



GLOBAL ECONOMIC DYNAMICS AND THE BIOSPHERE

THE ROYAL SWEDISH ACADEMY OF SCIENCES

The Erling-Persson Family Academy Programme

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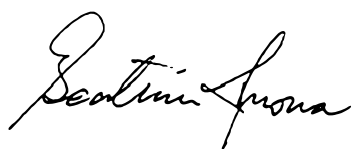
Directors' Note

In recent years, the strong interconnections between the biosphere and global economic dynamics of various forms have become explicitly apparent. Examples range from the emergence of new zoonotic infectious diseases to heat waves, floods and fires devastating ecosystems, undermining agricultural production and disrupting international supply chains. Such interconnections are at the very heart of research conducted within the GEDB Academy Programme. During the past year, GEDB continued to deliver new insights by linking the latest research on Planet Earth as a system to studies of, and conversations with, the financial sector. This work and the scientific discoveries made reveal challenges, but also new opportunities for progressive development more in step with biosphere dynamics.

We have seen how global health, biodiversity and antibiotic resistance can be approached from a systems perspective and leading international institutions, such as the World Bank,

have reached out to GEDB to provide science-based support for prioritising anti-microbial resistance (AMR) interventions in low- and middle-income countries. We view this as a sign of an increasing awareness among decision makers that a sustainable future will require a reinforcing relationship between the economy, societal development and the living planet. We are pleased and proud that GEDB is one of the science organisations to which leading institutions can turn for knowledge.

Against this background, it is both rewarding and a privilege to lead GEDB. Our skilled colleagues are breaking new terrain and producing high-quality science of relevance for human wellbeing, health and prosperity. We extend our sincere thanks to the Erling-Persson Family Foundation for its generous support and commitment, which allows us to continue working on science for change while building the next generation of transdisciplinary sustainability scholars.



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 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

In November 2022, **Honghong Li** joined our team as a joint postdoctoral researcher at GEDB and Stockholm Resilience Centre (SRC), Stockholm University. Honghong is interested in the diverse life stocks on Earth and will contribute to GEDB's work on Global Health and Biosphere Stewardship. In particular, she will be working within the 'Biodiversity hypothesis' project, aiming to understand how biodiversity impacts human health and wellbeing. Her academic journey progressed via the ecology of soil microorganisms, grassland and forestry, with the focus on sustainable nutrient management, to an interest in the interface between microorganisms, plants, animals and human health. Honghong received her PhD in Environmental Microbiology from Helsinki University in 2021. Before joining GEDB and SRC, she worked as a research scientist at Natural Resources Institute Finland (Luke).

2022 also saw the arrival of PhD candidate **Abigayil Blandon**. She is working with Malin Jonell in a project investigating alternative ways of promoting sustainable seafood in national contexts where the typical certification scheme approach is not effective. She is collaborating with the University of Tokyo and using Japan as an important case study country to

investigate alternative approaches. Abigayil has a background in marine conservation and sustainable seafood work in both academic and non-academic institutions. She has worked for a government advisory agency in the UK, as a project researcher at the University of Tokyo, and most recently for WWF-UK leading the sustainable seafood work with its retailer partner Tesco.

GEDB has also taken on two new research assistants, **Raf Jansen** and **Ege Pehlivanoglu**. Raf holds an MSc in Social-Ecological Resilience for Sustainable Development from Stockholm Resilience Centre, Stockholm University, and an MSc in Ecology and Development from the University of Antwerp, Belgium, following a BSc in Biology. He is currently working primarily within the Global Health and Biosphere Stewardship theme, where he is applying evolutionary theory to Anthropocene challenges. This includes investigating whether humanity may be stuck in undesirable pathways that are advantageous over the short term, but have increasingly negative payoffs over the long term, for example a reliance on fossil fuels. Ege was hired in late 2022 and started her position in January 2023. She holds a MSc degree through



Sofia Käll at her public defence of her PhD thesis together with her supervisors and the chair of the event. From left: Thorsten Blenckner (Chair, SRC), Tim Daw (SRC), Sofia Käll, Beatrice Crona (GEDB Executive Director).

the Erasmus Mundus Master's Programme in Evolutionary Biology from Uppsala University, Sweden, and University of Montpellier, France and has a BSc in Molecular Biology and Genetics from Istanbul Technical University, Turkey. With her experience from projects on human evolution, women's health and human fertility, Ege will contribute to the Global Health and Biosphere Stewardship theme.

On 18 November 2022, **Sofia Käll** successfully defended her PhD thesis entitled "*Reeling in Private Governance Approaches for Sustainable Fisheries: A Study of Fishery Improvement Projects*". The opponent was Andrés Cisneros-Montemayor from the Department of Resource & Environmental Management, Simon Fraser University, British Columbia, Canada. Through her thesis work, Sofia has informed various dialogues with practitioners and delivered insights into science-business platforms, such as [SeaBOS](#).

In December 2022, **Alice Dauriach** successfully defended her licentiate thesis entitled "*Financial Institutions, Companies, and the Biosphere*". Alice came to GEDB in 2016 as a research assistant and her work in amassing and analysing data was

fundamental to the production of some of GEDB's most widely recognised research articles, related to [Sleeping Financial Giants](#) and [tax havens](#). Alice's thesis work has continued to be an important part of the Biosphere Finance theme at GEDB and we are sad to see her leave, but wish her all the best in her new life in France.

We are proud to announce that Director **Carl Folke** was awarded the 2022 Dr A.H. Heineken Prize for Environmental Sciences, considered to be the Netherlands' most prestigious international science prize. The award honours his pioneering role in applying a transdisciplinary approach within sustainability science and his strong message that society and nature must be examined as a whole in order to maintain the resilience of Earth's social and ecological systems.

During the past year, several postdocs completed their work with GEDB. We wish Miina Porkka, Tiscar Graells, Hanna Ahlström and Andrea Downing all the best in their next exciting career steps and are grateful for their contribution to GEDB's mission of delivering societally relevant, yet rigorous, cutting-edge science.

Research Achievements and Activities

The Biosphere Finance theme has explored the links between corporate credit and deforestation in the Brazilian Amazon.

Biosphere Finance

The Biosphere Finance theme continues to evolve and each year the GEDB team manages to open up a new micro-frontier in the nexus between sustainability and corporate finance. The overarching ambition with research in this theme is to uncover and examine various links between corporate and financial actors and the biosphere, but also their ability to act to improve practices.

Alice Dauriach's work on corporate credit, particularly among companies in primary sector industries, has provided a more nuanced picture of the potential influence of financial institutions on corporate sustainability practice. Financial investments are increasingly used as leverage to influence companies to improve their environmental performance. However, where credit is obtained from sources with low transparency and accountability, corporate governance and environmental performance may be less strongly prioritised. Alice has developed a method to match corporate transaction-level data on foreign credit, to deforestation outcomes for companies involved in soy trade, cattle trade or mineral production in the Brazilian Amazon. This method can be applied more widely to examine the role played by opaque finance. While the effect of credit from secrecy jurisdictions remains unclear, GEDB researchers have found that companies displaying a risk of tax aggressiveness tend to be associated with more deforestation. This indicates that influence by financial institutions is limited by the reliance of companies on internal finance. The method can be adapted to other sectors and has the potential to uncover traditionally secretive financial flows using publicly available data.

Sustainability reporting and capturing the impacts of investments

At a time of large-scale corporate environmental impact and ambitious goals to reduce and reverse degradation, there is a urgent need to understand, monitor and assess the impacts of economic activities. In 2022, GEDB therefore had a strong focus on research to inform corporate reporting and disclosure. While there is growing recognition of the need to account for corporate environmental impacts, currently proposed frameworks for this purpose are not based on a causal understanding of environmental impacts. As such, they afford companies significant levels of discretion to decide on the environmental impacts they consider worthy of reporting and they ask companies to disclose relative measures of progress vis-à-vis targets. These relative measures are often not comparable across companies or industries, and do not allow for estimates of cumulative and aggregate environmental impact.

In a study led by PhD candidate Emmy Wassénus, GEDB researchers have developed an approach that brings the field of environmental monitoring and essential variables into the dialogue with rapidly evolving efforts to standardise corporate sustainability reporting, and proposes a set of essential environmental impact variables (EEIVs) grounded in scientific review and evidence. These 15 EEIVs can simultaneously provide i) a framework to guide disclosure of the data needed to construct many of the target progress indicators currently promoted and asked for; and ii) the means for companies to deliver on calls for more radical transparency to prevent greenwashing. The EEIVs should therefore be seen as a starting point for deliberations aiming to incorporate both accounting and sustainability science into efforts on standardisation of sustainability reporting.

Building on last year's development of a prototype metric that captures environmental impact beyond carbon emissions (i.e. including water, land use change and the interactions between these), Beatrice Crona and Giorgio Parlato have developed a method to test the prototype using publicly available company data from the mining sector. This new metric is called Earth System Impact (ESI) because it captures a number of key aspects that are important for assessing the environmental impact of corporate activity at the planetary scale. Together with colleagues at Stockholm Resilience Centre, Beatrice and Giorgio have shown that the ESI of a mine (or any company asset) can vary significantly depending on the location. Location matters, because carbon capture (through living ecosystems) is affected by local land use and water outtake. Different vegetation types have different capacity to store carbon and recycle water, and this has implications on the climate as a whole. The study, which is a first step in the development of a novel approach to measure corporate impact, shows that incorporating additional domains, such as land use and water, changes the perceived impact of a company and thus has the potential to fundamentally change the way in which investors assess and value companies.

In relation to sustainability reporting and governance, Shruti Kashyap has co-authored a book chapter on the reporting and assurance implications of an increasing societal and regulatory focus on environmental, social and governance (ESG) issues, and the accompanying implications for the audit industry. The chapter is part of a Routledge-edited volume with the title *"Auditing Transformation: Digitalization, Regulation and Sustainability"*, forthcoming in 2023. The auditing industry is likely to play a

more fundamental role as sustainability reporting becomes more standardised, and is increasingly seen as a tool to shift corporate practices at scale. At GEDB, we therefore regard the nexus between sustainability science, corporate disclosures and auditing as the next important area for transdisciplinary collaboration and development.

Fifty shades of green

A final strand of the research under the Biosphere Finance theme focuses on so-called 'green' funds. This work compares and contrasts non-ESG (environmental, social, governance) and ESG-labelled funds, to discern the degree to which green funds differ and whether they add any environmental sustainability value, as they are currently marketed. The project combines analysis of fund data with methods adapted from ecology, which allows the team to analyse almost the entire fund universe in both the EU and US, and provides an innovative and statistically robust methodology to compare investment funds at the level of individual holdings. This is a major departure (and arguably an improvement) from previous work that has relied on non-transparent ESG ratings to compare funds and has used smaller samples, comparing only funds of similar size, risk profile etc. In light of the recent criticisms of ESG ratings as non-transparent and unable to capture true sustainability (The Economist 2022¹), another methodological innovation is that the approach allows the environmental sustainability of funds to be assessed using currently available data.

¹ The Economist. 2022. [ESG Investing: A broken system needs urgent repairs](#). The Economist: Special report. July pp. 3–12



"I want to uncover alternative pathways for seafood sustainability"

ABIGAYIL BLANDON is a PhD candidate affiliated with Stockholm Resilience Centre who joined GEDB in the beginning of the year. She has background in marine conservation and her research centers around ocean stewardship, specifically seafood sustainability. In her PhD project Abigayil aims to uncover innovative ways for working towards sustainable seafood, using Japan as a case study. In previous research she found that certification schemes for seafood sustainability, which is typically used in the western context are not used so much in countries in Asia, like Japan. One reason is the structure of the supply chain, which is less consolidated than in many European and North American setting. This gives actors less incentives to engage with certifications.

Abigayil is now planning her field work campaign in Japan, working closely with the University of Tokyo. In one of her studies, she will be focusing on various initiatives in Japan that aim to create positive change in fisheries: "By focusing on small-scale initiatives that depart from certification and use different theories of change, I want to highlight other options to create incentives for actors" Abigayil says.

Japan is one of the the world's top consumers of seafood. It is therefore a good case study to learn from and compare to other sociocultural settings, like Sweden. In one of her ongoing studies, Abigayil is comparing and contrasting how different supply chain actors in Sweden and Japan are conceptualizing sustainable seafood. She hints that from her very initial data collection there might be more similarities between the two countries than originally thought. Abigayil, who has family in Japan and speaks Japanese, also see the added value of her work in terms of bringing in existing knowledge and literature from Japan into more English speaking literature and contexts: "I am excited to be able to do so because I feel that this may be where I can make the most difference".

Abigayil hopes that the results of her project can work as a hotbed for new innovative ways of moving into sustainability. "It would be nice if my research can highlight some of the ways where people are doing good practices but not necessarily in the typical way, and that these examples can inspire others".

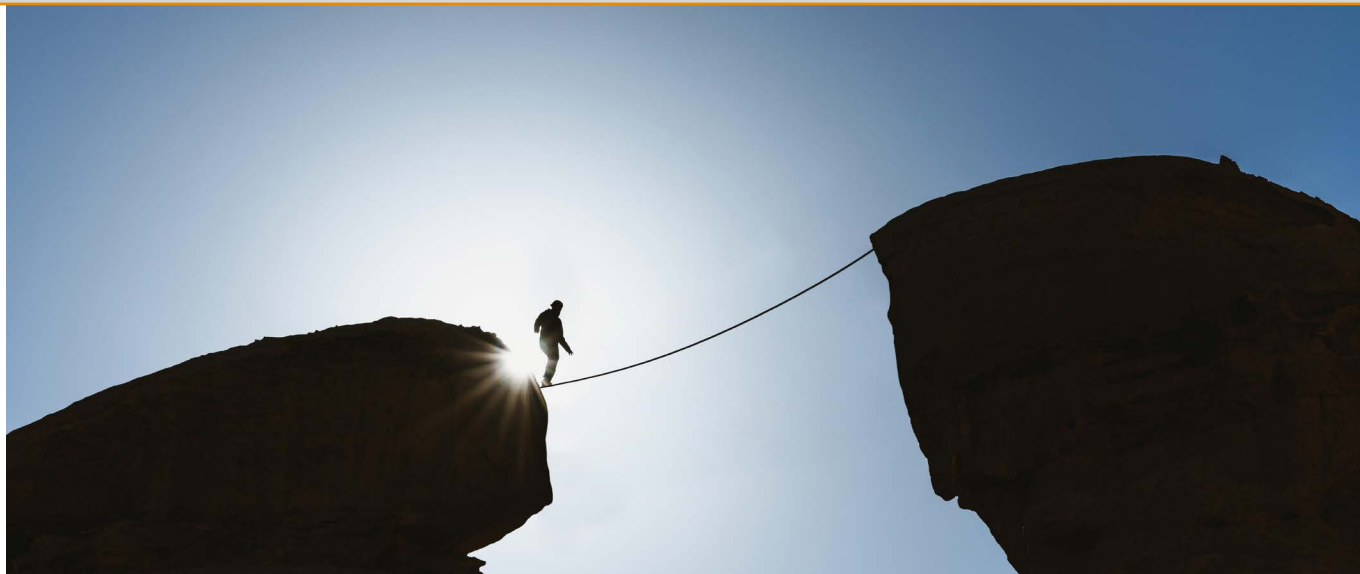


Photo: Alamy

Risk in the context of corporate investments for sustainability

Shruti Kashyap, who has a background in accounting and law, has been working to develop a better understanding of the links between complex environmental systems and risk, especially as it relates to financial and non-financial corporate reporting activities. Specifically, she has worked to delineate between how risk is understood, measured and disclosed in different fields of environmental law, accounting and risk science. This fruitfully complements [previous GEDB work](#) that synthesises the wide range of existing definitions of risk, and relates and aligns them with knowledge on complex adaptive social-ecological systems, to highlight the strengths of each risk approach. Shruti has also examined the role of artificial intelligence and digital technologies for understanding, addressing and incorporating risk into governance and decision-making frameworks. Together, the risk-related work by GEDB scholars from diverse disciplines is forging important connections between previously often disparate fields of accounting, risk science and sustainability. At a time when European Union and other international regulations on sustainable finance are developing rapidly, connecting corporate risks to environmental and social sustainability risks is paramount to inform the progress. GEDB is therefore intent on delivering research to support action in this dynamic space.

Together with Beatrice Crona, Shruti has written a working paper on integrating perspectives of risk and sustainability in accounting regulation, reporting and control within the financial sector. The paper was presented at the 17th EIASM Conference on Intangibles and Intellectual Capital – Sustainability and Integrated Reporting, Governance, and Value Creation in Italy, where it was awarded a special mention for its contributions to the theme of the conference. A revised version was also presented at the Risks of Unsustainability Conference in Oslo in December, where the boundaries and tensions regarding risk and sustainability in accounting standards and corporate disclosure regulations were further explored in the context of the enterprise value of firms and their impacts on the environment.

ACTIVITIES

- GEDB was involved in the launch of the report *Economy and Finance for a Just Future on a Thriving Planet*, commissioned by the Swedish government in preparation for Stockholm +50 in June 2022. The report was also discussed at an official side event at Stockholm +50, moderated by Beatrice Crona
- Shruti Kashyap presented a paper at the 17th EIASM Interdisciplinary Conference on Intangibles and Intellectual Capital – Sustainability and Integrated Reporting, Governance, and Value Creation, in Italy in September 2022. Her paper received a special mention for its contributions to the theme of the conference.
- Emmy Wassénus attended the Northern European Emergency and Disaster Studies (NEEDS) Conference in Denmark in November 2022, as part of GEDB's work on risks. The conference aim was to bring together different academic and practical disciplines to explore the status quo of disaster research and management.
- As part of GEDB's work on capturing environmental impacts of financial investments, a set of expert elicitation workshops was held in autumn 2022, as part of the process to develop essential environmental impact variables (EEIVs). For more details, see the section 'Systems transformations.'

Global Health and Biosphere Stewardship

Health has been one of the most dynamic fields of study in recent years, with global sustainability challenges leading to significant innovation in the field, especially through the integration of global environmental science. The work in this theme aims to uncover some of the critical ways in which human health and wellbeing depend on the living environment, from the individual to the societal scale. 2022 was a special year for this theme, with major new activities starting and others wrapping up or transitioning to a new phase. Work in the theme takes place across four topics that are all key for understanding how human health is dependent on the living planet. These are: new diseases and agricultural pests, global food system, chemicals and biotechnology (novel entities), and biodiversity.

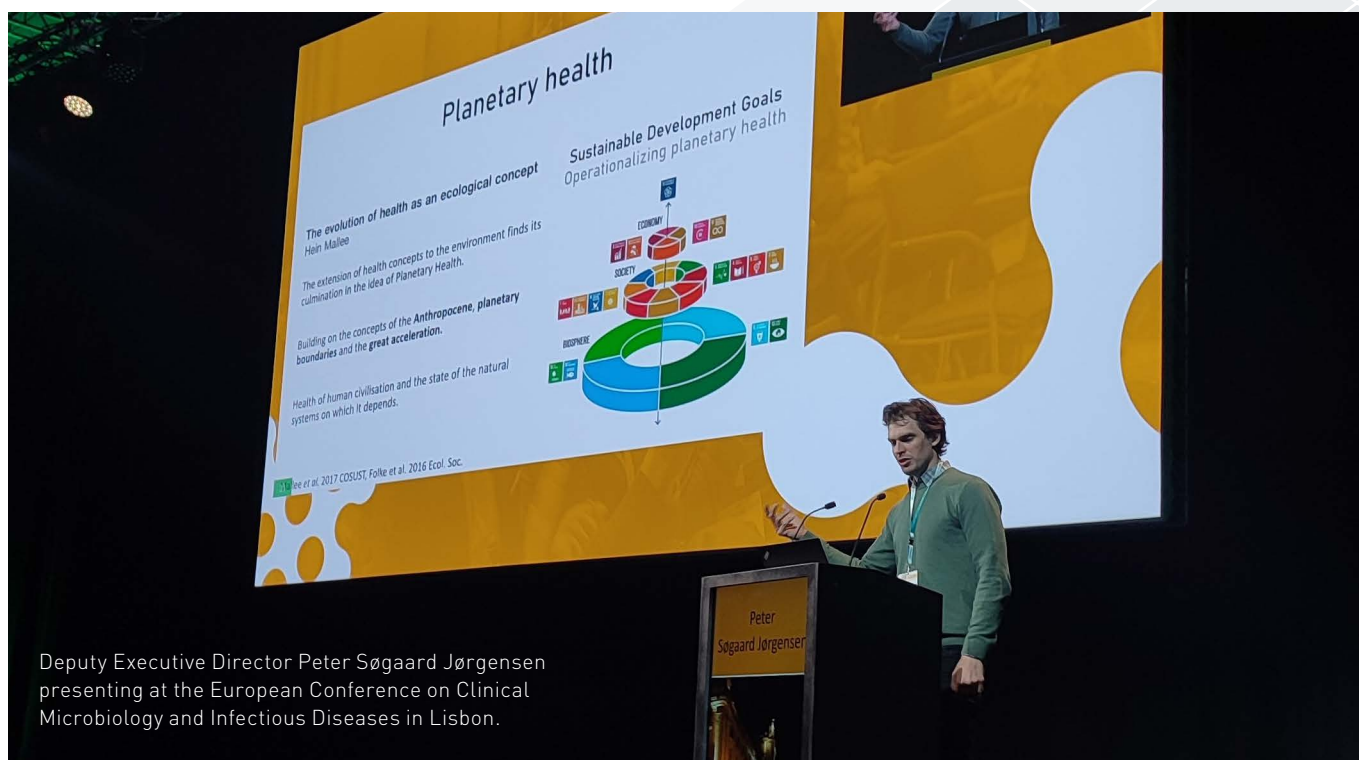
New diseases and agricultural pests

GEDB has had a coordinating role in the AMResilience project, which has run for the past four years with funding from the EU's [Joint Programming Initiative on Antimicrobial Resistance](#) (JPIAMR) and which involves partners from University of Geneva, Switzerland, and University of Waterloo, Canada. The project delivered several papers in 2022. One describes a study led by Tiscar Graells that analysed success factors and obstacles to AMR interventions through collection of survey

data. Results from the project were presented in a widely attended symposium at the European Conference on Clinical Microbiology and Infectious Diseases, in Lisbon in 2022. The symposium was co-organised by Tiscar Graells, while Peter Søgaaard Jørgensen presented the work. Several of the other papers present novel approaches to participatory scenario modelling, focusing on how AMR interacts with broader sustainable development challenges, such as climate change. As a whole, the AMResilience project has sparked significant interest and will be covered by the magazine *Healthy Europe* in early 2023, where a synthesis paper from the project will also be published.

Anti-microbial resistance work at GEDB also forms part of several other activities, such as the SeaBOS engagement, work on distal drivers of AMR (by GEDB PhD candidate Luong Nguyen Thanh) and the European Research Council-funded project 'Emerging pests and pathogens as a novel lens for unravelling social-ecological cascades (INFLUX)', that kicked off in 2022. The coming year (2023) will be a key year for GEDB to contribute to policy momentum, as AMR will once again be on the agenda of the United Nations General Assembly in a high-level forum.

The INFLUX project, which focuses on understanding how shocks from new diseases and agricultural pests alter societies and entire economies, aims to identify strategies for preventing and navigating these shocks while promoting sustainable development. In early 2022, the European Research Council





“I want to show that saving biodiversity is saving us”

HONGHONG LI joined GEDB at the end of 2022 as a postdoctoral researcher. With a background in biodiversity studies, extending from microorganisms to grassland to forests, she is now excited to be working in a new area – how human health and wellbeing are linked to biodiversity. Honghong will work within a project exploring the evidence for the “biodiversity hypothesis”, which states that loss of environmental biodiversity (e.g. decline in soil microbiota diversity) leads to immune dysfunction and diseases (e.g. allergy, asthma, obesity). “In this project, we are aiming to provide holistic information on how we can secure public health by protecting biodiversity”, Honghong says.

Together with an interdisciplinary research group established in 2021, Honghong is now developing a method to map existing evidence of biodiversity impacts on human health and wellbeing: “We are looking at many different aspects of biodiversity and human health, for example how exposure to blue space, such as rivers and oceans, impacts human wellbeing. We will systematically map the evidence provided in published scientific literature. The

mapping will give a fuller picture of the current state of knowledge about this topic, which I think is very important”.

Honghong hopes that she and her colleagues can provide the scientific community with crucial directions for future research, as the project will identify current knowledge gaps. The results are also expected to be useful for decision makers. “We hope to provide recommendations on how to better design urban environments to serve human health, by protecting biodiversity”, Honghong says.

As a postdoctoral researcher, Honghong is also reflecting over what the project means for her and for her future as a sustainability scientist: “For me personally, the project provides an opportunity to learn something new in terms of the methods we apply, but I am also eager to learn more about different aspects of human health and wellbeing, which is new for me. I really enjoy these types of learning processes and I am passionate about integrating concepts and methods from different disciplines. I enjoy GEDB’s transdisciplinary research approach and the focus on collaborations.”

awarded funding for the project to Peter Jørgensen, who will hire two PhD students and two postdocs. The first output from the project will be a special issue in *Current Opinion in Environmental Sustainability* entitled “Re-assessing the challenges of emerging pests and pathogens for sustainable development in the wake of COVID-19” due in early 2023. The issue highlights the diversity of disease-related challenges, going beyond emerging infectious diseases in humans to also look at new pathogens, animal and plant pests in livestock and crop production systems. The INFLUX project will contribute a paper on research and governance challenges for studying cascades across space, time and different sectors of the global economy.

Sustainable, healthy and just food systems

Since 2020, GEDB has been part of the Blue Food Assessment, through the active participation and leadership of Beatrice Crona, Malin Jonell and Max Troell. Between 2020 and 2022, the Blue Food Assessment delivered a set of papers (most published in *Nature* outlets) on various aspects of aquatic foods and their importance for food system policy around the world. In the final part of the assessment, GEDB Executive Director Beatrice Crona led research to compile and analyse a range of existing national data in order to uncover the four key roles that aquatic, or ‘blue’, foods can play to improve the performance and sustainability of national food systems. The resulting paper, published in *Nature* in early 2023 and entitled

‘Four ways blue foods can help achieve food system ambitions across nations’, looks at the potential for blue foods to deliver benefits and improvements across four policy dimensions: B12 and omega-3 nutrient deficiency, high rates of cardiovascular disease associated with excessive red (particularly processed) meat consumption, high environmental impacts, and climate adaptation and resilience to safeguard the contribution of blue food systems to nutrition, just economies, livelihoods and cultures.

Work on fisheries and seafood, such as that by the Blue Food Assessment, has shown that the sustainability of the world’s fish stocks and aquaculture needs to be improved, at the same time as the demand for seafood is set to double by 2050. The current sustainable seafood movement mainly consists of market-based mechanisms such as certification schemes, which are dominant in Northern Europe and North America. These schemes have been successful to some extent, raising awareness of sustainability issues with consumers and retailers. However, uptake has been slower in other parts of the world. The ‘Alternative Pathways to Sustainable Seafood (APSUS)’ project intends to look at contexts where this typical approach to sustainability is not suitable, and to examine other theories of change that could work better in these contexts. With project partners at the University of Tokyo, GEDB researchers plan to use Japan as an important case study country to investigate these alternative pathways.

A focus on Japan will allow key insights on the sustainable seafood movement to be drawn within a national context of high diversity and high-volume trade in seafood, complex distribution networks and potentially different views and values concerning sustainability. In this way, the project hopes to extend the toolbox of approaches that can move the seafood sector towards sustainability.

Late 2022 also saw the acceptance for publication of a paper by Emmy Wassénus presenting a global analysis on self-sufficiency of domestic food production. The paper shows that many countries are not self-sufficient in either macronutrients or micronutrients, findings that have important implications at a time when global shocks to supply chains are becoming more frequent. The paper will appear in *Global Food Security* in early 2023.

Biodiversity

The 'Biodiversity hypothesis' project aims at providing an overview of existing knowledge on the major ways in which biodiversity supports human health – from the level of the individual to the societal level. In 2022, the project recruited Honghong Li as a postdoc and together with research assistant Raf Jansen and collaborators from Stockholm Environment Institute, University of Gävle and Stockholm University, GEDB is now finalising the protocol for this topical study. The work promises to deliver a systematic map for strategic prioritisation of future research and policy to guide biosphere stewardship for global health. Another related project that is nearing completion is led by PhD student Daniel Avila

Ortega looking at how impacts of consumption on biodiversity have been measured in life cycle assessments and material footprint analyses.

Chemicals and biotechnology

Human technology, such as chemicals and biotechnology, play an important role in modifying the relationship between the living planet and human health and wellbeing. However, the planetary boundary dedicated to this issue, referred to as the 'novel entities' boundary, has posed problems for the research community because it has been difficult to conceptualise, assess and measure. In a landmark paper entitled "Beyond the safe operating space for novel entities", which was co-authored by Peter Søgaard Jørgensen, an international team of researchers provided the first assessment of the boundary. The results attracted significant interest, and the journal *One Earth* published a special issue in late 2022 focusing specifically on this topic. Peter Søgaard Jørgensen and Daniel Avila Ortega published a paper in the special issue focusing on whether and how novel entities can be used for food system transformations that promote global health. Finally, several papers within a project that hones in on the human health and wellbeing implications of marine biotechnology were published in 2022, in *Nature Ecology and Evolution* and the new journal *PNAS Nexus*.

ACTIVITIES

- Malin Jonell presented a paper at the Mistra Food Futures Conference in Sweden in October 2022. Mistra Food Future aims to create a science-based platform to enable transformation of the Swedish food system, and several GEDB researchers contribute to the programme. Malin's presentation focused on how Sweden's sustainability goals around food production could be improved.
- In April 2022, GEDB was invited to hold a symposium at the European Congress of Clinical Microbiology & Infectious Diseases in Portugal. The event was called 'Protecting health beyond mankind: Crossroads between public health, planetary health and the climate change crisis'. Peter S. Jørgensen was one of the main speakers and Tiscar Graells led the organisation of the symposium as part of the Public Health Study Group of the European Society of Clinical Microbiology and Infectious Diseases (ESCMID-ESGPHM).
- GEDB has continued to advance research within the SeaBOS initiative under Task Force III: Anti-Microbial Resistance (AMR), where the focus has been on mapping use of antibiotics by SeaBOS companies and identifying approaches for transparent reporting. Ongoing activities under the Task Force were presented at the Santpoort Dialogue, the Netherlands, in October 2022.

Cross-cutting theme: Systems transformation

Most of the GEDB work across themes has the overarching aim of contributing to transformation. The food retail sector is one example of a potentially important segment, and 2022 saw the start of the Formas-funded project 'Retail for sustainability – mid-value chain engagement for food system transformation (ReSus)'. The project is being led by GEDB researcher Malin Jonell and involves Beatrice Crona. It deals with the burgeoning new concept of corporate biosphere stewardship, which is gaining momentum as the private sector mobilises to reach key sustainability targets, and is looking at food retail actors who sit at the heart of the Swedish food system. Just three actors represent 90% of the sales value in Swedish food retail and they have recently launched numerous supply-side sustainability initiatives. Increased engagement and biosphere stewardship among these actors could therefore lead to large-scale improvements in production and consumption. The ReSus project aims to (i) analyse the effectiveness of existing and emerging retail-led sustainability initiatives; (ii) assess ways to enable retailers to facilitate a shift to more plant-based and organic production by producers in Sweden; and (iii) explore how pre-competitive collaboration could be implemented in Swedish retail as an engine for change. This transdisciplinary project involves researchers and public and private sector partners, including active collaboration from these three retailers in Sweden (ICA, COOP, Axfood). The project will develop case studies and a dialogue space that leverages the retail sector's capacity to enable acceleration towards food system transformation.

Another string of GEDB research focusing on food system transformation is the work reported in Sofia Käll's PhD thesis. It delivered insights on effective governance approaches to improve the sustainability of capture fisheries. In her thesis – which she defended in November – Sofia presents a new governance model for sustainable seafood. This model, called Fishery Improvement Projects (FIPs), is growing in uptake and importance globally, but has received little scientific attention to date. Sofia's research provided empirically grounded insights into FIPs that are relevant for the global community of practice within the sustainable seafood movement, involving actors such as retailers, businesses, NGOs, fishers and governments. Her studies show that strategies for improved fisheries need to work across complex global supply chains and present challenges that extend beyond individual fisheries governance. Therefore, improved stakeholder participation can be an important issue to improve the outcomes of these new private governance models.



Photo: Abigail Brandon

The ReSus project team and the first project meeting in May 2022 in Stockholm.

Sofia's work has received attention outside the fishery sector. In an interview for a news article by the Entrepreneurship and Small Business Research Institute (ESBI), she explained the main outcomes from her study about institutional entrepreneurship. She used the case of the blue swimming crab value chain from harvesters in Indonesia to importing companies selling crab meat in the USA. ESBI aims to spread scientific knowledge about entrepreneurship, innovations and businesses and its newsletter has over 8 000 subscribers, including entrepreneurs, financiers, and politicians across Sweden.

The Biosphere Finance theme is also working to influence transformation towards more sustainable practices. In autumn 2022, a series of seven workshops was held to better understand the environmental impacts of seven primary sector industries: fisheries, aquaculture, crop production, livestock, forestry, mining, and oil & gas. The workshops were run by Emmy Wassénus and Sasha Quahe, as part of an expert elicitation process to develop essential environmental impact variables (EEIVs). The workshop outputs were generalised across sectors to determine variables that would be essential to comprehensively capture the impacts of companies on the environment from a complex systems perspective. The project aims to improve corporate sustainability reporting by providing usable scientific input for the development of new reporting standards in the EU and worldwide (with the Task Force for Nature-related Financial Disclosures). The results are a step towards greater transparency in corporate reporting and could help the corporate and financial sectors contribute to staying within planetary boundaries.

Bridging science, policy and practice



Biosphere Stewardship in practice

GEDB continuously participates in processes to bring new science into the public and private domain, where it can be put to use. One example of this is Klimatkapitalet, a research-based dialogue series on the theme of transformation initiated by the four Swedish signatories of the [UN Net-Zero Asset Owner Alliance](#) (Alecta, AMF, Folksam, Nordea Life & Pension). The aim is to broaden knowledge about cutting-edge research at the intersection of sustainability and finance among decision-makers in different spheres of society, and to increase understanding of each other's toolboxes to find fruitful forms of collaboration moving forward. Klimatkapitalet includes representatives from politics, the energy sector, the financial sector, unions, academia, the real estate sector and other key real economic sectors. The dialogue series was developed by GEDB Executive Director Beatrice Crona, in close collaboration with representatives from each of the organisations behind the initiative. With the help of research assistant Sasha Quahe, several background briefs synthesising relevant research from GEDB and beyond were produced for the benefit of dialogue participants. Two dialogues were conducted in 2022, and the following two will be held in 2023.

Another example is Director Carl Folke's work on the external sustainability advisory board of the Swedish bank SEB. Together with three other leading scientists, including long-time GEDB collaborator Professor Gretchen Daily at Stanford University, Carl has had the opportunity to present and discuss GEDB-related research directly to SEB's leadership and to the wider finance community. For example, a presentation made at an SEB sustainability event called 'Transitions in numbers' in November 2022 has been seen by 1.5 million people. The advisory board aims to guide SEB on how to enable a rapid transition towards sustainability of its activities.

Carl also gave a keynote address on the interdependence of civilisation and the living world in the Anthropocene, at the US-UK Scientific Forum on Bringing Nature into Decision Making, held by the Royal Society in London, 2022. The aim of the event was to advance system-wide integration of biodiversity and nature's benefits to people into decision-making. The forum aims to strengthen scientific leadership and enable partnerships on pressing topics of worldwide scientific concern.

Over the past year, GEDB engaged in several initiatives seeking to bridge science, policy and practice regarding the issue of antimicrobial resistance.

The AMR-Intervene platform produced by the AMResilience project has attracted interest from various stakeholders. In 2022, GEDB engaged in dialogue with the International Centre for Antibiotic Resistance Solutions (ICARS) and the Public Health Agency of Sweden, to seek opportunities for upscaling the prototype to a fully operational learning platform for practitioners and policy makers. As part of these activities, Peter Jørgensen engaged in dialogue with the Swedish ambassador's round table on the topic of AMR. Peter was also invited to speak at a symposium at Europe's largest conference on infectious diseases, the European Congress of Clinical Microbiology & Infectious Diseases. The presentation, about AMR and sustainability, attracted interest from several government agencies in Europe to explore the potential of AMR intervene. These efforts will continue in 2023 when Sweden is hosting numerous events related to AMR as part of its Presidency of the Council of the European Union and in preparation for the 2024 high-level panel on AMR at the United Nations General Assembly.

GEDB has also engaged in bridging science, policy and practice in relation to AMR in the SeaBOS project. The work has primarily focused on mapping use of antibiotics by SeaBOS companies and identifying approaches for transparent reporting as part of a broader SeaBOS reporting and monitoring framework. It has also involved development of a Code of Conduct for reducing antibiotic use and AMR, development of a roadmap and investigations on the potential for a larger AMR mapping collaboration project with CRC-SAAFE (Australian Commonwealth research consortium). In addition, a global study survey of national legislation on antibiotic use has been completed.

Max Troell assisted in development of a new Swedish platform 'Antibiotika-plattformen – från gård till gaffel' (The antibiotics platform – from farm to fork) that aims to strengthen collaboration between key organisations and projects working with different AMR-related questions. Key work involves innovations, transformation, inspiration and engagement of actors such as the private sector, citizens, municipalities and regions.

Aquatic foods – finally a place around the table

Following its work in the Blue Food Assessment, GEDB has participated in several outreach activities to disseminate the science emerging from the assessment and contribute to efforts aimed at placing the role of aquatic foods at the heart of food system discussions. Executive Director Beatrice Crona has featured in Swedish business press as well as national television and radio (*Dagens Industri*, *SVT* and *SR P1*), talking about the value of bringing aquatic foods into the conversation when looking for sustainable paths to healthier eating. One example can be seen [here](#).

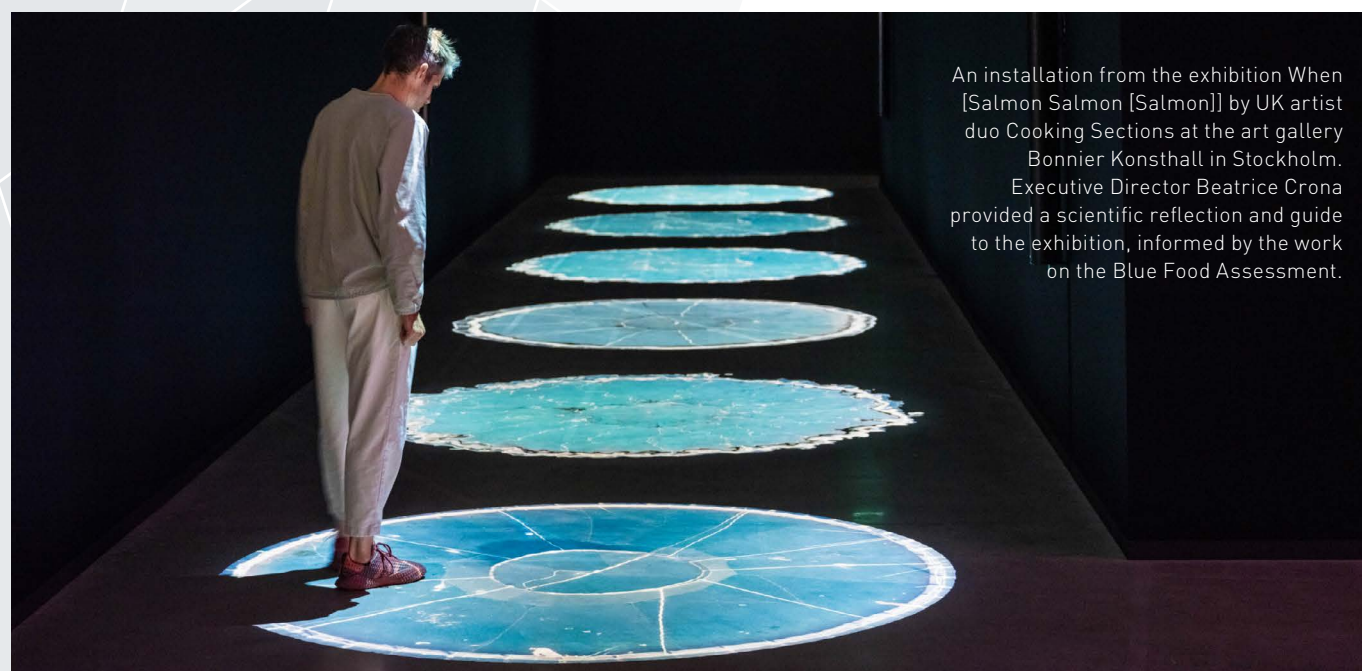
Malin Jonell was invited as a keynote speaker to talk about the Blue Food Assessment at Norway's annual seafood conference Sjømat Norge Årskonferanse 2022 in Bodø, Norway, in April.

The work of Sofia Käll on market-based models for fisheries governance, was selected to be part of the havet.nu catalogue of PhD dissertations, followed by a news article about the research. Havet.nu is a collaboration between universities and the Swedish Institute for the Marine Environment with the aim of transferring and communicating knowledge from researchers to authorities and decision-makers.

Science and art

Science communication and outreach can be achieved in many different ways, and GEDB has worked with art and design in the past to bring scientific insights into the public sphere – most notably through collaboration with Beckmans College of Design and furniture company Svenskt Tenn. This year, art gallery Bonnier Konsthall reached out to engage Beatrice Crona to provide a scientific reflection and guide to the exhibition [When \[Salmon Salmon \[Salmon\]\]](#) by UK artist duo Cooking Sections, informed by the work on the Blue Food Assessment.

Together with Stockholm Resilience Centre Director Line Gordon, Beatrice Crona also authored a chapter in the [anthology "Evigt Liv" \(Eternal Life\)](#), produced and published by the Nobel Prize Museum as a companion to the exhibition at art gallery Liljevalchs Konsthall October 2022–January 2023. The chapter provided reflections on the necessary transformation of our food systems to secure a prosperous and healthy future.



An installation from the exhibition [When \[Salmon Salmon \[Salmon\]\]](#) by UK artist duo Cooking Sections at the art gallery Bonnier Konsthall in Stockholm. Executive Director Beatrice Crona provided a scientific reflection and guide to the exhibition, informed by the work on the Blue Food Assessment.

Photo: Jean-Baptiste Bréanger

Photo: Stock/Getty Images

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

Appendix

STAFF:

Director	Carl Folke
Executive Director	Beatrice Crona
Deputy Executive Director	Peter Søgaard Jørgensen
Senior Academy Researcher	Max Troell
Research Fellows	Malin Jonell Andrea Downing
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Finance and HR Administration	Sofia-Kristin Kokinelis
Operations manager	Marie Huss

FUNDING:

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NEW FUNDING:

'Sustainable Finance Lab'. VINNOVA, SEK 1 400 000 for 2022 (Crona).

'Climate capital – Dialogues for Swedish competitiveness', Alecta/Nordea/Folksam/AMF for 2022.

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SELECTED ACTIVITIES FEATURING GEDB RESEARCH

Workshop: Monterey Bay Aquarium, International Antibiotic Program (online), 2 February 2022. Invited expert (Troell).

Seminar: Seafood eco-labelling seminar, Gulf of Maine Research Institute, Portland, USA, 3 March 2022. Presentation (Blandon).

Presentation: SEB top management of Large Corporates and Financial Institutions, Stockholm, Sweden, March 2022. Speaker (Folke).

Conference: Sjømat Norge Årskonferanse 2022, Bodø, Norway, 4 April 2022. Keynote speaker: *Blue Food Assessment* (Jonell).

Seminar: SUCCeSS seminar on Sustainable Food, 22 April 2022, Stockholm University. Presentation: *Untapped power of by-products for the food system* (Troell).

Symposium: Protecting health beyond mankind: Crossroads between public health, planetary health and the climate change crisis, European Congress of Clinical Microbiology & Infectious Diseases, Lisbon, Portugal, 23 April 2022. Main speaker (Jørgensen). Organizer (Graells)

Course: Executive course alumni gathering, Stockholm Resilience Centre, Stockholm, April 2022. Lectures (Crona and Folke).

Workshop: Antibiotikapattformen [The Antibiotic Platform], Axfoundation and Kungl. Skogs- och Lantbruksakademien (KSLA), Stockholm, Sweden, 12 May 2022. Participant (Troell).

Presentation: SEB External Sustainability Advisory Board, Stockholm, Sweden, May 2022, *Corporate biosphere stewardship for a prosperous future* (Folke).

Workshop: SeaBOS Technical workshop, Stockholm, Sweden 10–14 May, Stockholm, Sweden. Presentation: *Why stewardship, why SeaBOS?* (Folke). Participant. (Troell).

Presentation: Alder Nordic Investment Fund, Stockholm, Sweden, May 2022. Speaker (Folke)

Seminar: Copenhagen University VIII Interdisciplinary Seminar on Climate, Energy and Sustainability, Copenhagen, Denmark, 17 May 2022. Presentation: *Alternative approaches to sustainable seafood – investigating the Japanese and Swedish markets* (Blandon).

Conference: Människans Natur – Gräv där du står (Human nature – dig where you stand), Axfoundation, Torsåker, Sweden, 31 May 2022. Participant (Troell).

Conference: Sustainable planet, sustainable health – how science-based solutions can drive transformative change, Karolinska Institute, KTH Royal Institute of Technology, Stockholm University and Stockholm Environment Institute, Stockholm, Sweden, 1 June 2022. Participant and co-organiser (Jonell).

Seminar: Stockholm Global Business Experience, London Business School, Stockholm, Sweden, 13 June 2022. Presentation: *Sustainability, resilience and planetary boundaries in a business context* (Quahe).

Official side event: Stockholm +50, launch of the report Economy and Finance for a Just Future on a Thriving Planet, The Royal Swedish Academy of Sciences, June 2022. Moderator (Crona).

Workshop: Seafood within circular Bioeconomy, Stockholm, Sweden, 20–22 June, 2022. Organiser (Troell).

Conference: European Conference on Information Systems 2022, Timisoara, Romania, 18–24 June 2022. Associate Editor, Track Chair, and Doctoral Consortium Mentor (Kashyap).

Conference: The 20th Biennial Conference of the International Institute of Fisheries Economics and Trade (IIFET), Vigo, Spain, 18–21 July 2022. Presentation: *Seafood certification schemes in Japan: Examples of challenges and opportunities from three Marine Stewardship Council (MSC) applicants* (Blandon).

Seminar: Seafood supply chains in Japan and implications for the sustainable seafood market, Portuguese Institute for Sea and Atmosphere, Lisbon, Portugal, 26 July 2022. Participant (Blandon).

Conference: Scottish Blue Carbon Forum, International Policy Challenge, Oban, Scotland (online), 6–7 September 2022. Invited expert (Troell).

Workshop: Asia-Pacific Economic Cooperation Workshop (online), 8 September 2022. Presentation: *Strategies to reduce antimicrobial use: Seafood Business for Ocean Stewardship [SeaBOS]* (Troell). Participant (Folke).

Course: PhD and Postdoc Masterclass with the winner of Dr A.H. Heineken Prize for Environmental Science. Wageningen, the Netherlands, September 2022. Lecture (Folke).

Seminar: Sustainable seafood in the Anthropocene, Sustainable Society Design Center Graduate School of Frontier Science, University of Tokyo, Tokyo, Japan, 16 September 2022. Presentation: *APSUS: Alternative pathways to sustainable seafood in Japan and Sweden* (Jonell and Blandon).

Seminar: Invited honorary lecture Wageningen University & Research, Wageningen, the Netherlands, September 2022. Presentation: *The Anthropocene biosphere – transforming for sustainable futures* (Folke).

Seminar: Great minds exposed, Heineken Prize lecture, Leiden, the Netherlands, September 2022. Speaker (Folke).

Conference: 17th EIASM Interdisciplinary Conference on Intangibles and Intellectual Capital Sustainability and Integrated Reporting, Governance, and Value Creation, Taormina, Italy, 22–23 September 2022. Speaker (Kashyap).

Workshop: SeaBos CEO Workshop, Amsterdam, the Netherlands, 4–6 October 2022. Participants (Folke, Troell).

Course: Sustainability perspectives on contemporary fisheries – Where have all the fishes gone, Swedish University of Agricultural Sciences (online), 4 October 2022. Lecture (Jonell).

Conference: Mistra Food Futures Conference, Swedish University of Agricultural Sciences, Uppsala, Sweden, 12 October 2022. Presentation: *Matsveriges hållbarhetsmål – siktar de högt nog? [Sweden's sustainability goal for food – is it aiming high enough?]* (Jonell). Participant (Crona)

Course: Planetary boundaries and agriculture. The role of novel entities and biodiversity. Iberoamerican University, Mexico City, Mexico, 24 October 2022. Lecture (Avila-Ortega).

Public talk: Svenska Kockpriset i Gastronomisk Hållbarhet (Taste by Globe) Stockholm, Sweden, 25 October 2022. Presentation: *Hälsosam och hållbar mat – Vad är det och hur nås det? [Healthy and sustainable food – What is it and how do we get there?]* (Jonell).

Conference and pre-conference PhD workshop: Northern European Emergency and Disaster Studies (NEEDS). Copenhagen, Denmark. 1–3 November 2022. Participant (Wassénus).

Presentation: SEB's sustainability event, November 2022, Stockholm, Sweden and online. Keynote speaker: *Transitions in numbers*. (Folke).

Workshop: Conclusions Seawin Project, The Royal Swedish Academy of Sciences, Stockholm, Sweden, 24 November 2022. Organiser and Speaker (Troell).

Conference: Hållbar blå mat 2030: Framtidens sjömat i Sverige (Sustainable blue food 2030: Future seafood in Sweden), The Royal Swedish Academy of Sciences, Stockholm, Sweden, 24 November. Presentation: *Hur styr vi mot hållbar sjömatkonsumtion? [How do we navigate towards sustainable seafood consumption?]* (Jonell)

Conference: 1st International Financial Information Retrieval Ecosystem (FIRE), Örebro, Sweden, 11–12 November 2022. Participant (Kashyap).

Course: The Global Economy. Centre for Environment and Development Studies (CEMUS), Uppsala, Sweden, 22 November 2022. Lecture (Kashyap).

Conference: Framtidens betalningslösningar 2022 (Future payment solutions), Stockholm, Sweden, 1 December 2022. Speaker (Kashyap).

Colloquium: Human enterprises: Ecology & accounting philosophies. Paris, France. 2–3 December 2022. Participant (Kashyap).

Conference and post-conference workshop: The risks of unsustainability. Oslo, Norway. 7–9 December 2022. Participant (Kashyap).

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