



GLOBAL ECONOMIC DYNAMICS
AND THE BIOSPHERE

THE ROYAL SWEDISH ACADEMY OF SCIENCES

The Erling-Persson Family Academy Programme

ANNUAL REPORT 2021



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Directors' Note

2021 was a year in which the pandemic, and the restrictions it imposed on people's daily existence, became the new normal. As offices remained closed for much of the year, we continued to adapt the GEDB organisation to an online presence. In particular, we worked to find novel ways of facilitating continued team-building and maintaining open and active dialogue among members of the GEDB research group and with our collaborators.

A core part of the GEDB research has come to centre on various forms of sustainability risks, from emerging infectious diseases to droughts, floods and other hazards affecting food production, markets and, ultimately, investors. As realisation grows in society of the systemic risks that come in the wake of the current sustainability challenges, GEDB work is becoming ever more in demand, as highlighted by the examples provided in this report of our outreach and impact-related work.

Just as the Covid-related restrictions began to ease, war broke out in Europe, affecting all Europeans, GEDB research collaborations and several members of our staff. It is a time of uncertainty and, with continuing climate change and loss of key ecosystems that underpin human societal wellbeing, we are likely to see more unrest in the future. At GEDB, we are determined to conduct science that can actively contribute to improved decision making among those with the power to chart a new, more sustainable course. Examples of such efforts are presented in this year's report. We are grateful to the Erling-Persson Family Foundation, which makes this work possible.



Beatrice Crona
Executive Director, GEDB



Carl Folke
Director, GEDB

Aims and Visions

- To create a platform for interdisciplinary collaboration on the challenges of global change and sustainability, with a specific focus on how local-to-global, cross-scale interactions affect human wellbeing and sustainable use of natural resources and ecosystems.
- To facilitate and promote collaboration between early-career economists and scientists from other backgrounds focusing on sustainability science.
- To combine diverse knowledge systems and experiences, and conduct research for a broader understanding about the preconditions and opportunities for sustainable societal development in the new global context of the Anthropocene.

Staff News

Shruti Kashyap joined our team in November as a postdoctoral researcher with GEDB and the Sustainable Finance Lab. Shruti aims to contribute to GEDB's work on risk connections between environmental Earth systems and financial sector regulations and practices. At present, she is focusing on these links within financial sector risk assessment and disclosure frameworks. In this context, she has begun empirical investigations on how environmental Earth system risks can be translated into extant financial and non-financial disclosure frameworks in the financial sector.

Shruti's academic credentials include a Juris Doctor in environmental law from the University of Maryland, USA, a PhD in Business Administration from Uppsala University and undergraduate degrees in Philosophy (BA) and Financial Economics (BS) from the University of Maryland. Her PhD dissertation explored the interactions between law, accounting and governance in the context of risk and resilience within the European Union financial sector.

Shruti has worked previously as a derivatives analyst with Morgan Stanley, as an international trade economist and legal expert with the United Nations and the World Trade Organization, and as a lecturer and post-doctoral researcher in accounting and organisational studies at the Department of Business Studies, Uppsala University. On 1 April, she was also appointed to the position of Associate Professor at Örebro University, Sweden.

During 2021, two new PhD candidates joined GEDB:

Daniel Avila Ortega is a joint PhD candidate at GEDB and at Stockholm Resilience Centre, Stockholm University. He is conducting his PhD within the research project The Economics of Planetary Boundaries, led by Uppsala University. The aim

in that project is to explore policies that would keep humanity within the planet's safe operating space while meeting other United Nations Sustainable Development Goals (SDGs). His current work involves assessing different biodiversity metrics and their relationship with the Planetary Boundaries framework and top-priority criteria selected by ecologists to ensure that these metrics reflect the contributions of biodiversity to the global economic system. In addition, Daniel is working on integrating Earth System and Integrated Assessment Models to a greater extent, for better policy-making and future scenarios.

Daniel holds a joint Master's degree in Science in Industrial Ecology from Leiden University and TU Delft, the Netherlands, and postgraduate certification in Forest Carbon Science, Policy and Management from Michigan State University, United States.

Luong Nguyen Thanh is a joint PhD candidate at GEDB and Uppsala University. He obtained a Bachelor's degree in Public Health in Vietnam and a Master's degree in One Health in Belgium. His research interests lie in the use of integrative approaches such as One Health in analysis of the links between human-animal-environment, targeting in particular disease surveillance and antimicrobial resistance (AMR).

In his PhD research, Luong will explore the potential to leverage the UN SDGs agenda in combination with conventional AMR agendas to tackle challenges of AMR, with special attention to its distal drivers. The study will include exploring the landscape of distal drivers, then analysing how they have been addressed in recent AMR and SDG national action plans of 15 countries, and finally re-evaluating the national trend.

In June, the GEDB programme hired four new research assistants:

Solomiya Kasyanchuk has supported the Global Health and Biosphere Stewardship theme. Solomiya holds an MSc in Health Economics, Policy and Management from the Karolinska Institute, Sweden, and a BA in Mathematics and Philosophy from the University of Toronto. During her Bachelor's studies, Solomiya took a break from her studies and worked as an advisor to the Minister of Health in Ukraine, focusing on international relations.

Giorgio Parlato is involved in different projects, but most of his work revolves around Biosphere Finance projects. After completing a Bachelor's degree in Economics and Finance at LUISS University in Rome, Giorgio obtained an MBA with a focus on entrepreneurship and sustainability at Syracuse University, USA. Afterwards, Giorgio's passion for sustainable food systems led him to co-found a plant-based food company.

Sasha Quahe is addressing the interactions between corporate and financial institutions and key Earth system processes, especially climate and biodiversity. Her academic background is in political science, international relations and economics at the University of Western Australia, including an Honours degree in politics. Sasha also holds an MSc in Social-Ecological Resilience for Sustainable Development from Stockholm Resilience Centre, Stockholm University.

Charis Sijuwade supports the Global Health and Biosphere Stewardship theme, where she is conducting research on how biodiversity contributes to human health. Having obtained a BSc (Hons) in Biochemistry, Charis went on to complete an MSc in Public Health at Lund University, Sweden, where she focused on mental health outcomes in marginalised communities.

On October 10th, 2021, PhD candidate **Emmy Wassénus** successfully defended her Licentiate thesis, entitled: *Risk and Resilience: An Integrated Approach for Navigating a Complex World*.

In 2021, Executive Director **Beatrice Crona** was appointed to a newly established professorship in Sustainability Science at Stockholm University. She will continue to lead research at GEDB together with Carl Folke and Peter Sjøgaard Jørgensen, but will spend 20% of her time developing sustainable food system research at Stockholm Resilience Centre.

At the end of the year, Deputy Executive Director **Peter Sjøgaard Jørgensen** was awarded a European Research Council Starting Grant of 1.5 million Euro to collect and analyse a large dataset on new diseases and agricultural pests. The aim is to uncover the social and environmental chain reactions these can set in motion and to identify opportunities for governing the associated shocks in ways that promote, or do not prevent, sustainable development.

Research assistant **Kate Lillepold** has taken a position as an analyst at the Public Health Agency of Sweden, and research assistant **Moa Ohlsson** has moved on to a PhD candidature at Stockholm Resilience Centre.

In September, GEDB held a half-day staff meeting, bringing together the GEDB team in person for the first time since the start of the pandemic. It was a timely opportunity to kick-start the academic year by connecting with both long-time and newer colleagues. Researchers shared their ongoing and planned research activities across various themes, linking them back to GEDB's shared vision and aims.

Photo: Alamy



Research Achievements and Activities



The Biosphere Finance theme has analysed the issue of crop residue burning in Northern India, and suggested how public and private financial institutions can help steer away from this harmful practise.

Biosphere Finance

Measuring the impact of financial investments on the Earth system: A notable output from the Biosphere Finance theme during 2021 was a metric developed by Steven Lade, Beatrice Crona and several other colleagues at Stockholm Resilience Centre for measuring the impact of financial investments on the Earth system. This prototype is the first known metric to capture Earth system processes beyond simply greenhouse gases, by including water and land use change. It also captures their mutual interactions and has the capacity to account for

differential impacts of land use change depending on where on the planet it happens, thus incorporating the notion of tipping points in the Earth system. The team is now actively seeking collaborations with companies and investors to pilot the tool using company data, and during 2022 these tests will be a key focus.

Linking black carbon emissions to the finance sector: The Biosphere Finance theme also delivered a novel analysis of the complex issue of crop residue burning in Northern India, which



“I want to improve decision-making under risk and uncertainty.”

EMMY WASSÉNIUS is a PhD candidate jointly with Stockholm Resilience Centre, first joining GEDB in 2016 as a research assistant. Her PhD work centres on using resilience concepts and methods to help navigate sustainability risks, and in October she successfully defended her licentiate thesis. Her research spans a wide range of topics and disciplines, such as food systems, financial systems and public health.

Moving from theory to practice

Emmy and colleagues are now in a phase where they are trying to create risk tools and metrics, work that is attracting strong interest from academics and also from corporate and financial actors, Emmy says:

“So far we have mostly been pushing boundaries theoretically, so it is really exciting to take the next step and develop methods and metrics that can really be of practical use. It is difficult, of course, that’s why there are none available at the moment. But if we are successful, there would be a lot of interest.”

In current risk models in the business sector, for instance, companies do not take account of how the environmental impacts from their own activities can

harm the company itself. This is particularly important for primary industries, i.e. companies that use nature to supply the raw materials for their products.

“Currently there is no way of measuring this, so that is one area we are investigating”, explains Emmy.

Covid highlights systemic risks

The Covid pandemic clearly highlighted the issue of systemic risk, according to Emmy. One example is the way in which changes in land use are pushing wild animals closer to humans and increasing the risk of emergence of new zoonotic diseases. Another example is how a pandemic or other global crisis can affect supply chains and create e.g. food shortages or lack of parts for industrial manufacturing.

“The pandemic has really illustrated how risks and problems can cascade through different sectors and areas and has highlighted the fragility of the system we have created, which has very limited buffering capacity”, Emmy points out and concludes:

“The silver lining of the pandemic is that it has helped more people to understand these risks.”

has significant negative impacts on human health and also on soil and water. Crop residue burning is at the heart of the current destabilisation of the Indian summer monsoon and climate system. By mapping the value chains emanating from the rice and wheat production system in Punjab, a GEDB collaboration led by Andrea Downing with the Department of Environmental Science at Stockholm University and University of Groningen identified the investors providing capital for the Punjab agrifood sector. The team identified two types of system changes needed to bring about long-term sustainability of the rice-wheat system and four ways in which public and private financial institutions can play an important role in shifting practices.

Integrating risk and resilience: Human activities have progressively eroded the biosphere basis for modern societies and have introduced various risks. To navigate these risks, or potential undesirable outcomes of the future, researchers worldwide need tools and a good understanding of how to assess risk in a complex world. Within the Biosphere Finance theme, GEDB research on novel risks has been strengthened and deepened. Emmy Wassénus reviewed and synthesised the wide range of existing definitions of risk and aligned them with knowledge on complex adaptive social-ecological systems, in order to highlight the strengths of each risk approach. Her work also identified five challenges that, if overcome, could turn risk assessments into a much-needed multi-faceted toolbox for dealing with the certain uncertainty of a complex future.

Corporate sustainability risks: During the year, Hanna Ahlström analysed the EU Taxonomy Regulation and its affiliated delegated acts, and developed a framework for corporate risk. She also

co-coordinated a transdisciplinary project with Beate Sjøfjell at the University of Oslo and sustainability manager Karoline Bakka Hjertø at the Norwegian bank SpareBank 1 Østlandet. The goal was to co-produce knowledge, in which research-based and practical insights were integrated, to improve sustainable banking solutions. This included work to improve the bank's strategy, its sustainability strategy and its risk management.

Sustainable Finance Lab: In January, the Sustainable Finance Lab Sweden, funded by Vinnova, was established to bring a transdisciplinary approach to financial research, balancing the environment, equity and economics. GEDB was a funding consortium member and will be contributing to the development of this interdisciplinary sustainable finance research platform over the coming years.

Investment impacts on sustainability goals: Lastly, over the year, GEDB's whole team of research assistants worked with Executive Director Crona to deliver an extensive mapping of economic sector impacts on the UN SDGs. This database has been included in an impact screening tool developed by the Swedish bank SEB. In work led by Sofia Maniatakou, this research is now being developed into a scientific paper with the aim of improving the methods used by sustainable finance scholars and practitioners to capture investment impacts on the UN Sustainable Development Goals.

ACTIVITIES

- As a founding member of the Sustainable Finance Lab (SFL) Sweden, GEDB co-organised the first SFL Research Day in October, with the focus on discovering the frontiers in sustainable finance thinking in Sweden and developing disciplinary cross-pollination between the different research institutions and academics involved.
- The work on novel risks and complexity has become a platform that has deepened relations with researchers at Princeton and The Potsdam Institute for Climate Impact Research (PIK), in part through the Earth Resilience and Sustainability Initiative network. For example, Emmy Wassénus participated in a Princeton University Climate Futures workshop on "Climate Solutions, Money and Politics" in June, presenting GEDB work on portfolio diversification of Earth system risks.
- GEDB continues to contribute to the development of Earth Commission advice on translating scientific findings for corporate and financial decision making (Working Group 5), through the involvement of Beatrice Crona and Sasha Quahe.



“I have a passion for research on how to finance sustainability”

HANNA AHLSTRÖM is a postdoctoral researcher with a background in law, sustainability science and environmental economics. She is investigating how to better incorporate systemic risks into corporate risk management, as well as analysing the EU agenda on sustainable finance. Right now, the details and impacts of the EU taxonomy for sustainable economic activities are high on her agenda.

She has just submitted a chapter entitled ‘Complexity and uncertainty in sustainable finance: An analysis of the EU taxonomy’ to the *De Gruyter Handbook on Sustainable Development and Finance*. The overarching question is whether the taxonomy will make a marked difference in steering private capital toward sustainable investments. Hanna has some doubts on whether this is the right way to proceed:

“To create results as fast as possible and bring clarity to markets, it makes more sense to focus first on harmful activities. Therefore, the taxonomy needs to be as powerful as possible on everything that needs to be shifted away from.”

“This chapter is only one attempt to analyse what the taxonomy entails. There is a lot more to be said about the limitations and potential of the taxonomy, especially

in light of the political turmoil surrounding it.” Hanna continues:

“There is a substantial debate going on right now on which business models belong to the future and which do not, and as a researcher it is very interesting to follow and be part of that debate. There are many controversial processes, not least the recent publication of the final Complementary Delegated Act under the regulation with technical screening criteria for nuclear power and natural gas, which is seen as a huge mistake by many sustainable finance enthusiasts, including within industry.”

Under normal circumstances, Hanna would have been travelling regularly to Brussels in order to conduct interviews and participate in hearings and other events, but during the pandemic she was confined to deskwork.

“Initially, I planned to focus more on what different actors think about the development, but I have steered my current research toward literature reviews, commentary and analyses.”

“However, the change in circumstances has also been beneficial for me, since many more events are now digital; thus I have been able to take part in more conferences and discussions than before.”

Global Health and Biosphere Stewardship

2022 will likely be the year when we exit the acute phase of the Covid-19 pandemic in some parts of the world, while this disease continues to be a major health emergency in other parts of the world, especially in many low- and middle-income countries. Apart from the challenges of the pandemic, we are now also likely to be at the verge of a new biosphere-related health crisis, namely in terms of rising global food prices and a likely drop in supply. In 2011 and 2012, we saw the wide-ranging ramifications of such a shock to the global food supply, in terms of the Arab uprisings and the still ongoing civil wars and refugee crises these generated. This new crisis has the potential to be even greater, as a combined result of three global trends: i) the pandemic and its disruptions of supply chains and undermining of global health; ii) climate change-amplified weather extremes; and iii) the Russian war on Ukraine, since these two countries are among the top five exporters of wheat in the world. Given these growing challenges at the intersection between global health and the global living environment, the research presented below is likely to be of urgent relevance for decision makers and society in general. In the following paragraphs, we provide a brief description of some highlights from the theme’s research activities in 2021 and look forward to what we might see in 2022.

Stepping up research on new diseases and agricultural pests:

New diseases and agricultural pest organisms, also known as emerging pests and pathogens (EPPs), have been a major focus of the Global Health and Biosphere Stewardship theme since several years before the pandemic. In 2021, the novelty and importance of GEDB work on EPPs was recognised by European Research Council in the form of a large (1.5 million Euro) research grant to Peter Sogaard Jørgensen under the ERC Starting Grant funding scheme. This funding will be used on a project examining the wide-ranging chain reactions that outbreaks of EPPs set in motion in society and how these can be governed so that they contribute positively to the overarching agenda of sustainable development. The importance of such cascading dynamics is richly illustrated by the widespread changes in society during the Covid-19 pandemic, such as changes in travel and recreation patterns, to name a few. During 2022, the project will hire two PhD students, with two postdoctoral researchers joining the research group later in the project.

Antimicrobial resistance: A specific form of EPP on which GEDB has a relatively long tradition of research is antibiotic-resistant bacteria. Resistance to antibiotics causes at least 1,7 million deaths per year, particularly among children under

5 years of age. GEDB coordinates the international consortium of the AMResilience project, which is seeking to strengthen societal capacity to navigate this global health challenge in ways that do not undermine opportunities for future development. In 2021, we published a series of research papers describing such opportunities in high-income regions, such as Europe (including Sweden specifically), and in low-and-middle income countries, such as in South East Asia.

Biodiversity and health: One of the overarching hypotheses being tested by the Global Health and Biosphere Stewardship theme is that biodiversity, the collection of all life forms on Earth at multiple scales, supports human health and wellbeing. For example, during the relative social isolation of the pandemic, many came to recognise the importance of nature or green spaces for mental wellbeing. The hypothesis guiding this research field is known as the 'biodiversity hypothesis of human health', but there are many gaps in the current understanding of when, where and at what scales the biodiversity hypothesis finds most support. During 2021, we assembled an interdisciplinary team of researchers who are now embarking on uncovering the many different ways in which biodiversity supports human health and wellbeing. In 2022, we hope to have the first results ready, providing evidence of how the biodiversity hypothesis varies across different forms of health and wellbeing outcomes, such as non-communicable disease and mental health. The results will be published in the form of a systematic mapping of the biodiversity hypothesis.

Biodiversity and health in food systems: One form of biodiversity that has been of particular interest in GEDB work is the biodiversity of food systems. In 2021, we continued to advance this research in two important projects, examining: (1) How well-suited countries are to sustain major interruptions to international trade networks and continue to feed their population with a nutritious and resilient diet, and (2) whether undernutrition in low- and middle-income countries can be traced back to the diversity of foods produced in those food systems. It looks as though 2022 will be the year in which we can raise the curtain on the exciting results generated by this research.

The importance of blue food and ocean stewardship: 2021 saw the publication of a special issue in the internationally recognised journal *Nature* focusing on the ability of food from global oceans and freshwater bodies (blue food) to promote human health. The special issue received broad interest in the media and we are proud that some of the driving forces behind that major project were GEDB executive director Beatrice Crona and researchers Malin Jonell and Max Troell. The work of PhD student Sofia Käll in examining the role of Fisheries Improvement Projects (FIPs) for global fisheries governance also came to fruition, as it formed the basis for a very successful workshop and learnshop attended by nearly 60 representatives from 25 different FIPs in November 2021.



TISCAR GRAELLS is a researcher within the Global Health and Biosphere Stewardship theme and is studying how microorganisms become resistant to drugs. Antibiotic resistance has huge consequences for the environment, animal health and human health, and is already causing the deaths of at least 1,7 million people every year.

"It is very scary, we are only beginning to imagine the consequences", Tiscar says, "modern medicine is completely dependent on antibiotics and society has evolved because of good healthcare founded on antibiotic use."

Currently, Tiscar's main focus is trying to disentangle the success rate of measures to curb antibiotic resistance. The interventions that are most effective and the factors that make them successful can vary widely between different sectors, sites and contexts. Tiscar and her colleagues want to determine why.

For instance, a region can introduce a protocol for doctors to follow in order to prescribe fewer antibiotics and save some critical antibiotics for use as a last resort, if all others fail. Most hospitals work according to the same protocol, but some hospitals still perform much better than others.

"We have found that this is due to differences in protocol design and implementation. Small details can make a big difference, such as organising a seminar once a year to refresh staff knowledge on antibiotic resistance or, perhaps even more surprising, such as hospital leaders giving doctors credit for doing a good job in prescribing fewer antibiotics", she explains.

Due to results like these, Tiscar has become increasingly interested in behavioural science and complex adaptive systems, subjects far from her background in molecular microbiology.

"Antimicrobial resistance (AMR) is a social-ecological challenge that requires collaboration and coordinated transdisciplinary studies on the social-ecological system from different perspectives, to identify vulnerabilities and strengths. Working at GEDB has really opened my eyes to the fact that many issues which I previously would not have considered in relation to AMR are actually highly important for spreading or preventing AMR", Tiscar concludes.

"I want to reverse antibiotic resistance!"



MIINA PORKKA works within the Global Health and Biosphere Stewardship theme, with a focus on food systems as the connector between human health and the biosphere. Her research explores links between food systems and childhood undernutrition in low- and middle-income countries, with an aim of improving understanding on how different aspects of food systems can help promote child nutrition and health. Her work also investigates risks and vulnerabilities in the global food production system, and explores avenues for more resilient food systems that promote both a healthy biosphere and human health.

“Right now I am at an exciting stage in several of my projects, where I am starting to get the results in and I am trying to understand the story and key messages before starting to write. This is my favourite phase of a project”, Miina says.

In one project, she is investigating the extent to which food production affects child malnutrition, together with socioeconomic and environmental variables like GNI (gross national income), exposure to natural hazards and access to water, in order to get a sense of the larger context around child health.

One interesting preliminary finding is that the diversity of food supplies seems to be as important for child health in low- and middle-income countries as the quantity of food, indicating the importance of providing different kinds of nutrients.

“Previous research on global food security focused more on calories, rather than looking at the significance of micronutrients, although that is beginning to change”, according to Miina, who is now refining her model by splitting it into regional components that can be more accurate and provide insights into differences between food systems across low- and middle-income countries.

The Covid pandemic revealed the extent of international food trade and how it can be affected by pandemics and other shocks, highlighting the vulnerabilities within the global food system. For Miina, one aspect of conducting research in isolation has become obvious:

“I didn’t really understand previously how much I valued informal meetings with colleagues, which also give rise to new research ideas and provided input into my research. To put it simply, my colleagues make my science better.”

“I want to promote sustainable and just food systems.”

Cross-cutting themes:

Cross-scale dynamics

GEDB and Stockholm Resilience Centre researchers have been collaborating to create a framework for assessing the transformative potential of large corporate actor coalitions, by analysing website data from five coalitions working within the financial and food systems. The working name of the project is ‘Anthropocene Mobilisations’ and it is led by Peter Sjøgaard Jørgensen and Per Olsson (Stockholm Resilience Centre), with the support of Sofia Maniatakou.

Systems transformation

Most GEDB research has the overarching aim of contributing to transformation in one way or another. Some specific examples from 2021 worth highlighting include:

Two public talks by GEDB researcher Malin Jonell on changing consumer behaviour to promote less impactful blue foods were held, in June and August. The first of these, a Baltic Breakfast organised by the Baltic Sea Centre on ‘Seafood

consumption from a sustainability perspective’, was an online event open to international participants. The second talk was an invitation-only event during the Baltic Sea Day at the outdoor museum, Skansen, Stockholm, in collaboration with Race for the Baltic. Both occasions offered opportunities to communicate results from the Blue Food Assessment and other related GEDB research on how to alter consumer behaviour through mid-value chain actor strategies.

In November, a workshop was held to assess the potential and challenges for Fishery Improvement Projects (FIPs) as pathways towards more sustainable fisheries. Nearly 60 FIPs, from both the global North and South, participated in the workshop, which proved to be a valuable opportunity for FIPs to share information, compare practices and learn from each other. The work of GEDB PhD candidate Sofia Käll laid the foundations for this event.

Bridging science, policy and practice

Blue Food Assessment

The Blue Food Assessment (BFA) is a global initiative bringing together more than 100 world-leading researchers with the aim of demonstrating the specific role that aquatic foods can play in transforming future food systems to better align with human and planetary health. The research and translation of the findings into policy recommendations provide a firm foundation for decision-makers, enabling them to make decisions about how blue foods can best form part of improved food systems. The initiative was co-chaired by GEDB executive director Beatrice Crona and Stanford University Professor Roz Naylor, and involved GEDB and Beijer Institute researchers Max Troell and Malin Jonell.

The assessment was summarised and introduced to world leaders and policymakers participating in the first United Nations Food Systems Summit in September 2021. This event, together with participation by BFA members in preparatory work streams for the Summit, effectively paved the way for making blue foods more visible and part of all Summit collaborative actions. Moreover, BFA members are part of Blue/Aquatic Foods Action, which is working to make blue foods more prominent in the draft “Political Declaration” for the United Nations Ocean Conference in Lisbon in June, 2022.

The BFA received significant interest in the Swedish media, featuring in the Swedish daily business newspaper Dagens Industri on November 23rd, 2021, and in national TV broadcasts. Co-chair and Executive Director Crona was also asked to provide a special briefing on BFA to HRH Crown Princess Victoria of Sweden.

Sustainable investments

With growing demand for science that can meaningfully inform transition towards sustainable investments, the corporate and financial communities are showing greater interest in the work pioneered and developed by GEDB. In 2021, GEDB was asked to participate and provide insights into the links between Earth system dynamics, biodiversity and climate at events for a number of financial institutions in various formats, from large filmed events to internal capacity building seminars. Some examples include:

- A seminar for Sustainalytics focusing on deforestation, broadcast to all their clients.
- Development of a set of webinars on the role of biodiversity for the financial sector, on behalf of Sweden’s Sustainable Investment Forum (Swesif) and the Swedish Foundation for Strategic Environmental Research (Mistra).
- A televised event focusing on sustainable investments by Dutch asset manager Robeco, at which GEDB research was presented.
- The Swedish bank SEB sustainable investment event Accelerating Change, at which GEDB research was presented.

More information on these events and links to video material are available on our website (www.gedb.se).

During 2021, a whole team of GEDB research assistants worked in a specific SEB-funded project to map scientific evidence



Overuse of antibiotics in animal farming is greatly contributing to antibiotic resistance.

of the impact of the UN SDGs on financial investments. The database was incorporated into the SEB SDG Impact Model, as part of the bank's drive to improve the sustainability of equity investments.

These events show the breadth of GEDB engagement, from education and capacity building to webinars and lectures and more in-depth engagement with specific industry actors.

Antimicrobial resistance and national policy action

There is increasing recognition that antimicrobial resistance (AMR) is a global health crisis that cannot be addressed as a stand-alone problem, as it is embedded in the larger challenge of sustainable development. GEDB's work on antimicrobial resistance has addressed the AMR challenge from the sustainable development angle for several years now. Most recently, the AMResilience project and its learning platform on AMR interventions have attracted considerable interest.

In 2021, we engaged in dialogue with the World Bank Group about how GEDB scientific findings can be applied in training World Bank staff or in concrete projects. We were also invited to give a keynote presentation at the annual call to action at an AMR conference organised by the Wellcome Trust, the International Center on Antibiotic Resistance Solutions (ICARS) and several national governments. At the conference, we presented published and ongoing work on learning, evaluation and governance of AMR in a holistic all-society perspective. Read more at: www.amresilience.gtlab.com.

During 2021, GEDB also contributed to ongoing efforts aimed at mobilising action to address antimicrobial use in the world's largest seafood companies, through the SeaBOS project. In connection with this, GEDB researchers gave a private lecture on AMR as a sustainability problem to HRH Crown Princess Victoria of Sweden.

A woman in a bright blue jacket and black pants is walking through a dense forest. She is accompanied by a brown dog, likely a Weimaraner, which is walking towards the camera. The forest floor is covered in lush green ferns and moss. Tall, thin trees are visible in the background, creating a sense of depth and a serene atmosphere. The lighting is soft, suggesting a misty or overcast day.

GEDB conducts interdisciplinary collaboration on the challenges of global change and sustainability.

Appendix

STAFF:

Director	Carl Folke
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Deputy Executive Director	Peter Søgaard Jørgensen
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Project Coordinator	Helene Karlsson

FUNDING:

Core funding by the Erling-Persson Family Foundation. Additional funding was also received in 2021 from the Swedish Research Council Formas, the Swedish Foundation for Strategic Environmental Research Mistra, Sweden's innovation agency Vinnova, The Walton Family Foundation, EAT Foundation, Stanford University, Mistra Food Futures.

NEW FUNDING:

'Seafood in Japan and Sweden – alternative pathways to sustainability'. The Swedish Research Council Formas, SEK 3 999 678 for 2021–2024 (Jonell).

'Sustainable Finance Lab'. Vinnova, SEK 1 400 000 for 2021 (Crona).

'ReSus': 'Retail for Sustainability – Mid-value chain engagement for food system transformation'. The Swedish Research Council Formas, SEK 7 999 052 [of which 5 344 033 to GEDB] for 2021–2025 (Jonell).

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- ## BOOK CHAPTER
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- Jonell, M., T. Lindahl, K. Bergman, P. Henriksson, S. Hornborg, M. Troell and F. Ziegler. 2021. Hållbar konsumtion av sjömat – hur nå dit? [Sustainable seafood consumption – how do we get there?] Seawin Policy Brief 4. Seawin Earth and Lantbruksnätverket.
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- Luthman, O., M. Jonell, P. Rönnbäck and M. Troell. Strong and weak sustainability in Nordic aquaculture policies. *Aquaculture*. In press.
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SELECTED ACTIVITIES FEATURING GEDB RESEARCH:

Workshop: SDG network workshop, Aarhus University, Aarhus, Denmark, 8 January. Presentation: *Interdisciplinary to transdisciplinary sustainability research – experiences of a junior scholar* (Ahlström).

Course: The International Sustainable Development Research Society New Professionals Group's Mentorship Programme. Online, 25 January–31 December. Organiser/coordinator (Ahlström).

Colloquium: Sharing knowledge and methodologies towards interdisciplinary collaboration. Geneva, Switzerland, 3–4 February. Presentation: *Success factors of antimicrobial resistance interventions* (Graells).

Workshop: Progress, Challenges, and Opportunities for Sustainability Research, Weatherhead Forum, Harvard University, USA. February 2021. Presentation and panel member (Folke).

Webinar: Land rights – what is the responsibility of investors? Organised by Swedfund as part of Human Rights Day, 19 March. Moderator (Crona).

Webinar: Centre for Collective Action Research seminar, Gothenburg University, 11 March. Presentation: *Financial secrecy and environmental degradation* (Dauriach).

Seminar: Big Fish Seminar Series: Is aquaculture breaking into the food system? Stirling University, 20 March. Organising member (Troell).

12th meeting, Monaco Blue Initiative and 3rd meeting of the Monaco Ocean Science Federation, 22 March. Participant (Folke).

Webinar: Climate Change – Sustainable Forests and Finance. Organised by Sustainalytics (online), 26 March. Speaker (Crona).

Symposium: The Nobel Prize Summit 'Our Planet, Our Future'. Beijer Institute, Potsdam Institute for Climate Impact Research (PIK), the Nobel Foundation, Stockholm Resilience Centre and US National Academy of Sciences. 26–28 April. Keynote speaker, organiser of the academic science sessions, member of steering group and steering committee (Folke).

Dialogue: Food Systems Summit dialogue, 'Powering the Seaweed Revolution for Transformational Change in our Food System.' UN Global contact, 28 April. Invited participant (Troell).

Seminar: Our Planet – From Human Impact to Climate Action and Sustainable Industry Solutions. The Embassy of Sweden to the U.S., Washington DC, April. Speaker and panel member (Folke).

Conference: Competition in Fintech Markets. The Swedish Network for European Legal Studies (SNELS) and the Universities of Leeds, UK (online), 6–7 May. Presentation: *Sustainable Finance, what is it and how do we promote it?* (Crona).

Workshop: Ocean strategy lab. The David and Lucile Packard Foundation, online, 27 May. Presentation: *Unintended outcomes of sustainable seafood interventions: implications for human wellbeing* (Käll).

Workshop Series: Antimicrobial Assessment on Global Aquaculture Production. *Workshop 1: An Ecological Perspective*. Organised by Seafoodwatch and Worldbank, Monterey Bay Aquarium, May–October, Participant (Troell).

Conference: DNV's Marine Aquaculture Forecast launch. Organised by DNV Bergen at North Atlantic Seafood Forum and online, 9 June. Panellist (Jonell).

Annual Conference: Conference Society for Risk Analysis Europe 'The Discipline(s) of Risk Science'. Espoo, Finland (online), 13–16 June. Presentation: *Risk in sustainability science: Adapting risk assessments for a complex future* (Wassénus).

Seminar: Land use seminar, Chalmers University of Technology, Gothenburg. Online, 15 June. Presentation: *Sources of corporate capital and deforestation risk in the Brazilian Amazon* (Dauriach).

Public talk: Baltic breakfast, organised by Baltic Sea Centre, 16 June. Presentation: *Sustainable seafood consumption* (Jonell).

Webinar Series: Sustainability Month. Leiden Observatory, Leiden, the Netherlands, 16 June. Presentation: *Science-based targets* (Quahe).

Workshop: Climate Futures 2021 – Climate Solutions, Money and Politics. Princeton University (online), 16–30 June. Presentation: *Portfolio diversification of Earth system risks* (Wassénus).

Conference: Transformations 2021 – Enabling positive tipping points in an uncertain world. Online, 17–18 June. Session organiser and chair (Downing). Presentation: *A brief history of stewardship and transformations* (Folke).

Conference: The 11th MARE People and the Sea conference. Centre for Maritime Research, online, 28 June–2 July. Presentation: *Institutional entrepreneurship in fisheries improvements processes – A cross-scale historical analysis of the Indonesian blue swimming crab fishery* (Käll).

Workshop: Governance at Critical Junctures – Timing, Scales and Interdependence in Sustainability Transformations. Princeton University (online), June. Member of advisory group and participant, (Folke).

Workshop: Earth Resilience and the Anthropocene (ERA) workshop. Stockholm Resilience Centre, Potsdam Institute for Climate Impact Research (PIK), June. (Folke, Wassénus)

Conference: Interpretive Policy Analysis Conference. Rotterdam, the Netherlands, 28 June–2 July. Presentation: *Science-based targets: Framing sustainability problems, solutions and transformations* (Quahe).

Conference: The 24th International Sustainable Development Research Society Conference 'Accelerating the progress towards the 2030 Sustainable Development Goals in times of crisis'. Online/Mid Sweden University, Östersund, Sweden, 13–15 July. Co-organiser, track chair of session: *Legal Aspects of Sustainable Development* (Ahlström).

Workshop: Interacting Tipping Elements in the Natural and Social Components of the Earth System. 728. WE-Heraeus-Seminar. Bad Belzig, Germany, 15–18 August. Presentation: *Portfolio diversification of earth system risks* (Wassénus).

Seminar: Baltic Sea Day. Organised by Race for the Baltic and Skansen, Stockholm, Sweden, 28 August. Presentation: *Från Tellus till tallriken (From Tellus to the plate)* (Jonell).

Conference: 2021 World Conservation Congress. Marseille, France, 2 September. Keynote speaker: *Evolution in the Anthropocene: Informing policy and governance* (Jørgensen).

Conference: Ambio 50 years. Royal Swedish Academy of Sciences, 9 September. Keynote speaker (Folke).

Conference: Bratislava Conference on Earth System Governance: 'Earth System Governance in turbulent times: prospects for political and behavioral responses'. Online/ SlovakGlobe, CETIP, Slovak Academy of Sciences, Slovak University of Technology, Bratislava, Slovakia, 9 September. Presentation: *An Earth system law perspective on social-hydrological systems* (Ahlström).

Seminar: V-Dem institute, Gothenburg University. Online, 15 September. Presentation: *When the whole is less than the sum of all parts – Tracking global-level impacts of national sustainability initiatives* (Downing).

Webinar: Finance and Biodiversity. Organised by Swesif (online) 16 September. Presentation: *Why care about biodiversity?* (Crona).

Conference: Global Conference on Aquaculture Millennium + 20 (GCA +20). 23–24 September, Shanghai, China. Panellist and presentation: *Transforming aquaculture to achieve the SDGs* (Troell).

Seminar: Big Fish Seminar Series: Blue Food: A Food Systems Solution? Stirling University, 29 September. Organising member (Crona, Troell).

Webinar: Finance and Biodiversity. Organised by Swesif (online) 30 September. Expert commentator (Crona).

Dialogue series on ocean sustainability for HRH Crown Princess Victoria. Stockholm, Sweden, September–November. Tutors (Crona, Folke, Jørgensen, Troell).

Web conference: Blue Eco forum 2021. 22 October. Invited speaker: *Blue Food Assessment, Building healthy, equitable and sustainable food systems* (Jonell).

Conference: Partners in Crime: Linking Environmental Crime and Human Trafficking/Exploitation. Ontario Tech University, online, 4–5 November. Presentation: *The role of private governance institutions in addressing the nexus between IUU fishing and forced labor* (Käll).

Public dialogue: COP26LIVE STHLM. Organised by the British Embassy and Nordic Council of Ministers Kulturhuset (House of Culture), Stockholm, Sweden, 9 November. Invited speaker (Crona).

Seminar: Uppsala Antibiotics Centre seminar series. 15 November. Speaker (Jørgensen).

Conference: Third Call to Action on Antimicrobial Resistance (AMR) Conference. Organised by ICARS, Wellcome Trust, the Fleming Fund, UN Foundation, UNICEF, World Bank and the governments of Colombia, Denmark, Ghana, Indonesia, Thailand and Zambia (online), 15–17 November. Speaker (Jørgensen).

Webinar: Become Sustainability @TO ACT. Organised by Expansion and Robeco (online) 16 November. Presentation (Crona).

Workshop: Fishery Improvement Projects: Strategies, Successes, and the Future of FIPs. Organised by GEDB, online, 30 November. Organisers (Crona, Käll, Parlato).

MEDIA APPEARANCES

Interview for SEB sustainable finance event Accelerating Change (Crona).

Novel chemical entities: Are we sleepwalking through a planetary boundary? Mongabay. (Jørgensen).

Vetenskapsradion, nyheter (Swedish Radio, Science news). Laxodling exponeras för Norska havets höga vågor (Salmon farming exposed to the high waves of the Norwegian Sea). 13 January 2021 (Jonell).

Interview by Expressen TV, Comment on Seaspiracy, 29 April 2021 (Jonell).

Interview by NowThis, Could eating more seafood be better for the planet?, 4 October 2021 (Jonell).



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