goods and services (Table 1), and engaged at least 900 times with stakeholders of the region.

Table 1. Contribution of the BONUS VE projects to policy and management regulation in the Baltic Sea region and the total percental share on the overall 150 events reported by the projects (completeness of numbers relies on reporting). Detailed information obtainable from the BONUS Secretariat upon request. BS = Baltic Sea

	%	BAMBI	BIO-C3	BLUEPRINT	CHANGE	COCOA	INSPIRE	SOILS2SEA
A. Contributing to EU strategies and directives for the BS	20	√	√		√	√	√	√
B. Providing policy and management recommendations	35	√	√		√	√	√	√
C. Updating / developing indicators and descriptors for BS Good Environmental Status	7		√			√	√	
D. Closing the gap between science and management, and enhancing BS ecosystem approach to management	38	√	√	√	√	√	√	√

For instance...

A. BONUS BAMBI, BIO-C3 and COCOA gave scientific input for the development or update of strategies related to the national implementation of the EU Marine Strategy Framework Directive (MSFD) in Estonia, Finland, Germany, Lithuania, Poland, and Sweden. BONUS CHANGE was chosen as a flagship project of the EU Strategy for the Baltic Sea Region (EUSBSR) Policy Area Hazards representing a significant support to progress towards the EUSBSR goals.

B. Recommendations for improvement of policy and management action included e.g. "Request to improve adaptive potential of Baltic Sea species – and include genetic diversity in management" (BONUS BAMBI), "Recommendations towards regulations for sustainable antifouling practices in the Baltic Sea" as well as "Calling for a change in leisure boat antifouling practices in the Baltic Sea" (BONUS CHANGE), and "Proposing new governance concepts and policy options" (BONUS SOILS2SEA).

C. Developing indicators and descriptors for the Baltic Sea Good Environmental Status entailed e.g. EU Marine Strategy Framework Directive (MSFD) descriptors for *Non-indigenous species* (BONUS BIO-C3) and *Sea-floor integrity* (BONUS COCOA), and HELCOM indicators for *Eutrophication* (BONUS COCOA) and *The state of the offshore fish community* (BONUS INSPIRE).

D. BONUS BAMBI created a webpage specifically targeting ecosystem managers, BONUS CHANGE developed a certificate for leisure boat owners regarding old remains of antifouling paint with tributyl tin that were found to be still present on a large share of Baltic leisure boats, and BONUS COCOA influenced current and future nutrient loading to the Baltic coast by helping to calculate maximum allowable nutrient load and evaluating nutrient load reduction needs and measures in Denmark, Finland, and Poland.

KEY RESULTS OF 'BONUS CALL 2012: VIABLE ECOSYSTEM' PROJECTS

BONUS BAMBI: Genetic diversity matters and needs better recognition and implementation in the design of Baltic Marine Protected Areas

The current design and spatial distribution of Baltic Marine Protected Areas, serving as a tool to conserve biodiversity, do not support high connectivity between populations and thus maintenance of genetic variations, which are however important as they can underpin adaptations to future environmental conditions.

BONUS BIO-C3: Biodiversity and ecosystem function of the present Baltic Sea as outlook for the future coastal ocean

The specific environmental conditions of the Baltic Sea (low salinity, high nutrient load and many invasive non-indigenous species, rapid ocean acidification) and their impacts on the ecosystem represent conditions that will likely be met by other coastal systems in the future. Hence, the Baltic Sea can serve "as a time machine for the future coastal ocean" (Science Advances Vol. 4, no. 5, DOI: 10.1126/sciadv.aar8195).

BONUS BLUEPRINT: Environmental conditions in the Baltic Sea can be predicted from microbial genetic information contained in a water sample

- This may lead to a potential future application as a revolutionary tool for environmental status assessments.

BONUS INSPIRE: Answering where which fish is when and why with implications for Baltic fisheries management

- Increased understanding of the spatial ecology of Baltic cod, flounder, herring and sprat throughout their development from egg to adult will significantly contribute to improving present and future ecosystem-based fisheries management in the Baltic Sea.

BONUS CHANGE: Biofouling on leisure boats can be prevented by much less-toxic antifouling paint than currently used in the Baltic Sea or using alternative antifouling measures

- As fouling pressure in the Baltic Sea is comparatively low, biofouling is prevented by using antifouling paint with far lower concentrations of toxic components, such as copper, than currently used.

BONUS SOILS2SEA: Adjusting nutrient management strategies to present and future local conditions in the catchment can significantly reduce nutrient loading to the Baltic Sea

- Such spatially differentiated strategies consider for instance areas of naturally high / low nutrient retention and variations in land use. Mitigation measures should also consider future nutrient loading, which is predicted to increase due to climate change (4–10 % for N, 6-20 % for P by 2050) and depend on regional socio-economic scenarios.

BONUS COCOA: Nutrient turnover in the coastal zone varies between the major Baltic coastal types with implications for nutrient management

- Coastal lagoons are relatively effective in removing nitrogen (N), archipelagos are efficient in trapping phosphorus (P), and taken together, the entire Baltic coastal zone potentially removes ~ 16 % N and ~ 53 % P of land-derived inputs. These properties of the coastal zone shall be taken into account while designing and implementing HELCOM's nutrient reduction scheme in the Baltic Sea Action Plan.

More information: www.bonusportal.org/veprojects

BONUS BAMBI:	www.bonusportal.org/bambi
BONUS BIO-C3:	www.bonusportal.org/bioc3
BONUS BLUEPRINT:	www.bonusportal.org/blueprint
BONUS CHANGE:	www.bonusportal.org/change
BONUS COCOA:	www.bonusportal.org/cocoa
BONUS INSPIRE:	www.bonusportal.org/inspire
BONUS SOILS2SEA:	www.bonusportal.org/soils2sea

Publicly accessible data sets and tools created or extended with VE project funding

- "Baltic Sea Genetics for Managers" (BONUS BAMBI)
  https://bambi.gu.se/baltgene
- "Baltic Sea Reference Metagenome / BalticMicrobeDB" (BONUS BLUEPRINT)
  https://barm.scilifelab.se
- "Baltic Sea Metagenome Dashboard" (BONUS BLUEPRINT)
  https://cberg.shinyapps.io/baltic-sea-metagenome-dashboard
- "Baltic Sea Mesozooplankton Dataset" (BONUS INSPIRE, BONUS BIO-C3)
  www.bonus-inspire.org/metadata

This briefing is based on the BONUS EEIG compiled performance statistics summarised by Dana Hellemann.

BONUS, THE JOINT BALTIC SEA RESEARCH AND DEVELOPMENT PROGRAMME (2011–2020), produces knowledge and eco-technological advances to support development and implementation of regulations, policies and management practices specifically tailored for the Baltic Sea region. It issues calls for competitive proposals and funds projects of high excellence and relevance based on the BONUS strategic research agenda www.bonusportal.org/sra.

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BONUS is funded jointly from the national research funding institutions in the eight EU member states around the Baltic Sea and the EU by a total of EUR 100 million (2011–2020).