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Beijer Institute of Ecological Economics

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Annual report 1 July 2021 – 30 June 2022

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The Beijer Institute of Ecological Economics is an international research institute under the auspices of the Royal Swedish Academy of Sciences. Since 1991, the Beijer Institute has been an institute of ecological economics. The major objectives of the Beijer Institute are to carry out research and stimulate scientific cooperation to promote a deeper understanding of the interplay between ecological systems and social and economic development.



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# Director's column

And you better start swimming Or you'll sink like a stone *For the times they are a-changing* 

wrote the epic song 'The times they are a-changing' in 1964. At that time, the great acceleration of the human dimension on Earth future through interacting policy and norm was still in its early decades. Since then, humanity has expanded into a global force shaping the functioning of the planet's biosphere. The like *Nature*, *Nature* Food, *Nature* Sustainability, globalised human world has indeed become truly intertwined with the dynamics of our life-supporting blue planet. In this new situation, it seems as though the rules of the game and also the whole playing field are changing, Such great work, with exciting findings, prochallenging the safe operating environmental space for prosperity. It is becoming widely acknowledged that a sustainable future will require a positive reinforcing relationship between the economy, societal development and the living planet.

"It is becoming widely acknowledged that a sustainable future will require a positive reinforcing relationship between the economy, societal development and the living planet."

I find it most gratifying to report that the Beijer Institute continues to play a significant role in generating insights about complex and challenging global dynamics and in providing It is getting close to sixty years since Bob Dylan solutions for how to move forward. A recent Askö meeting publication in Ambio, entitled 'Earth Stewardship - shaping a sustainable shifts', is a neat example. Other examples include fine contributions in strong journals Scientific Reports, PNAS, Global Environmental Change, Global Food Security, Environmental Innovation & Societal Transitions and One Earth.

> vides guidance for actions and engagements with practice, business and policy. A striking example during the year was the collaboration with the Nobel Foundation and the Swedish Central Bank on the launch of the Stockholm +50 report 'Finance and the Economy for a Just Future on a Thriving Planet', which took place on 1 June at the Academy. Another major milestone was the first ever SeaBOS Progress Report on the achievements of the science-business collaboration for a healthy ocean over the past six years. The report was introduced by HRH Crown Princess Victoria of Sweden on 29 June, during the UN Ocean Conference in Portugal. These landmark reports are based on solid science generated over several years and serve as inspirational examples of transdisciplinary science and collaboration for a better future.

> I could easily provide many more examples of amazing projects, collaborations and achievements, of which the pages of the Annual Report are a proof. It is quite fantastic and a

real privilege to serve as Director of the Beijer Institute, thanks to the impressive collaborative work of Beijer Institute colleagues, networks and close partner organisations here in Stockholm. The cooperation with the Royal Swedish Academy of Sciences is also a pleasure. Working with Göran K. Hansson, who stepped down as Secretary General of the Academy at the end of 2021, was great and constructive, thanks a lot Göran! A productive collaboration has begun with Hans Ellegren, the new Secretary General, who engaged with diverse Beijer Institute events during the spring. With the support of the Academy, we have secured a major grant from the Wallenberg Foundations to set up an 'Anthropocene Biosphere Laboratory' at the Academy, serving as a think tank and a meeting place for truly devoted and committed work across disciplines, helping to guide development into a sustainable future. Many exciting and important interactions are envisioned!

During the spring, working life started to return to normal and we moved back into the Beijer Institute's renovated premises. We now have a beautiful, stunning and fantastic working environment, thanks to the support of the Academy and especially to the Beijer Foundation for enabling furnishings from Svenskt Tenn throughout the Institute. It is quite simply magnificent! The Beijer Foundation has also generously supported the renovation of the Academy's Beijer Hall. The results are remarkable and the Beijer Hall is now a wonderful venue for gatherings, seminars and symposiums.

For more than thirty years, Anders Wall and the Beijer Foundation have provided core support to the Academy for its Beijer Institute of Ecological Economics. The flexibility of their trust-based support, which allows for new directions and discoveries, is unique in many ways and highly appreciated!

The results of the past year are presented in this Annual Report. I hope that they spur curiosity in the reader and inspire news ways of 'swimming' in times that are a-changing.

Carl Folke Director of the Beijer Institute Stockholm, July 2022













The Beijer Institute offices have also been renovated, with support from the Beijer Foundation. The beautiful classical furniture and organic patterns of Svenskt Tenn textiles, designed by Josef Frank, are now part of the institute's working environment.



1, 4 and 5: The Beijer Institute office. 2. Beijer Hall dressing room. 3. Beijer Hall foyer.



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# Research programmes × 4

Work at the Beijer Institute strives to create research frontiers at the interface of ecology, economics and related disciplines, to promote a deeper understanding of the interplay between ecological systems and social and economic development in relation to sustainability.

Our research framework recognises that economies and societies are components embedded within the Earth's biosphere, the thin layer around our blue planet where life exists, resulting in biosphere dependence. Today, the globalised human world is shaping the operation of the biosphere at planetary level in truly intertwined systems of people and nature.

In dialogue with the Institute's scientific advisory board, we discuss, assess and modify our research programmes to better capture and understand this intertwined world. There are currently four research programmes of the Beijer Institute, all combining important theoretical insights with novel and grounded empirical research. The focus and progress of each are presented under this section.



[1]

Gephart, J. A., P.J.G. Henriksson, R.W. Parker, A. Shepon K.D. Gorospe, K. Bergman, G. Eshel C. D. Golden, B.S. Halpern, S. Hornborg M Jonell M Metian K Mifflin R Newton P. Tvedmers, W. Zhang, F. Ziegler and M.Troell, 2021 Environmental performance of blue foods. Nature 597(7876): 360-365

# [2]

Tigchelaar, M., W.W. Cheung, E.Y. Mohammed, M.J. Phillips. H.J. Payne, E.R. Selig, C.C. Wabnitz, M. A. Oyinlola, T. L. Frölich er, J.A. Gephart, C.D. Golden, E.H. Allison, A. Bennett, L. Cao, J. Fanzo, B. S. Halpern. V.W.Y. Lam, F. Micheli, R.L. Naylor, U.R. Sumaila, A. Tagliabue and M. Troell. 2021. Compound climate risks threaten aquatic food system benefits. Nature Food 2(9): 673-682



Kishore, U. R. Sumaila I. Issifu, B. P. Hunter. B. Belton, S. Bush, L. Cao, S. Gelcich, J. A. Gephart, C. D Goilden M Jonell J.Z. Kohen, D. Little S.H. Thilsted, M. Tigchelaar and B Crona, 2021, Blue food demand across geographic and tem poral scales. Nature communications. 12(1), 1-14.

# [4] Zhang, W., B. Belton,

P. Edwards, P.J.G. Henriksson, D. Little R. Newton and M. Troell, 2022 Aquaculture will continue to depend more on land than sea. Nature. 603(7900), E2-E4

# Aquaculture and sustainable seafood

In 2021 we entered the "Ocean Decade", a UN-led initiative convening work on the role of oceans in achieving the 2030 agenda. A set of key ocean challenges unites partners on science priorities, capacity development and behavioural change. Sustaining and managing aquatic food production is central, which aligns well with the Aquaculture and sustainable seafood research programme. However, the programme goes beyond oceans to consider freshwater systems and the many important links between land- and sea-based resource systems.



Figure: Major stressors stemming from aquaculture and capture fisheries. From Gephart et al. 2021.

# Blue insights

The final year of the "The Blue Food Assessment" (BFA) was challenging but rewarding, with several scientific papers published in the Nature family of journals<sup>1,2,3</sup>. The broad insights gained have increased overall understanding of seafood sustainability, both marine and freshwater, and seafood's role in sustainable food systems and human well-being.

Environmental sustainability is a long-standing priority for the Beijer Institute's seafood programme and the BFA created an opportunity to combine different research projects. The resulting paper, published in Na*ture*<sup>1</sup>, describes standardized methods for more rigid comparisons between seafood types, filling an important research gap. Another strength is that the paper goes beyond the usual life cycle analysis (LCA) impact

categories and includes other ecological considerations, e.g. biodiversity loss and antibiotic use (see figure). Read more about BFA on page 33.

# Identifying the environmental impacts of food

Through its work on environmental sustainability and LCA, the programme contributes to the development of HESTIA, a giant online open-access platform intended to harmonise environmental impacts for all foods, including seafood. HESTIA provides a valuable alternative to existing accounting models for GHG emissions by avoiding aggregation of non-harmonised methodologies and/or paywalls. Aligning many LCA data sources on one platform will enable more detailed recommendations on sustainable dietary choices. The platform is already being used by companies providing environmental footprint advice to food producers and consumers. In coming years, the platform will continue to develop in terms of impact assessment methodologies, accuracy and inclusion of available food commodities world-wide. hestia.earth

# Different kinds of seafood narratives

Two different work streams within the programme challenge and complement the current narrative that future seafood must come from the oceans as the potential for freshwater aquaculture growth will be constrained by land and freshwater availability. A paper in Nature<sup>4</sup> shows that fed mariculture and fed freshwater aquaculture both depend on land and freshwater resources from feed inputs. It points out that the common farmed freshwater finfish species are easy to breed and require relatively low-cost basic technologies, so they can be produced in large volumes (>70% of all farmed fish). They are thus available and accessible to low- and middle-income consumers and make an important but underappreciated contribution to global food and nutrition security. Extending low-cost freshwater aquaculture could better match future demand at global scale, but this will require new investment in research on key freshwater species and farming systems.

A second paper, published in *One Earth*<sup>5</sup>, assesses common aquaculture species and systems that contribute most to food security globally and identifies "performance gaps", e.g. on types of targeted interventions and investments that could significantly boost production without simultaneously increasing environmental impacts.

# Strong versus weak sustainability

Is salmon farming sustainable? A paper published in Aquaculture<sup>6</sup> uses this question as a starting point to discuss aquaculture policies in terms of weak and strong sustainability. The analysis shows that aquaculture policies in the Nordic countries emphasise technological advances, intensification and economic growth, representing weak sustainability. Environmental sustainability is considered, but to a lesser degree than intensification and profitability, and fed aquaculture is prioritised. To achieve strong sustainability, measures for reducing pollution, spread of pathogens and use of high-grade food resources and energy need to be included.

A paper<sup>7</sup> published in *Ambio* examines the rapid expansion of brackish-water shrimp farming in the Sundarbans wetlands, India, driven by human-caused salinization and economic incentives. A current focus

mental impacts.

Blue foods are often promoted as an important source of essential nutrients, in particular omega-3 polyunsaturated fatty acids. The current supply of omega-3 is failing to meet global demand and consumption is below recommended levels in many parts of the world. Globally, an estimated 1.5 million deaths are attributed to low intake of omega-3 each year. Opportunities for increasing omega-3 supply from capture fisheries are limited, but a solution may lie in how omega-3-rich fishmeal and fish oil are used in aquaculture. A paper published in Resources, Conservation and Recycling<sup>8</sup> shows that more efficient seafood supply chains can boost omega-3 access by up to 50%. Efficiency can be improved by changing the global aquaculture portfolio to increased farming of species with omega-3 high conversion efficiency, such as carp, catfish and other freshwater fish, diverting fish resources used for animal feeds to direct human consumption, reducing food waste and optimising use of by-products.

The claim that seaweed can help "fix" the climate is increasingly being communicated, e.g. in recent high-level ocean-climate meetings. A programme study<sup>9</sup> investigated this claim and concluded that seaweed can help reduce carbon emissions, but does not offer a quick fix and has several shortcomings. A major misconception is that carbon in seaweed biomass can constitute a carbon sink while also serving as food for humans or feed for animals. Consumed seaweed biomass will in fact enter the fast carbon cycle and be released back to the atmosphere rather quickly. However, if consumers could be persuaded to eat more wild and farmed seaweeds instead of foods with higher carbon emissions, this would help reduce the carbon footprint of food. Other decarbonisation efforts, such as seaweed bioenergy production or reducing methane emissions from ruminant animals by including certain seaweeds in their feed, have potential, but more research is needed.

in Tanzania

on quick economic returns risks causing severe longterm socio-economic damage. The paper suggests actions for strengthening sustainability through introduction of farming systems employing a combination of extensive and intensive practices that can provide more income for farmers without adverse environ-

# The race for omega 3

# Looking for climate fixes - what about seaweed?

Seaweed plantation

#### [5]

Henriksson P.I.G M. Troell, L.K. Banks B Belton MCM Beveridge, H. Klinger N Pelletier I Phillins N. Tran. 2021. Interventions for improving the productivity and environmental performance of global aquaculture for future food secu rity One Farth 4(9).1220-1232

#### [6]

Luthman, O., M. Jonell, P. Rönnbäck and M. Troell. 2022. Strong and weak sustainability in Nordic aquaculture policies. Aquaculture 550: 737841.

#### [7]

Giri, S., T.D. Daw, S. Hazra M Troell S Samanta, O. Basu, C.L. Marcinko, and A. Chanda. 2022. Economic incentive drive the conversion of agriculture to aquaculture in the Indian Sundarbans Livelihood and environmental implications of different aquaculture types, Ambio 18: 1-15

#### [8]

Shepon, A., T. Makov H. A. Hamilton, D. B. Müller, J. A. Gephart. P. J. G. Henriksson, M. Troell and C. Golden. 2022, Sustainable optimization of glob al aquatic omega-3 supply chain could substantially narrow the nutrient gap. Resources, Conser vation and Recycling 181:106260.

#### [9]

Troell, M, P. J. G. Henriksson, A. H. Buschmann, T. Chopin and S. Quahe 2022. Farming the Ocean - Seaweed as a Quick Fix for the Climate?, Reviews in Fisheries Scienc & Aquaculture, DOI 10.1080/23308249 022,2048792

**Programme directors** J. Marty Anderies and Therese Lindahl

Wijermans, N., C. Schill, T. Lindahl, and M. Schlüter. approaches: Looking behind the scenes o types of evidence from controlled behavioural experiments through agent-based mod elling, Internationa Journal of Social Re search Methodolo 25(4):569-581

Lindkvist, E. et al 2022. Untangling social-ecologica interactions: A methods portfolic approach to tackling contemporary sustainability challenge in fisheries. Fish and

[3]

Lindahl, T., M. A. Janssen, and C. Schill. 2021. Controlled behavioura experiments. Pages 295-306 in R. Biggs A. de Vos, R. Preise H. Clements, K. Maciejewski, and M. Schlüter (eds.) Routledge Handboo for Social-Ecological Systems. Routledge,

# [4]

Lindahl, T. and R. Jarungrattanapond 2022. Avoiding catastrophic collapse i small-scale fisherie through inefficient dence from a frame Environment and Development Eco nomics. In press.

# [5]

Chaigneau, T., and C. Schill. 2022. Environmental behaviours within ecological and social limits: Integrat ing wellbeing with behavioural researc for sustainability. Current Opinion in tainability 57:101201

# Behaviour, economics and nature

Research programmes

The mission of the *Behaviour, Economics and Nature* (BEN) programme is to develop an understanding of human behaviour that can assist in designing robust institutions for environmental protection and sustainable development. Programme researchers study behaviour and behavioural motivators at different levels, as reflected in our various research topics, our multi-method approach and the interdisciplinary expertise on which we rely.

# Formal institutions and human behaviour

The challenges facing societies this century will require significant capacity for global coordination and collective action. Although many global organisations have emerged throughout modern history to provide public goods, none can provide this capacity at the required scale and for the types of problems humanity is currently encountering. One current BEN research theme is exploring whether the success and failures of formal institutions can be explained by the capacity of these organisations to account for human behaviour, i.e. to amplify or attenuate certain aspects of human behaviour. These are aspects that we deem critical for large-scale collective action to take place (e.g. trust, empathy, reciprocity and low levels of free riding and rent seeking) and aspects typically associated with behavioural barriers for sustainable action (e.g. cognitive biases, numbness, heuristics and denial). We explored these issues during a series of meetings and workshops in the past year, and we look forward to reporting concrete outputs in the coming year.

# Advancing understanding of human behaviour in changing contexts

Given the grand challenge of exploring how humans interact, not only with each other but also with their social, cultural and ecological context, we need to move beyond very abstract or case-specific models of human behaviour and develop models that capture the essential features of human behaviour within different contexts. This will require insights derived from empirical studies and expert knowledge. We have some ongoing research efforts addressing this frontier.

In a paper published during the year<sup>1</sup>, we reflect on the pros and cons of mixing agent-based models with behavioural experiments aimed at better understanding human behaviour. We also reflect on the new knowledge that can be generated and potential pitfalls associated with such mixing. Together with colleagues at Stockholm Resilience Centre, BEN researchers Caroline Schill and Therese Lindahl recorded these 'behind the scenes' experiences and observations. BEN researcher Caroline Schill also contributed



Therese Lindahl, Maja Schlüter, Caroline Schill and Nanda Wijermans at a writing retreat Photo: Nanda Wijermans

to a related paper<sup>2</sup> which shows the importance of developing methods portfolios for studying the complexity of human-nature relationships in fisheries contexts. The authors describe several categories of methods (including different types of modelling and controlled behavioural experiments) and their applications, strengths and limitations. Both papers draw on a book chapter<sup>3</sup> on controlled behavioural experiments, work led by Therese Lindahl, for the Routledge Handbook of Research Methods for Social-Ecological Systems. The chapter provides an overview of the types of social-ecological systems issues for which behavioural experiments are suited, the potential resources and skills required for their implementation, and examples of practical applications.

Several ongoing BEN research efforts rely on data collected in controlled behavioural experiments, often in combination with other methods and approaches. Together with collaborator Rawadee Jarungrattanapong (Sukhothai Thammathirat Open University), Therese Lindahl has completed data collection from e.g. fisher communities in Thailand using behavioural experiments. In these field experiments, the emphasis has been on behavioural outcomes of contexts involving different forms of fishery regulations. This project



built on recently published<sup>4</sup> work in which behavioural responses of fishers to different ecological contexts were the focus of investigation (see also last year's report for more details on our experimental work).

Together with Tomas Chaigneau (Exeter University, UK), Caroline Schill published an article<sup>5</sup> arguing for integration of well-being with behavioural research to advance understanding of feedbacks between the well-being of people and their behaviours regarding natural environments. They propose three future research directions: 1) implementing social limits when investigating environmental behaviours; 2) investigating the direct impact of different types and extents of inequality on environmental behaviours; and 3) incorporating different domains of well-being into controlled behavioural experiments. The authors are currently working together with other colleagues on these research directions. They are finalising an

"Public opinion is a crucial factor in policy making because it can limit the ability of key actors and policymakers to implement policies for sustainability."

Research programmes

Photo: Mika Bameister/Unsplash

experimental design, to be piloted in autumn 2022, that investigates the effect of inequalities and social and ecological limits on collective action and sustainable resource use.

# Temperature check – are people ready to accept change

Public opinion is a crucial factor in policy making because it can limit the ability of key actors and policymakers to implement policies for sustainability. In policy, the public can be seen as a "thermostat" signalling what is politically feasible. In a chapter<sup>6</sup> of the Stockholm +50 report (see also pages 15 and 30), Therese Lindahl and Caroline Schill highlighted this topic and argued that local conditions can act as the foundation for large-scale behavioural change. Using e.g. existing large-scale opinion surveys and observations of youth movements and trends in the financial and economic sectors, they assessed the current public "thermostat setting" for environmental concern and willingness to accept costly interventions. They concluded that the time may be ripe to proceed with action.

Acceptability of costly interventions is also the topic of two BEN-related research projects investigating public opinion on a large range of policy interventions that differ in type, design and scope.

# A post-pandemic BEN next year?

The past year was not quite the post-pandemic year that we cautiously anticipated when writing last year's report. Plans had to be adapted and fieldwork plans needed to be changed or postponed yet again. However, in-person BEN meetings and workshops became possible again in spring 2022 and planning is currently under way for fieldwork in the autumn. We are looking forward to the coming year with renewed energy and new inspiration provided by vital in-person interactions.

Lindahl T. C. Schill D Collste A -S Crépin, C. Folke, and V. Galaz, 2022, Founral change. In: Galaz, V and D Collste (eds.) Economy and Finance for a Just Future on a Thriving Planet Report for cal Economics (Roval Swedish Academy of Sciences) and the Centre (Stockholm



# Governance, technology and complexity

The Governance, technology and complexity research programme strives to combine important theoretical insights with novel and grounded empirical research. The emphasis is on how societal complexity interacts with complex systems of the biosphere and new technologies, and on governance issues associated with these interactions.

#### [1] Galaz, V., M.A. Cen-

teno, P.W. Callahan, A. Causevic, T. Patterson, et al. 2021. Artificial intelligence systemic risks, and sustainability. Technology in Society 67:101741.

Programme director Victor Galaz giving

a keynote speech at the exhibition

2022. Photo: Katy Otto.

The last year has been unusually busy for the programme. The publication in *Technology in Society*<sup>1</sup> of one of the main outputs from the initiative 'AI, People and Planet', about artificial intelligence (AI), systemic risks and sustainability, led to numerous online speaker engagements and requests to help frame the sustainability challenges and opportunities created by AI. The programme was also heavily involved in the international meeting Stockholm+50.

As a selection of all activities, and reflecting the growing interest in our work, the programme presented keynote speeches at the 2021 Sweden Innovation Days (17-19 November), the Nordic Innovation House Silicon Valley's series Sustainability Talk! (October, 2021) and panel presentations and contributions to online conversations about the climate and environmental impacts of AI (Just AI Network, February 2022 and Co-Opting AI: Climate hosted by New York University, March 2022), to mention but a few.

One of the major events hosted by the programme was the online conference 'Intelligent Machines, Emotions, and Our Planet' on 13-14 January 2022. This conference was a continuation of the programme's ongoing collaboration with colleagues at Princeton University

in May Cause we have to make collective 'Unearthing the Present' in Berlin in May decisions to avoid 2 rsible changes and the New School, and explored the way in which AI technologies are increasingly collecting and using data about people's emotional world. Emotions affect how we make sense of the world, communicate with each other and collaborate. Emotions also influence the way in which information is shared online, how communities perceive and respond to environmental crises, and how elites, civil society and citizens engage in the climate crisis. Our ambition is to elaborate these issues further, as part of ongoing work led by Stefan Daume on automation of climate and environmental mis- and disinformation, and also as part of a growing portfolio of research at the interface between sustainability sciences, AI and emotions.

# "Emotions affect how we make sense of the world, communicate with each other and collaborate. Emotions also influence the way in which information is shared online"

Complexity governance has been another part of the work in the past year, with several high-profile activities. One example is the invitation to contribute to Berlin's Haus der Kulturen der Welt's (HKW) renowned work on the Anthropocene, which bridges science and arts and hold public conversations with leading artists and scientists. This year's exhibition, 'Unearthing the Present', took place on 19-22 May 2022, with Victor Galaz as one of the invited keynote presenters and panellists. The focus was on how to understand the new governance challenges created by a new geological epoch and the need to grasp the complexity and the differences in time perspective between geological time and political time.

Another major international event was the work coordinated by the programme (in close collaboration with colleagues at Stockholm Resilience Centre and other international collaborators) for the Stockholm+50 conference organised by the United Nations on 2-3 June to commemorate the 50th anniversary of the historic 1972 United Nations Conference on the Human Environment held in Stockholm. Governments and others met with the ambition to accelerate implementation of climate and biodiversity commitments and the UN's sustainable development goals, and to support 'green' post-COVID-19 recovery.

The Governance, technology and complexity programme was commissioned by the Swedish government offices to produce a synthesis report on the role played by the globalised economies and the financial sector in biosphere-based sustainability. The report was prepared by engaging with several international and national collaborators such as the Natural Capital Project, the United Nations Development Programme,

(online) and Dr. Anna Breman (Deputy Governor of the Swedish National Bank). We were delighted to welcome the singer Maxida Märak as one of the contributors to the launch event. The report was also presented on 3 June at the official Stockholm+50 venue, as an official side-event. We look forward to continued engagement with many of the organisations that showed interest in our work, and the work of the Beijer Institute. The content of all seminars and the report can be found online at the Beijer Institute's website.

Princeton University, Future Earth and others. The programme also facilitated and hosted a series of online conversations that explored various aspects of this complex area, including the role of economic metrics and indicators; the role of institutional investors in achieving the UN's Sustainable Development Goals; and the role of tax havens and tax fairness in reducing harm on people and the planet. The report, entitled Economy and Finance for a Just Future on a Thriving *Planet*<sup>2</sup>, was launched on 1 June at the Royal Swedish Academy of Sciences, and in collaboration with the Nobel Foundation. Invited speakers included Nobel Laureate Joseph Stiglitz (online), Nobel Laureate and former Vice-President of the United States Al Gore

> Illustration for the conference 'Intelligent Machines, Emotions, and Our Planet', created by Jerker Lokrantz/Azote



[2]

Galaz, V. and D Collste (eds). 2022 Economv and Finance for a Just Future on a Thriving Planet, Report for Stockholm+50, Beije Institute of Ecologica Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University)



# Urban socialecological systems

The world is urbanising at an unprecedented rate. Cities currently account for around 70% of global energy use and global greenhouse gas emissions and contribute to environmental degradation at global scale. The highest rates of urban growth are occurring in regions previously relatively undisturbed by urban development. The Urban social-ecological systems research programme aims to improve planning and design of more resilient cities that can offer social-ecological benefits and contribute to sustaining life on Earth.

# [1]

Colding, J., S. Barthel, R. Ljung, F. Eriksson, and S. Sjöberg. 2021. Urban Commons and collective action to address climate change, Social Inclusion 10(1):103-114

During the past year, much work centred around the new Fairtrans programme, which is jointly funded by the Swedish research councils Formas and Mistra. The programme, which is devoted to fair transformation to a fossil-free future, is developing economic and political frameworks for transformation together with key actors from the business sector, trade unions and a multitude of organisations within Swedish civic society. The aim is to produce roadmaps that keep Sweden within the remaining carbon budget of the Paris Agreement.

"It is an accepted fact that climate change and loss of ecosystem services pose major collective action problems whereby all individuals would benefit from cooperating and taking action, but fail to do so due to conflicting interests and insufficient incentives to act alone."



A work package led by programme director Johan Colding (WP4), entitled Fair Digital Transformation and Co-creation for Socially Accepted Climate Action, aims to: 1) develop knowledge for ensuring smart digital climate action that is fair, inclusive and fosters democratic values; 2) improve science-based and co-produced knowledge for carbon-reducing remote work; and 3) improve science-based knowledge about public acceptance of transformation.

Five internal meetings were held during the past year, starting with a kick-off meeting in September 2021 at the Royal Swedish Agricultural Academy (KSLA) in Stockholm, together with programme staff and representatives of civil society.

WP4 also participated in the first Fairtrans workshop with partners, held at Stockholm Resilience Centre in March 2022. This workshop dealt with the carbon budget and included a workshop on economic investments run by Professor Eva Alfredsson from KTH Royal Institute of Technology and Associate Professor Mikael Karlsson from Uppsala University.

A first peer-reviewed publication from the Fairtrans programme, on the topic of urban commons, was published in the journal Social Inclusion<sup>1.</sup> Using a multi-layered and cross-disciplinary approach, this paper addresses both social and environmental issues, exploring the role of collective-choice arenas for civil society organisations in adapting to and mitigating climate change. It is an accepted fact that climate change and loss of ecosystem services pose major collective action problems whereby all individuals would benefit from cooperating and taking action, but fail to do so due to conflicting interests and insufficient incentives to act alone. Hence, developing what late Economics Laureate Elinor Ostrom referred to as 'action arenas' is essential. A key message of the paper is that 'community climate commons' could fulfil this role more effectively mobilising civil society organisations for climate-proofing collective action.

# Remote working as a catalyst for collective action on climate change

The work in WP4 resulted in a second paper on urban commons dealing with co-working spaces as an instigator of collective action on climate proofing. This paper, which has the tentative title 'Resilience implications of teleworking strengthening transformation to a fossil-free future', describes the new type of collective action arena mentioned above (community climate commons) with the potential to facilitate transformation towards a low-carbon society. The paper identifies several benefits of tele- and co-working, and also elaborates on governing teleworking in ways that promote participation and fairness. This forthcoming multi-author paper was presented by Professor Stephan Barthel as a conference proceeding and as a Fairtrans deliverable at the Nordic Environmental Social Science (NESS) conference Emergency and Transformation on 7-9 June 2022 at the University of Gothenburg.

# Urban Commons

Much work in the Urban Social-Ecological Systems programme has been devoted to the Strategic Research Programme Urban Commons, centring on interdisciplinary research for socially sustainable urban development. The programme is hosted by University of Gävle and the network of Urban Commons and includes some twenty researchers from different Swedish universities and research institutions, with Beijer Institute being a kev actor.

As part of the Fairtrans collaboration between Beijer Institute and the University of Gävle, two seminars dealing with urban commons were held during the year. The first, in December 2021 at Gävle Concert Hall, with over 80 participants, set the stage for future work on co-working spaces. The second was held in May 2022 and addressed human well-being in relation to the urban environment from different scientific perspectives - from the importance of nature for mental health and feelings of well-being to questions about aesthetics, art and spirituality.

# Promoting resilient and healthy cities for everyone

A new method for supporting urban planners and policymakers in geographical prioritisation of investments in green infrastructure was presented in an article in *Frontiers in Built Environment*<sup>2</sup>. The aim of the method is to promote community resilience through improving public health and closing the health gap. The article was part of a special issue entitled 'Social-Ecological Urbanism – Designing Spatial Urban Form and Institutions



in Support of Resilient Social-Ecological Systems in Cit*ies*'. Programme director Johan Colding and researcher Åsa Gren were part of the guest editorial board.

Åsa Gren co-supervised Master's student Steven Reich at the Department of Earth Sciences, Uppsala University, who wrote his thesis during the year. It explores whether the quality of Stockholm's recreational urban green spaces correlates to the socioeconomic status or wellbeing of local neighbourhoods. The plan is to report some of the findings in a scientific publication.

# [2]

Rostang, O., Å. Gren A. Feinberg, and M Berghauser Pont 2021. Promotina resilient and healthy cities for everyone in an urban planning context by assessing areen area accessibility. Frontiers in Built Environment 7:797179



[1] Galaz, V. and D. Collste (eds). 2022. Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50, Beijer Institute of Ecological Economics (Roval Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University).

# [2]

Sara et al. 2022. The synergistic impacts of anthropogenic stressors and covid-19 on aquaculture: a current global perspective. **Reviews in Fisheries** and Aquaculture 30: 123-135.

[3] Mangano et al. 2022.

The aquaculture supply chain in the time of covid-19 pandemic: vulnerability, resilience, solutions and priorities at the global scale. Environmental Science & Policy 127: 98-110.

# [4]

Henriksson et al. 2021. Interventions for improving the productivity and environmental performance of global aquaculture for future food security. One Earth 4:1220-1232

# [5]

Lambraki, I.A., et al. 2022. Factors influencing antimicrobial resistance in the European food system and potentia leverage points for intervention: A participatory, One Health study. PLOS ONE 17(2):e0263914.

[6]

Graells, T.,et al. 2022. Studying factors affecting success of antimicrobial resistance interventions through the lens of experience: A thematic analysis. Antibiotics 11(5):639.

# Topics

Some areas of research at the Beijer Institute are conducted outside the research programmes. This may occur for instance when the research is relevant for several research programmes or is in the form of early investigations into a new field that may develop into a research programme in the future. To highlight these and how they fit within our general research agenda, they have been collected under the section Topics.

# Anthropocene

In the Anthropocene – the age of humankind – the magnitude, speed, spread and connectivity of the human dimension are unprecedented in Earth's history. Humanity and its actions now constitute the major force in the evolution of life on Earth. Social conditions, health, culture, democracy, power, justice, inequity, matters of security and even survival are intertwined and dynamic interplay of local, regional and worldwide interactions and dependencies.

Being part of the biosphere means that the environment is not outside the economy or society, or a driver to be considered at will, but rather the very foundation on which civilisations rest and rely. Therefore, our research at the Beijer Institute is based on a recognition that the economy is embedded in the biosphere, and that the global economy operates within the planetary the Anthropocene.

Our work during the year on the Stockholm+50 report Economy and Finance for a Just Future on a Thriv*ing Planet*<sup>1</sup> (pages 13, 15 and 30) clearly reflects the new reality and the challenges and opportunities for operating the economy in the Anthropocene.

An intertwined human-nature world embedded in the biosphere is the foundation for the work of our Beijer Young Scholars groups focusing on (respectively) Inequality and the Biosphere and on Globalisation and the Biosphere (pages 26-27).

# Health risks on an intertwined planet

The rapid global spread of Covid-19, combined with climate change and political tensions such as the invasion of Ukraine, revealed the fragility of the tightly

interconnected world of the Anthropocene. The food system, and especially seafood supply, was scrutinised in this context during the year, with important publications<sup>2–4</sup> on food security, Covid-19, interacting shocks and supply chains.

Antimicrobial resistance (AMR) is another consequence of the intertwined planet. In two recent studies<sup>5-6</sup>, Beijer Institute researchers have been part of research teams that have identified factors influencing with the Earth system and its biosphere, in a complex AMR, e.g. in the European food system, behavioural patterns and places to intervene.

> Global change-induced financial risks are the focus of two Beijer Discussion Papers<sup>7–8</sup>, one of which examines financial dimensions of global zoonotic disease risks.

Beijer researchers and fellows have also contributed to chapters in two important books on intertwined social-ecological systems of the Anthropocene, The Routledge Handbook of Research Methods for Social-Ecological Systems<sup>9</sup> and Applied Panarchy: Appliboundaries of Earth systems and the new realities of *cations and Diffusion across Disciplines*<sup>10</sup>. The latter is a follow-up volume to the successful book Panarchy: Understanding Transformations in Systems of Humans and Nature produced by a former Beijer Institute research programme.

# Inequality and the Biosphere

The overarching aim of this project is to identify tradeoffs and synergies between reducing inequalities and safeguarding the biosphere. The project spans several Beijer Institute research programmes. Two published papers<sup>11–12</sup> are a direct result of project work the past year and several others have been inspred by the discussions within the research group, a formed through the Beijer Young Scholars initiative (read more on pages 26-27). In addition, two team papers have been submitted for publication, the first of which discusses lessons

for navigating the post-Covid 19 anthropocene and the second explores global trade-offs between prosperity, inequality and the environment. In addition, a compilation of statistical data has been made to enable national and sub-national analyses of relationships between inequality and environment indicators for a selected set of countries, which will later inform an online data explorer.

Alongside this, work continued on a major literature review, with the aim of identifying the main topics around which previous research on relationships between social inequality and environmental change has clustered. Moreover, behavioural economic experiments that aim to integrate social and environmental limits and inequalities, and explore the effects of these on sustainable resource use, are being designed.

Finally, the Royal Swedish Academy of Sciences has received a research grant from two Wallenberg Foundations to start an Anthropocene Biosphere Laboratory. This laboratory will act as both a think tank and a meeting place for collaborations, virtual and in real life, gathering key researchers internationally on key topics of high relevance and involving younger scientists. The Beijer Institute and our close collaborators SRC and the GEDB Academy Programme, along with other leading research groups and centres, will serve as a critical asset for the Anthropocene Biosphere Laboratory. An exciting collaboration is envisioned.

# **Biosphere economics**

Biosphere economics is a recurring topic in Beijer Institute research. Grasping how the economy interacts with nature's complexity is essential to achieving a deeper understanding of the interplay between ecosystems and socio-economic development. While this topic covers all kinds of ecosystems and biomes, recent efforts have had a strong focus on the Arctic.

The case-study component of the project is focusing on the Indonesian palm oil and seafood industries. To date, this work has involved mapping the supply chains for these two industries, to enable analyses of dynamics related to inequalities and environmental impact. Furthermore, an economic game-theory model is under construction, to explore the effect of sustainability certification on palm oil supply chains, with the focus on inequality.

# Anthropocene Biosphere Lab

# Winners and losers in the climate casino

Beijer Institute researchers were part of a team with a successful funding application for a project entitled Winners and losers in the climate casino: Arctic marine resources under climate change. The objective is to examine climate change impacts on fish, shellfish and their fisheries in the Atlantic and Pacific Arctic Shelf seas. The knowledge obtained will be applied to develop an integrated framework of the social-ecological connections in the area, which could be used for scenario analysis. Researchers will use a systemic approach to track the main impacts of climate change through the seascape and society in the Arctic, and the economic activities these support. Anne-Sophie Crépin is leading a project team aiming to develop a system-based tool that can support decision making in situations of substantial uncertainty. This work will build on existing knowledge and information from the case studies generated within the project. The ambition is to study the Arctic social-ecological

system from many different systemic approaches,

#### [7]

Galaz. V., J. Rocha, P.A. Sanchez García, T. Roukny, P. Søgaard Jørgensen A. Dauriach, and A. Golland. 2022. **Beijer Discussion** Paper 277: Financia dimensions of global zoonotic disease risks. Beijer Discus sion Paper Series.

### [8]

Sanchez-García. P.A., V. Galaz, and J. Rocha. 2022. Beijer **Discussion Paper** 278: Finance, climate and ecosystems: A literature review of domino-effects between the financial system climate change and the biosphere. Beijer Discussion Paper Series.

### [9]

Biggs, R., A. De Vos, R. Preiser, H. Clements, K. Maciejewski, and M. Schlüter (eds.) The Routledge Handbook of Research Methods for Social-Ecological Systems. First edition. Routledge London

#### [10]

Chapin III, F.S., R. Biggs, N. Sitas, C. Folke, and G.P. Kofinas, 2022, Cross scale social-ecological stewardship for navigating toward more sustainable and just futures. In: Gunderson, L.H., C.R. Allen, and A. Garmestani (eds.) Applied Panarchy Applications and Diffusion across Dis ciplines. Island Press, Washington DC. USA, pp. 275-288

#### [11]

Chaigneau, T., and C. Schill. 2022. Environ mental behaviours within ecological and social limits Integrating wellbeing with behavioural research for sustainability. Current **Opinion in Environ** mental Sustainability 57:101201



# [12]

Collste, D., P. Henriksson, S. Akbik, A.-S. Crépin, C. Folke, L. Lerpold, E. Lindkvist, P. Malmer, G. Ordenes, J. Rocha, C. Schill, and M. Schultz, 2022, The co-evolving nature of inequality. In: Galaz. V. and D. Collste (eds.), Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50, Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and the Stockholm Resilience Centre (Stockholm University), Chapter 3,

[13]

Engström G., J. Gars, C. K. Krishnamurthy, D. Spiro, R. Calel, T. Lindahl and B. Narayanan. 2020. Carbon pricing and planetary boundaries. Nature Commu nications 11(4688).

such as causal look diagrams, GIS mapping and a framework for ecosystem-based management developed within an earlier research programme, ACCESS (co-led by Anne-Sophie Crépin). The results of this system mapping will be used to identify systemic risks and potential scenarios for Arctic development that will feed into the synthesis.

# Project name

Winners and losers in the climate casino: Arctic marine resources under climate change

#### Project leader:

Sturla Kvamsdal, Samfunns- og næringslivsforskning (SNF), Norwegian School of Economics.

# Team members from Beijer Institute:

Anne-Sophie Crépin (team leader) and Åsa Gren. Funded by the Norweigan Research Council.

# Marine Arctic Resilience Adaptation and Transformation

Another project aims to develop resilience assessment tools that are scalable to the Arctic region. The current focus is on modelling the response of marine food webs to climate and fishing pressures; assessing the social-ecological implications of changing marine food webs and fisheries in Nunavut; assessing and modelling the resilience of salmon-dependent communities to climate change and genetic erosion; and developing tools for assessing adaptive and transformative capacities of Arctic communities.

# Project name

Marine Arctic Resilience Adaptation and Transformation (MARAT)

Project leader: Juan Carlos Rocha, Stockholm Resilience Centre.

Beijer Institute project member: Anne-Sophie Crépin.

Funded by Belmont Forum

# Climate-economy modelling

The project Global biophysical processes in climateeconomy modelling: Implications for economic policy has come to an end. The aim of the project was to study interactions between the global economy and the main biophysical processes regulating conditions for life on earth, with focus on the processes included in the planetary boundaries framework. The main outcome was a model covering the economic sectors that cause the greatest planetary pressures (energy and food production are critical sectors), how they interact through the global economy and the resulting planetary pressures. The model thus allows assessment of how a proposed policy would affect the pressures on most planetary boundaries. In a paper in Nature Communications<sup>13</sup>, highlighted in last year's report, the model was used to consider the wider effects, beyond the impacts on climate, of a carbon tax. Several other articles covering topics with relevance for the main goal, such as climate policy, biodiversity and the role of energy in the global economy, were also published during the year.

The project Global biophysical processes in climate-economy modelling: Implications for economic policy was funded by the Ragnar Söderberg foundation. Beijer Institute researchers Gustav Engström, Johan Gars and Chandra Kiran were participants, but the work was carried out in collaboration with many researchers from a number of countries.

# The economics of planetary boundaries

The project The Economics of Planetary Boundaries, which started in 2021 (described more in depth in last year's report), is building on the results from the climate-economy modelling project described above, by considering the interactions between UN Sustainable Development Goals. This is done by studying planetary pressures, food security and poverty in combination. The overarching aim is to identify policies that would keep humanity within the planet's safe operating space while meeting other Sustainable Development Goals.

One objective is to develop an integrated assessment model of the global economy and its two-way interaction with the Earth system that is specifically designed to answer the research questions addressed by the project. So far, much of the core work has focused on biodiversity, since its relationship with the global economy has been much less thoroughly researched to date, and is arguably also more complicated, than that between e.g. climate change and the global economy. Hence, much work is needed to find the best way to include biodiversity in analyses of the global economy.

#### Project name:

The economics of planetary boundaries.

Project leaders: Johan Gars (Beijer Institute) and Daniel Spiro (Uppsala University).

Johan Gars (PI), Gustav Engström and Chuan Zhong Li. Funded by Formas.

Levin, S. A., J. M. Anderies, N. Adger, Barrett, E. M. Bennet J. C. Cardenas, S. R. Carpenter, A.-S Crépin, P. Ehrlich, J Fischer, C. Folke, N. Kautsky, C. Kling, K. Nyborg, S. Polasky, M. Scheffer, K. Segerson, J. Shogre J. van den Bergh, B Walker, E. U. Weber and J. Wilen. 2021. Governance in the Face of Extreme from Evolutionary Processes for Struc turing Intervention and the Need to Go Beyond. Ecosyste 25(3):697-711.

# [2] Chapin III, F.S., E.

Weber, E. Bennett R. Biggs, J. van den Bergh, W.N. Adger A.-S. Crepin, S. Polasky, C. Folke, M. Scheffer, K. Seger son. J. Anderies. S. Barrett. J.C. Cardenas, S.R. Carpenter, J. Fischer, N

Kautsky, S.A. Levin, J Shoaren, B.H. Walker J. Wilen, and A. de Zeeuw. 2022. Earth a sustainable future through interacting policy and norm shifts, Ambio 51(9):1907-1920.

# The Askö meetings

Since 1993, the Beijer Institute has organised an annual meeting in September for informal discussions between ecologists and economists at the Stockholm Centre for Marine Research on Askö, a Swedish island in the Baltic Sea. Over the years, the Askö meetings have generated unique cooperation between these disciplines that has extended outwards to other disciplines. Each year, an exciting frontier issue is discussed and this generally results in a full paper, often published in a leading scientific journal.

The 2021 Askö meeting took place 13–15 September and was held online for the second time, due to the pandemic. The theme of the meeting was: Cross-scale *pathways to sustainability*. The aim was to address the complex question: How can we create opportunities for pathways to sustainability, given cross-scale interactions of social and ecological systems, uncertainty about pathway interactions across scales, and uncertainty about future challenges? The organising group consisted of Elena Bennet (lead), Oonsie Biggs, Kathleen Segerson, Elke Weber and Stephen Carpenter. In the spirit of the live Askö meetings, time was devoted to multiple discussions in plenary and small groups, as well as social gatherings and some music.

Two articles initiated during Askö meetings have been published in the past year.

# Governance in the face of extreme events

In an article published in the journal *Ecosystems*<sup>1</sup>, the authors argue that low-cost, rapid responses to extreme events, while necessary, are not enough. Solutions must include investment in higher-cost systemic responses. The article is based on discussions at the 2018 Askö meeting, with Beijer Fellow Simon Levin (Princeton University) as lead author.



The increasing frequency of extreme events poses challenges for societies world-wide. The Covid pandemic is a case in point, but "once-in-a-century" weather events are also becoming more common. They are leading to erosion, wildfires and even volcanic events that change ecosystems, threaten the sustainability of our life-support systems and challenge the robustness and resilience of societies.

The authors' analysis draws on evolutionary processes to propose pre-emptive and adaptive systems of governance that would assess and prepare for the repercussions of extreme events, rather than simply responding to these increasingly more frequent disasters as they occur.



Musical entertainment by Marten Scheffer at the 2021 Askö meeting.

Pre-emptive measures can increase general resilience as a first line of protection, while more reactive responses are being developed to increase specific resilience to particular events. General resilience includes diversity, but also redundancy (instead of one highway from one place to another, there might be several roads) and modular organisation. Moreover, science points to the identification of systemic risk/regime shifts, the role of diversity and slow variables. Improving system knowledge helps identify positive feedback loops, the sets of slow variables that influence them and their critical thresholds (systemic risk elements). Specific resilience means putting in place good policy responses that contain elements of redistribution of the effects (in time, space and/or between different social categories: insurance payments, catastrophic help) and a learning process that involves reflection on what has happened and whether future policy needs to change to avoid similar issues in the future.

# Earth stewardship

Another paper in *Ambio*<sup>2</sup>, describing a study led by Beijer Fellow Terry Chapin (University of Alaska) identifies five pragmatic and strategic leverage points for transformation toward earth stewardship. This work was initiated at the 2019 Askö meeting. Read more on page 23.

# Healthy ecosystems crucial for reaching climate targets

Earth's ecosystems have played a central role in keeping our planet's climate system unusually stable throughout the past 11,700 years. Today, ocean and land ecosystems remove around 50% of human-induced CO<sub>2</sub> emissions from the atmosphere each year. Without this biosphere carbon storage, current international climate targets cannot be met. Therefore, alongside efforts to transition away from fossil fuels, deforestation, environmental degradation and loss of biodiversity must be halted immediately, researchers argue in a opinion paper in *PNAS*, and biosphere stewardship is key.

# Taken for granted in climate models

All major global climate models that provide hope of meeting the target of the Paris Climate Agreement, to keep warming well below 2 °C, take continued provision of this gigantic biosphere endowment for granted. This means that the ability of intact nature to continue to sequester carbon is already included in the estimate of the remaining carbon budget to hold to the Paris climate target. However, this fundamental assumption relies on terrestrial and marine ecosystems remaining intact and resilient to human pressures, even as climate change progresses. In reality, more than 75% of the land surface has been altered by

humans, with 50% of vegetation biomass having been removed and less than 5% of the oceans remaining free from human interference. Today, major carbon sinks exist in remaining intact tropical, temperate and boreal forests.

The research team, led by Beijer Fellow Johan Rockström, Director of the Potsdam Institute for Climate Impact Research, and including Beijer Institute director Carl Folke, warn that these systems may be reaching tipping points:

"Human activities driving deforestation and degradation have already turned the Brazilian Amazon into a carbon source, and other tropical biomes may be moving toward a similar fate", they write. They add: "Global warming also increases risks of wildfires in temperate and boreal forests, which could flip Northern hemisphere ecosystems from sink to source in coming decades."

# Biosphere stewardship necessary to keep under 3 degrees

Without this natural carbon storage, the team calculates that by 2100, global mean temperature will be moving decisively toward 3 °C warming, even with the rapid decarbonisation actions assumed in the most positive climate scenario used by IPCC (the



only one to meet the goals of the Paris agreement). The team call for biosphere, or Earth, stewardship, which involves a fundamental shift in governance from only reducing human pressures to managing nature actively to promote human wellbeing, in this and future generations. This includes recognising critical biomes as global commons in the service of humanity.

# Three urgent global transformations

The team list three urgent global transformations to avoid a climate catastrophe:

1) A transformation of the energy system that cuts emissions by half each decade to reach net zero by 2050; 2) a transformation of the agriculture and forestry sectors from greenhouse gas sources to sinks within 30 years; and 3) a transformation of our relationship with nature to one that conserves, restores and enhances its benefits for people and the planet. Each transformation must begin immediately.

"a transformation of our relationship with nature to one that conserves, restores and enhances its benefits for people and the planet."

"Biosphere stewardship is an indispensable guiding principle and foundation for successful implementation of these transformations," they write.

The team go on to list three strategic considerations, including translating the overall framing of biosphere stewardship into actionable paths for all sectors and actors in society.

# How to ramp up transformation to Earth stewardship

A related study in the journal *Ambio* identifies five pragmatic and strategic leverage points for transformation toward earth stewardship. It stresses that all countries can and must contribute, but also that current and historical responsibilities and uneven access to power and resources must be considered.

"There is increased public demand for an 'earth stewardship vision' that replaces competitive consumerism with an ethic of responsibility, care and empathy", according to the author team, led by Beijer Fellow Terry Chapin (University of Alaska), and including several Beijer Institute researchers and Beijer Fellows.

# Catalysts for earth stewardship

Earth (or Biosphere) stewardship is defined as "the proactive shaping of physical, biological and social conditions to sustain, rather than disrupt, critical earth-system processes in support of nature and human wellbeing at local to planetary scale."

A number of potential catalysts for earth stewardship are identified, including novel democratic institutions and engagement of social movements.

One example is "the Greta Thunberg effect": climate activism by young people directly calling for a change in social norms among everybody, regardless of political perspective.

When it comes to policy incentives, the authors highlight how Covid-19 demonstrated that massive concerted global action can happen quickly, despite short-term economic costs.

"The Covid-19 response invites us to reimagine how to create a large-scale stewardship effort that coordinates top-down and bottom-up actions to build new pathways toward a more sustainable future for nature and society," they write.

# Five leverage points

The study focuses on approaches that can be initiated now by all countries, but emphasises the need to consider current and historical responsibilities and uneven access to power and resources. The authors also stress the importance of finding the best places to intervene in a system to trigger transformations.

#### Five strategic leverage points are listed in the paper:



Grazing cattle can enhance biodiversity in some ecosystems.



Rockström, J., T. Beringer, D. Hole, B. Griscom, M.B. Mascia, C. Folke, and F. Creutzig, 2021. We need biosphere stewardship that protects carbon sinks and builds resilience. Proceedings of the National Academy of Sciences 118(38).

Chapin, F.S., E.U. Weber, E.M. Bennett, R. Biggs, J. van den Bergh, W.N. Adger, A.-S. Crépin, S. Polasky, C. Folke, M. Scheffer, K. Segerson, J.M. Anderies, S. Barrett J.-C. Cardenas, S.R. Carpenter, J. Fischer, N. Kautsky, S.A. Levin, J.F. Shogren, B. Walker, J. Wilen, and A. de Zeeuw. 2022. Earth stewardship: Shaping a sustainable future through interacting policy and Norm Shifts. Ambio 51(9):1907-1920.

# The big picture on seafood sustainability

Seaweeds and farmed bivalves, such as mussels and ovsters, are the most sustainable aquatic foods and investment in production of these would benefit human health and the environment. This is shown in the most comprehensive estimate to date of blue food's environmental performance, comparing stressors across the wide range of farmed and wild aquatic species.

Blue foods comprise thousands of species of aquatic animals, plants and algae. This diversity is often overlooked in food system policies, which tend to group aquatic foods under the banner of 'seafood' or 'fish'.

In a landmark study, led by Jessica A. Gephart (American University) in *Nature*, a group of researchers including Patrik Henriksson, Malin Jonell and Max Troell from the Beijer Institute, chart the environmental performance of 23 species groups of aquatic food, representing three-quarters of global production. Drawing on studies collectively reporting data from more than 2,500 fisheries and aquaculture farms worldwide, they provide standardised estimates of greenhouse gas emissions, nitrogen and phosphorus pollution, and freshwater and land use.



"Our research includes blue food systems that are often overlooked in policy and in dietary studies but are essential to food security, like carp farming in China and India," says Patrik Henriksson.

The study shows that farmed bivalves and seaweeds perform best, generating the lowest greenhouse gas and nutrient emissions and using the least land and water. Capture fisheries perform well for most stressors, but greenhouse gas emissions range from relatively low, such as for sardines and cod, to relatively high for flatfish and lobsters, compared with farmed fish. Since much of the negative environmental impact is brought about by the feed, unfed aquaculture production is more environmentally friendly than fed aquaculture. Even so, the most common fed-aquaculture species (carp, trout, salmon, catfish and tilapia) are comparable to chicken, the most efficient landbased animal-source food.

The authors conclude that reducing fuel use and improving the efficiency with which feed is converted into biomass may represent the greatest opportunities to improve the environmental performance of capture fisheries and fed aquaculture, respectively.

Cross-sector analyses such as these allow synergies and trade-offs to be explored. For example, investment in small pelagic fish and shellfish aquaculture – which are rich sources of nutrients and generate relatively low levels of stressors - could deliver benefits for human health and the environment.

# Making more informed decisions

This new set of standardised metrics can be used to benchmark the environmental impacts of blue foods and steer future production toward lower emissions and resource use.

The paper also highlights the significant potential of many subsectors, such as carp and milkfish farming, to improve their environmental performance through better farm management, reduced feed conversion ratio and innovative technological interventions.

Capture fisheries have further potential to reduce greenhouse gas emissions through for example improved management and optimising gear types.

"Most aquaculture systems have not achieved the levels of efficiency seen in terrestrial production systems, leaving substantial opportunities for optimisation and improvements in efficiency and sustainability," said Patrik Henriksson.

The study will ultimately allow businesses, certifiers, NGOs and other interested parties, including consumers, to make more informed decisions about how to support sustainable blue foods, while also helping to highlight the rich diversity and variety of the blue food sector.

The article was one of five initial scientific papers published as part of the Blue Food Assessment (read more on page 33).

"farmed bivalves and seaweeds perform best, generating the lowest greenhouse gas and nutrient emissions and using the least land and water."

Gephart, J.A., P.J.G. Henriksson, R.W.R. Parker, A. Shepon, K.D. Gorospe, K. Bergman, G. Eshel, C.D. Golden, B.S. Halpern, S. Hornborg, M. Jonell, M. Metian, K. Mifflin, R. Newton, P. Tyedmers, W. Zhang, F. Ziegler, and M. Troell. 2021. Environmental performance of blue foods. Nature 597(7876):360-365.

# AI in farming can create new sustainability risks

The growing use of artificial intelligence (AI) technologies offers opportunities for ramping up sustainability efforts, but there are also numerous poorly explored and serious systemic risks as humans, machines and ecosystems interact in new ways. This is the main message from a new study looking into the global uptake of AI technologies in farming, forestry and the marine sector.

"While applications of AI could lead to more effective use of landscapes and seascapes, improved environmental monitoring and increased transparency in supply chains, it could also create a number of new risks for both people and nature," says lead author Victor Galaz, director of the Beijer Institute programme "Governance, Technology and Complexity" and deputy director of Stockholm Resilience Centre.

The study, which is published in the journal Technology in So*ciety*, also presents new data about areas in the world to which AI technologies for sustainability are currently diffusing. The analysis shows that the most rapid development is taking place in farming, with substantial investments in these technologies in China and the United States in particular.

# Need to address gap

The study is the result of a collaboration between the Beijer Artificial intelligence in combination with sensor technology Institute, Stockholm Resilience Centre and the Princeton Inand robotics is increasingly being applied in agriculture, foreststitute for International and Regional Studies. Two workshops ry and marine resources extraction. In these sectors with high in 2019 gathered a number of experts and formed the basis for impact potential for sustainability, the study explores emerging the study. Authors include researchers from Cornell University, CGIAR Platform for Big Data in Agriculture, Graz University of systemic risks in four areas: Technology and University College London.

# 1. Algorithmic bias and allocative harms.

For example, training data and a resulting model developed from these data may be suitable for a large industrial farm sponsible AI". Most emphasis so far has been on social aspects. in a data-rich context, while using it as decision-support for "If we are serious about using AI for sustainability, this is a a small-scale farm in a low-income country could lead to gap that needs to be addressed urgently," says Victor Galaz. flawed and damaging results.



Selected publications

# 2. Unequal access and benefits.

Due to the global "digital divide", small-scale farmers in less wealthy countries often face serious obstacles to accessing big data and mobile technologies, a situation which is likely to distribute the benefits of AI technologies in unequal ways.

# 3. Cascading failures and external disruptions.

One example is how "Virtual farms," using AI and big data from sensors, often require cloud storage, which is susceptible to breaches. Recently, this risk was manifested in cyberattacks forcing the shutdown of numerous meat plants in the US.

# 4. Trade-offs between efficiency and resilience.

Using AI technologies to increase the efficiency and productivity of a particular crop, tree or seafood species risks undermining overall system functioning and resilience. This has proven to cause abrupt, unwanted and sometimes irreversible changes in ecosystems.

The article concludes that much more can be done to integrate environmental sustainability dimensions in the principles of "re-

> Galaz, V., Centeno, M. A., Callahan, P. W., Causevic, A., Patterson, T., Brass, I., et al. 2021. Artificial intelligence, systemic risks, and sustainability. Technology in Society 67:101741.

# The Beijer Young Scholars

The Beijer Young Scholars (BYS) Programme was started in 2012 with the aim of creating an international network of early-career researchers and stimulating emergence of new research paths and new ways of interdisciplinary collaboration on global sustainability topics. Conducting collaborative, integrative and interdisciplinary research is a time-consuming endeavour that is not always well recognised in the academic incentives system. One important aim of the BYS programme is to facilitate and provide space for such research.

# Beijer Young Scholars III

This year we were fortunate to be able to host the 3<sup>rd</sup> cohort of the Beijer Young Scholars for their first in-person working group since 2019. While the ongoing pandemic and other personal life events (including five new babies!) kept some of the group from attending in person, 11 of the 20 scholars were able to join for a weeklong meeting in Stockholm and the archipelago. They continued working to bring an inter-disciplinary and international perspective to their topic *Globalisation* and the biosphere.

Over the past three years this group has remained connected using many of the same technologies that have consumed all our lives of late. Even before the pandemic made it impossible to hold in-person work meetings, the group met quarterly online to share personal and project updates, although setting a time for online calls that worked for time zones stretching from the North American West Coast to East Asia was challenging. In addition to these quarterly meetings, in 2020 and 2021 the group also experimented with different formats for virtual working groups, connecting with professional facilitators for 2-4 hours over the course of three days to try to recreate the feel of a conventional working group.

However, the return to an in-person setting was a welcome reprieve. The group focused on two major projects during their time at the Bejier Institute headquarters and on the island of Lidö in the Stockholm archipelago. The first was to re-visit a paper that took shape early on during the Covid pandemic, which attempted to draw parallels between the ongoing pandemic and climate change in order to imagine a range of possible

outcomes for both crises depending on international policy decisions. The group made use of science fiction prototyping to explore how varying levels of domestic policy strength and international cooperation could lead to these crises playing out in dramatically different fashions. The group submitted the manuscript for review last year, receiving valuable comments. They are in the process of updating this piece, but in order to keep the perspectives more timely, the vision has shifted from forecasting to retrospection – using observed trends over the past 30 months to evaluate which of the three likely pathways our global society has taken.

Over time, the group also became increasingly energised about an emerging project idea. Spurred by many interdisciplinary conversations over the course of the week, those meeting in person coalesced around the idea of using charting social-ecological indicators of the impacts of globalisation on the biosphere. The beginning of the week centred around the volume of recent publications using either biophysical indicators to document the decline of the biosphere or socioeconomic indicators to show the



Participants of Beijer Young Scholars III workshop in June 2022. Back row: Usman Mirza (Alfa Laval), Elsa Ordway (UCLA), Tamma Carleton (UC Santa Barbara) Anouch Missirian (Toulouse School of Economics), Eval Frank (University of Chicago), João Vaz (Gothenburg University), Odirilwe Selomane (Stellenbosch University).

Front row: Jeffrey Smith (Stanford University). Jamila Haider Jean-Baptiste Jouffray, Lan Wang-Erlandsson (Stockholm Resilience Centre)

Photo: Agneta Sundir

rise of globalisation. However, very few papers made use of truly social-ecological indicators or data that are truly interdisciplinary in nature to consider these two patterns in conjunction, rather than tracking each in isolation. The group focused on brainstorming and gathering data on such indicators, such as the spread of invasive species, the shifting patterns of global deforestation and reforestation, and the increasing emergence of zoonotic diseases. The week ended by creating concrete plans to move forward on this project over the coming weeks and months.

In addition to these scientific conversations, the group continued ongoing discussions over the different norms in their fields as related to incentives and expectations for publication and collaboration. Many of these conversations took place on the island, on long hikes or kayak rides, or in the hot tub and sauna. The group shared good food, drink and company throughout the week and had no the project is to identify trade-offs and shortage of laughs and good memories from their time together – although they certainly missed those who were not able to attend.

# Inequality and the Biosphere: Achieving the Sustainable Development Goals in an Unequal World

In 2020, the second cohort of the Beijer Young Scholars (BYS2) received a 20 milproject titled *Inequality and the Biosphere:* discussions and smaller working group Achieving the Sustainable Development meetings, but the workshop also provid-Goals in an Unequal World (presented in ed the space for spontaneous discussions last year's report). The overarching aim of that sparked many new ideas. Read more



Photo: Agneta Sundin

synergies between reducing inequalities and safeguarding the biosphere. After more than two years of Covid-19 restrictions and online meetings, the core project team was able to meet for a physical workshop in Stockholm in January 2022, to concretise the plan for the coming year. A few months later, in May 2022, the full project team met for a much anticipated five-day workshop on the island of Lidö in the Stockholm Archipelago. The time lion SEK grant from Formas for a four-year on Lidö was divided between full-group



Beijer Young Scholars III workshop. Outdoor session at the island of Lidö in Stockholm Archipelago.

about the project's research and results on pages 18 and 19.

The project provided the theme for the 2022 edition of the collaboration between the Beijer Institute, Beckmans College of Design and Svenskt Tenn. Students in Visual Communication at Beckmans were supervised by the project PIs in their creative process to interpret relevant insights at the interface of inequality in society and environmental change. The students' artworks were displayed in an exhibition in April (read more at page 32). The participating researchers found this collaboration highly enriching: "Following the students' process provided us with new perspectives and ideas in how to approach our own work and plentiful inspiration for how to make our work more accessible."

Lunch break for participants and advisors at the Beijer Young Scholars II workshop.

Left side: Tomas Chaigneau (Exeter University), Tracie Curry (Northern Social Ecological Research), Tong Wu (Stanford University), Emmy Iwarsson (Beijer Institute), Juan Carlos Rocha (Stockholm Resilience Centre, SRC) and Maike Hamann (Stellenbosch University), Right side: Yolanda López, Alon Shepon (Tel Aviv University), Anne-Sophie Crépin (Beijer Institute), Henrik Österblom and Patrik Henriksson (both Beijer Institute and SRC). Caroline Schill (Beijer Institute) and Emilie Lindkvist (Stockholm Resilience Centre).

Photo: Yolanda López

# Conferences

# Ulvön Conference on Environmental Economics

The Beijer Institute is happy to be one of the numerous friends of Ulvön. The Ulvön Conference on Environmental Economics is an annual event held just before midsummer in a small fishing hamlet on the island of Ulvön in Northern Sweden. The 2022 event was held on 21–23 June. The key purpose of the conference is to allow PhD students to present their work and interact with leading researchers in the field. It is a much-appreciated forum for dissemination of high-quality research in the field of environmental economics. The annual conferences are organised by the Centre for Environmental and Resource Economics (CERE) in Umeå, Sweden.

For the first time in three years, it was possible to hold this year's conference on-site. Beijer Deputy Director Anne-Sophie Crépin was one of the keynote speakers and presented her joint research with Juan Carlos Rocha (Stockholm Resilience Centre) on *Cascading regime shifts in pollution recipients and resource systems*. Beijer Young Scholar João Vaz (Gothenburg University) also participated and presented his work on *Adaptation management to exogenous regime shifts: The role of non-convexities.* 

# Intelligent Machines, Emotions and Our Planet

An online two-day conference on 13–14 January on Intelligent Machines, Emotions and Our Planet gathered researchers, artists and practitioners to explore the frontiers and social challenges created by the increased interplay between human emotions, machines and nature.

Emotions affect how we make sense of the world, communicate with each other and collaborate. Emotions also influence the ways in which information is shared online, how communities perceive and respond to environmental crises, and how elites, civil society and citizens engage in the climate crisis. The importance of emotions in our lives is certainly not a new observation, but human emotions are now being increasingly mediated and affected by a variety of technologies, advanced machine intelligent systems and digital platforms. Data extracted from wearable devices, cameras, social media and "behavioural surplus" created by online behaviour can be combined with artificial intelligence to extract, measure, understand, simulate and respond to human emotions at depths and at scales that are unprecedented in human history.

However, there may be risks embedded in "emotion technologies" as we move into a more turbulent climate future. There are pressing questions, such as whether these technologies could act as a force for good by helping people expand and deepen their empathy towards other humans, non-human species, future generations and even nature, and how societies can prepare for this new reality in creative and constructive ways. These were



Anne-Sophie Crépin giving a keynote speech at the Ulvön Conference of Environmental Economics. Photo: Stina Kalén/Umeå University

some of the questions discussed at the conference, where Beijer Institute Programme Director Victor Galaz and researcher Stefan Daume led the organising team and moderators included Programme Director Therese Lindahl and researcher Caroline Schill.

This event was organised by "AI, People & Planet", an initiative between the Beijer Institute, the Urban Systems lab at the New School, and the Princeton Institute for International and Regional Studies at Princeton University. The event was funded by The Crafoord Foundation.

Videos from the conference can be found at aipeopleplanet.earth.

# 2022 US-UK Scientific Forum on bringing nature into decision making

Every year, the Royal Society and the National Academy of Sciences (NAS) jointly convene the US-UK Scientific Forum to help the scientific leadership of the United Kingdom and the United States forge an enduring and productive partnership on pressing topics of worldwide scientific concern. The objective of the 2022 Forum was to advance integration of biodiversity and nature's benefits to people into decision-making, systemically and globally. Specific aims were: to describe the grand challenge of valuing, sharing and regenerating nature's benefits; to showcase successful models in use today; to identify barriers to adapting, replicating and scaling these models in science, capacity, social innovation and institutions; and to identify key opportunities for lifting barriers and creating nature-positive, climate-smart and inclusive systems and pathways for sustainable development.

Gretchen Daily (Stanford University), Beijer Fellow and Yadvinder Malhi (University of Oxford) co-chaired the Forum

Planning Committee, with Beijer Fellow Steve Polasky (University of Minnesota) and Beijer Institute Director Carl Folke among the members. Invited participants were from science, finance, policy, NGOs and editors of *Nature* and *Science* and newspapers such as *the Guardian*.

This high-level meeting was held at Royal Society in London, 16–17 June 2022.

Videos from the event can be found at royalsociety.org

# Ambio 50 years

*Ambio*, an interdisciplinary journal of the Royal Swedish Academy of Sciences with the focus on environmental and sustainability challenges, celebrated its 50<sup>th</sup> anniversary in 2021. This was celebrated with a jubilee collection that included Beijer Institute research (described in last year's report) and an online conference on 9 September. The Institute has published around 50 papers in the journal since its launch in 1991, and these papers in combination have been cited some 5800 times (according to Web of Science).

The 2021 conference opened with a retrospective talk by science historian Sverker Sörlin (KTH Royal Institute of Technology) on the emergence of systems-based social-environmental research and how *Ambio* evolved in parallel. The remainder of the conference was forward-looking, with discussions on, for instance, where emerging social-environmental issues with high relevance for humanity may lie and what standards to set for high quality interdisciplinary and transdisciplinary research.

Beijer Institute director Carl Folke held one of the keynote talks, entitled *Our future in the Anthropocene biosphere – the de-velopment and current status of a research field*. He also took part in a panel discussion on the science needed to tackle current and future environmental challenges.

In a later session, the issue of how science and scientific journals can become more directly accessible and useable for policy and practice was discussed with representatives from The International Union for the Conservation of Nature, the publishing company Springer, The Swedish International Development Cooperation Agency and The Earth Institute.

The conference was filmed and is available at kva.se





Panel discussion at the Population and environmental change symposium.

# Population and environmental change

During the year, the Beijer Institute and the Environment Committee of the Royal Swedish Academy of Sciences organised an international symposium examining both how demographics affect the environment and how changes in the environment and climate can impact the global population. The symposium took place on 23–24 September 2021, at the Academy and online.

People are now generally healthier, live longer and have a higher standard of living than in previous centuries, but future health and wellbeing are completely dependent on functioning natural systems and the ecosystem services they provide.

At the symposium, world-leading researchers in demographics, geography and sociology lectured and answered questions on this topic. The symposium ended with an interdisciplinary panel discussion on "Which demographic issue is most important for the transition to a sustainable future?"

From Beijer Institute, Anne-Sophie Crépin formed part of the organising committee and Agneta Sundin moderated the symposium. The event was funded by The Crafoord Foundation. Videos of the two half-day sessions are available at the Beijer Institute website, under 'News'.

# The state of the ocean

How can science, policy and business achieve sustainability in an increasingly crowded ocean? This was the theme for a halfday seminar on 3 May at the Academy, where all participants emphasised the urgency of action.

It was organised by the Beijer Institute and Stockholm Resilience Centre (SRC) in the presence of Their Royal Highnesses Crown Princess Victoria and Prince Daniel of Sweden, and their Royal Highnesses Crown Prince Haakon and Princess Mette-Marit of Norway.



Their Royal Highnesses Crown Princess Victoria of Sweden, Crown Prince Haakon and Princess Mette-Marit of Norway and Prince Daniel of Sweden arriving at the Royal Swedish Academy of Sciences. Photo: Eva Nevelius/RSAS

# Royal commitment to the ocean

HRH Crown Princess Victoria and HRH Crown Prince Haakon are both actively engaged in ocean sustainability. During the seminar, both highlighted the close connection to the ocean each of their countries have. They emphasised the need to become better stewards of this resource.

"We share a true passion for the ocean. We need to bring the ocean back into balance. We have a collective opportunity. Let's take care of the ocean and thereby take care of ourselves," Crown Prince Haakon said.

# A race for the ocean

Beatrice Crona, Executive Director of the Academy's GEDB programme and Deputy Science Director at SRC, provided a comprehensive overview of how the human pressure on the world's ocean shows no sign of slowing.

Of the 14 largest ocean sectors currently operating, such as shipping, oil & gas and telecommunications, 13 have a negative environmental impact. This has significant consequences for ocean ecosystems.

"We must ask ourselves whether the blue economy can continue to grow," Beatrice Crona said.

### Partnerships for the future

One solution may be found in new collaborations between science and business. SRC researcher Robert Blasiak highlighted the process that eventually led to Seafood Business for Ocean Stewardship (SeaBOS) and explained how real progress is now being made within the initiative, with potential major benefits for the ocean.

Vidar Helgesen, CEO of the Nobel Foundation and co-chair of the advisory council to the UN Decade of Ocean Science showed how science can lay the foundation for sound policies.

Like all the other participants, he emphasised the urgency of action. Both the speed of change and the opportunities available are accelerating. To deal with both, science will need to play a crucial role.

# Report launched on financial actors' role in sustainability

The report "Economy and Finance for a Just Future on a Thriving Planet" was launched at the Royal Swedish Academy of Sciences on 1 June 2022. It points out that current investments are driving Earth perilously close to tipping points in the Amazon rainforest, the great ice sheets, coral reefs and the Atlantic circulation. Financial institutions that mediate these investments play a central role in the ability to shift economies in a direction that promotes a thriving planet for all.

The report was commissioned by the Swedish Ministry of Environment as an independent contribution to the Stockholm+50 conference.

"The world's largest investors are crowd-funding a dangerous climate future," said lead author Victor Galaz, Programme Director at the Beijer Institute and Deputy Director of Stockholm Resilience Centre.

The report highlights the role of sleeping financial giants, a group of investors who play a significant role in destabilising crucial tipping elements such as the Amazon rainforest. If pushed too far, these elements can destabilise Earth's climate and exacerbate global warming.

"It is possible to redirect capital and change economic indicators to enhance the resilience of the planet, and reduce the risk of crossing dangerous tipping points," said co-lead author David Collste, Stockholm Resilience Centre. At the launch, he pointed out a need for new indicators of human well-being, macroeconomic performance and financial risks.

The report also calls on governments and financial institutions to devote more effort to phasing out subsidies and investments in activities that are pushing ecosystems towards tipping points.

Several Beijer Institute researchers contributed to the report, including Therese Lindahl and Caroline Schill, who underlined the importance of social norms in instigating large-scale behavioural change for sustainability.



Panel discussion with Victor Galaz, Emine Isciel (Head of Climate and Environment, Storebrand Asset Management), Susanna Gable (Sisa) and Anna Breman (Deputy Governor of the Swedish Central Bank). Photo: Helene Karlsson (SRC)

# SeaBOS – progress report launched

On 29 June 2022, at the UN Ocean Conference in Portugal, Sea-BOS launched its first progress report, following commitments made at the 2017 UN Ocean Conference.

Setting out to tackle the most urgent challenges in the seafood sector, SeaBOS shares lessons learned and progress made to advance its mission: to lead global transformation towards sustainable seafood production and a healthy ocean.

SeaBOS has established 10 commitments to guide its work, ranging from reducing IUU fishing and eliminating modern slavery to reducing greenhouse gas emissions. As of June 2022, all 10 member companies have established time-bound climate goals aimed at reducing their greenhouse gas emissions in line with the Paris Agreement. They have also undertaken to report publicly on their emissions by October 2022.

# Gearing up

Progress includes the establishment of:

- a roadmap for reducing antibiotics in aquaculture
- an endangered species strategy
- science-based best practice guidelines for reducing negative impacts on endangered species of elasmobranchs (sharks, skates and rays) and seabirds
- a City to Sea plastics strategy

Work is underway on commitments such as improving fisheries and aquaculture management through policy collaboration, and on identification of mechanisms to grow aquaculture sustainably and ensure greater transparency in seafood value chains.

# Science industry collaboration

SeaBOS is a unique collaboration between scientists and seafood companies operating in the wild capture, aquaculture and feed production sectors. Together, SeaBOS members represent over 10% of global seafood production and over 600 subsidiary companies globally.





Excursion on a tall ship at a SeaBOS meeting in Stockholm, May 2022.

SeaBOS is the result of a science-based identification of "keystone actors" in global seafood carried out by Stockholm Resilience Centre (SRC) in collaboration with the Beijer Institute and the GEDB programme at the Royal Swedish Academy of Sciences, together with Stanford University's Centre for Ocean Solutions and Lancaster University.

An article in *Scientific Reports* describes the process bringing the companies and the scientists together, showing how interactions went from tentative and uncomfortable in the beginning to shaping the dynamic, operational organization SeaBOS is today. Backed by the companies it has the mandate to take on a global leadership role in the seafood industry. It has also started to inspire other sectors.

Since the first interactions in 2015, the initiative has involved 135 industry representatives and 28 independently funded scientists in 588 meetings, in six distinct phases of cooperation.

The author team led by Henrik Österblom (science director at Stockholm Resilience Centre and affiliated researcher of the Beijer Institute), including several Beijer Institute researchers, claim that "mobilizing transformational agency through learning, collaboration, and innovation represents a cultural evolution with potential to redirect and accelerate corporate action, to the benefit of business, people and the planet."

"We are seeing changes within the companies that were difficult to imagine in 2015. They are now collectively pushing for science-based policies and international agreements," says co-author Carl Folke. Together with Österblom he was instrumental in the conceptual development of SeaBOS.

HRH Crown Princess Victoria of Sweden (front row, centre) pictured with company representatives and members of the scientific team during a working meeting in Stockholm May 2022. Crown Princess Victoria has been involved since the start in 2015, providing consistent support and participation in events. Photo: E-L. Jansson/Azotelibrarv.com

# Exhibition combining science, art and design

Using visual communication as a language, art students have created works that provide new entry points to complex research. With design, imagination and humour, their works evoke visitors' curiosity and reflections about different aspects of sustainability.

The eight works in the exhibition are based on the interdisciplinary, international research project Inequality and the Bio*sphere*, which is led by researchers from the Beijer Institute and Stockholm Resilience Centre. The research areas of equality and environmental change are usually treated separately from each other, but if we are to create a true picture of reality and our future challenges, we need to understand how the two are linked. The Inequality and the Biosphere project deals with how different sustainability aspects affect each other in complex cause and effect processes – so-called feedback loops.

Among the works presented are 'I Visited the Aral Sea and All I Got Was This Lousy T-shirt', by Eliot Siekkinen Lydéen, paraphrasing souvenir t-shirts to highlight travel and overconsumption





and how inequality can lead to environmental degradation, which in turn leads to even greater inequality; and 'Monopoly Philanthropist', by Lova Rehle, a new version of the classic board game. In this version, the player is a philanthropist with sights set on the survival of humanity. The goal is now to try to solve the trilemma of achieving sustainability, prosperity and equality in parallel.

The exhibition Feedbacks | Inequality and the Biosphere is part of a long-term collaboration between the Beijer Institute, Beckmans School of Design and the design store Svenskt Tenn in Stockholm. Through the Kjell and Märta Beijer Foundation, Svenskt Tenn's profits support research at the Beijer Institute. It was shown at Svenskt Tenn in April 2022.

# The Taskforce on Nature-related **Financial Disclosures**

During the year, the Beijer Institute, the Academy programme GEDB and Stockholm Resilience Centre took on the role of knowledge partners to the Taskforce on Nature-related Financial Disclosures (TNFD), an initiative designed to develop a risk management and disclosure framework for organisations to report and act on evolving nature-related risks.

The knowledge partners, from leading research organisations, support the TNFD by providing top-class scientific knowledge and expertise on market standards, risk management and reporting practice. Carl Folke and GEDB Executive Director Beatrice Crona serve as the core knowledge partners to the TNFD. TNFD's knowledge partnerships reflect its commitment to building on existing expertise, initiatives and standards and to creating a framework that is both market-led and science-based.

The TNFD knowledge partners provided instrumental input to the first prototype version of the TNFD framework, released in March 2022, and will continue to support the Taskforce until the launch of its final recommendations in September 2023. Funding for the TNFD is provided by governments, the UN and philanthropic foundations. tnfd.global/

Photos: Calle Elf

Science in society

# Blue Food Assessment

In February 2000, researchers launched a scientific study to look The Swedish Environmental Protection Agency hosted the Fifth into the role of seafood as the world prepares to feed a global IPBES conference on Biodiversity and Human Wellbeing on 20 population estimated to reach 10 billion by 2050. A year and a October, 2021. The conference was held in Swedish and broadcast half later, five peer-reviewed papers provide a scientific foundaonline due to Covid restrictions. Beijer Institute Deputy Director tion upon which to base policy discussions on how blue foods Anne-Sophie Crépin, who is also a member of the Swedish Envicould contribute to healthier, more sustainable and more eqronmental Protection Agency's Environmental Research Board, uitable food systems. These papers form part of the Blue Food was one of the plenary speakers. Her talk focused on "Navigating Assessment (BFA), an international initiative bringing together uncertainty; how can we make decisions despite missing inforover 100 scientists from more than 25 different institutions. The mation?" It was based on her individual research as well as on a research and translation of the findings into policy recommenresearch paper written together with several Beijer Fellows and dations provide a firm foundation for decision-makers, enabling led by Stephen Polasky (University of Minnesota). As a result of them to make informed decisions about how blue foods can best this presentation, she was later invited to talk on the same topic form part of improved food systems. at the research funding agency Formas.

The initiative was co-chaired by GEDB Executive Director Beatrice Crona and Beijer Fellow Roz Naylor (Stanford University). It also involved 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 was accompanied by a series of action briefs with specific findings and recommendations tailored to decision-makers in the public health, development, environment, retail and food service sectors, as well as those working at blue food companies.

Members of the BFA also led a session at the pre-summit on blue foods, in which seven member states and leaders of the UN participated – including the UN Secretary-General's Special Envoy for the Food Systems Summit and Special Envoy for the Ocean.

The five papers, published in Nature in 2021, address nutrition, climate change, environmental performance, demand and small-scale actors in the blue food sector. Four more papers are expected to be published in 2022. These will address environmental change, justice, systems transformation and collaboration between public and private decision-makers.

The BFA continues to participate in and organise global events, workshops and meetings to engage decision makers and stakeholders with these new perspectives. Recent events include the United Nations Ocean Conference in Lisbon in June, 2022. bluefood.earth



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Science in society

# Biodiversity and human wellbeing



The Swedish Parliament building, Stockholm

# Bringing science to parliament

The Beijer Institute is an active member of the Royal Swedish Academy of Sciences' Environment and Energy Committee. In April 2022, the committee and the institute jointly organised a seminar at the Swedish parliament on "Are we ready for the future climate?". The seminar was held within the Rifo series, a forum for dialogue between scientists and parliament members. The aim of the seminar was to draw politicians' attention to the fact that we will have to face climate change and that it is time to prepare and adapt to that new reality. At the seminar Ilona Riipinen (Stockholm University) presented a report on the most recent insights in climate science. Her introduction was followed by several lectures by, among others, Line Gordon (Stockholm Resilience Centre at Stockholm University) and Göran Enander (Governor of Uppsala County). The lectures were moderated by Martin Jacobsson (Stockholm University) and Anne-Sophie Crépin (Beijer Institute) and were followed by a panel discussion by the lecturers, moderated by Academy member Anders Wijkman.

# Collaborations

# The Global Economic Dynamics and the Biosphere (GEDB) Academy Programme

The GEDB Academy Programme – *New Approaches to the Grand* Challenge: Global Finance, Global Health and the Biosphere - focuses on two broad areas of research. The first, Biosphere Fi*nance*, studies finance and capital markets linked to the latest research on planet Earth as a system. This new research area is rapidly emerging and the engagement by companies and financial actors is rapidly expanding. Within the past year, GEDB researchers have engaged with diverse actors, such as banks and investment companies. GEDB plays a central role in the Vinnova-funded Sustainable Finance Lab. During the year, the GEDB's Executive Director was engaged in securing a major grant from Mistra on Finance and Biodiversity. A notable output from the *Biosphere Finance* theme during 2021 was a metric for measuring the impact of financial investments on the Earth system, the first known metric to capture Earth system processes beyond simply greenhouse gases, by including water and land use change<sup>1</sup>.

The second broad area of research is on Global Health and *Biosphere Stewardship*. Within this area there are collaborations with multiple research groups, including medical professionals, psychologists, behavioural economists and food actors, to tackle everything from antibiotic resistance to human health, habitats and food production. New diseases and agricultural pest organisms, also known as emerging pests and pathogens (EPPs), have been a major focus of this theme for several years, as recognised by European Research Council with a 1.5 million Euro research grant to Peter Søgaard Jørgensen. The importance of blue food and ocean stewardship saw the publication of articles in the journal *Nature* focusing on the ability of food from global oceans and freshwater bodies (blue food) to promote human health. The work on antimicrobial resilience building and on health, evolution and biosphere stewardship is progressing well, with new analyses in the pipeline<sup>2</sup>.

GEBD is a significant channel for research, synthesis and synergies between the Beijer Institute and Stockholm Resilience Centre and our diverse activities. Last year's achievements are described in the GEDB Annual Report 2021, to be found at the webpage.

GEDB is funded by the Erling-Persson Family Foundation. gedb.se

# [1]

Lade, S.J., I. Fetzer, S.E. Cornell and B. Crona. 2021. A prototype Earth system impact metric that accounts for cross-scale interactions. *Environmental Research Letters* 16(11):115005. Another notable publication of GEDB biosphere finance is Wassenius, E., and B. Crona. 2022. Adapting risk assessments for a complex future. *One Earth* 5: 35-43.

# [2]

Recommended article: Léger, A. et al. 2021. Characterizing social-ecological context and success factors of antimicrobial resistance interventions across the One Health spectrum. *BMC Infectious Diseases* 21(1):1–13

# Stockholm Resilience Centre

The close collaboration with Stockholm Resilience Centre (SRC) continues to be very productive, with numerous synergies and benefits through joint projects, grants, workshops and publications. SRC researchers are engaged in Beijer Institute research programmes and in major research grants, while Institute researchers are active in the research themes of SRC and collaborate and participate in seminars, teaching, supervision, projects etc. The communication, outreach and policy engagements of the Beijer Institute are substantially enhanced through the interplay with SRC.

# Stanford collaboration

The work with the significant grant *Fundamental Research in Biosphere-based Sustainability Science* from the Marianne and Marcus Wallenberg Foundation is progressing well and strengthens and extends the collaboration between the Beijer Institute, SRC and Stanford University. The grant provides a research platform for the development of new theory, analysis and synthesis on stewardship of natural capital and the biosphere, for social-ecological resilience, human wellbeing and sustainability. The work draws on the long legacy of Beijer Institute collaborations with Stanford researchers and also new collaborations within the Beijer/GEDB/SRC cluster. Carl Folke and Beijer Fellow Gretchen Daily (Stanford University) serve as project leaders.

# Executive programme in resilience thinking

The fourth executive programme of the SRC took place in autumn 2021-spring 2022. In the programme, carefully selected CEOs and board members of influential companies within diverse business sectors in Sweden meet scientists and thought leaders to deepen their understanding of the latest research and accelerate the transformation towards sustainability. All-in-all, around 60 high-level participants have been part of the programme. Corporations represented in the fourth executive programme included Epiroc, Handelsbanken, Husqvarna, Interflora, Lindén-group, Postnord, Stena Line Group, Scania, SEB and Stora Enso. Conversations unveiled how business can indeed play a pivotal role in sustainability transformations, informed by science and driven by purpose. The deeper meaning and challenge of 'corporate biosphere stewardship' is increasingly appreciated. The Director of the Beijer Institute is the science director for the programme. An alumni gathering was held at SRC in April 2022. stockholmresilience.org

# Environment and Development Economics

The journal *Environment and Development Economics* (EDE) was founded by, and is published in association with, the Beijer Institute. EDE is positioned at the intersection of environmental, resource and development economics and encourages submissions from researchers in both developed and developing countries. The journal is divided into two main sections, *Theory and Applications*, which includes regular academic papers, and *Policy Options*, which includes papers that may be of interest to the wider policy community. The editors are Carlos Chavez, Susana Ferreira, E. Somanathan and Beijer Fellow Jeff Vincent. The

journal focuses on encouraging and giving maximum support to authors for high-quality theoretical and empirical research in environmental and development economics, paying special attention to papers submitted from developing areas without compromising the quality of papers published, and planning and publishing special issues that focus on specific areas of policy interest.

# HiG Urban Studio, University of Gävle

The Beijer Institute programme *Urban social-ecological systems* collaborates with the *HiG Urban Studio* at the University of Gävle. Johan Colding is currently employed as a part-time research coordinator at *HiG Urban Studio*, which conducts research supporting urban development confined within the Earth's carrying capacity, while maintaining a focus on human well-being. A key mission of *HiG Urban Studio* is to promote collaborations with other prominent Nordic research settings working on sustainable urban development. These include the *SMOG* group at Chalmers Technical University, Sweden, which holds an internationally leading position in research related to architecture and urban morphology, and environmental psychology groups at Aalto University, Finland, and Uppsala University, Sweden.

# RISE – Research Institutes of Sweden

RISE Research Institutes of Sweden, is an innovation partner in international collaborations with industry, academia and the public sector. RISE ensures the competitiveness of the Swedish business community and contributes to a more sustainable society. It is an independent, state-owned research institute that advances research in a broad spectrum of areas. The food sustainability group of RISE has undertaken Life Cycle Assessment studies of foods since the early 1990s and was a pioneer in this now rapidly expanding research field. Through a longterm Formas project, the Beijer Institute has established a formal collaboration with the seafood group at RISE, which is an internationally highly recognised research group in the field. Main collaborators include Max Troell, Therese Lindahl, Patrik Henriksson and Malin Jonell, representing Beijer and SRC. The collective expertise also involves international collaborators adding insights to the role and challenges related to the future of global seafood.

ri.se

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# SARAS – The South American Institute for Resilience and Sustainability Studies

The Beijer Institute has been engaged since 2007 in the South American Institute for Resilience and Sustainability Studies (SARAS). SARAS is an interdisciplinary research institute based in Maldonado, Uruguay, and is intended to catalyse high-impact science that serves to enhance South America's long-term resilience and sustainable development. SARAS is working towards becoming a regional centre cooperating closely with the scientific community and relevant funding agencies in several South American countries and with an established set of international key scientists. Beijer fellows Marten Scheffer, Steve Carpenter, Frances Westley and Carl Folke have been deeply engaged in setting up SARAS over the years. At present Henrik Österblom, Juan Carlos Rocha and Therese Lindahl sit on its advisory board and work as associates.

saras-institute.org

# WorldFish

WorldFish is an integral part of the Consultative Group on International Agricultural Research (CGIAR). It is an international, non-profit, scientific research centre created to conduct, stimulate and accelerate research on fisheries, aquaculture and other living aquatic resources for sustainable benefits of the present and future generations of low-income users in developing countries. WorldFish was early to pick up on the contemporary resilience research, upon which it builds its research and actions in poor and vulnerable communities. During the past 10 years, the mode of cooperation between the Beijer Institute and World-Fish has developed from mainly informal partnerships to collaborative research projects. One project investigating equitable development of aquaculture in East Africa is led by Max Troell. Formal support from WorldFish also includes supporting activities within the Beijer Institute programme on sustainable seafood, as well as co-funding a post-doc (Patrik Henriksson) over several vears.

worldfishcenter.org

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# **Reflection of** a board member

Of all the fields within economics that one could study - e.g., labor economics, macroeconomics, econometrics, and the like – environmental economics is (in my view) the most important, the most interesting, and the most fun! For all of these reasons, I am very honored that, as an environmental economist, I've had the opportunity to serve as a member of the Beijer Scientific Advisory Board and participate in the Askö meetings for the past five years, where all three of these come together and are on full display. At Beijer and Askö, environmental economists like me have an opportunity to interact with

"Seeing the world through the perspectives of other disciplines has given me a better understanding of the mosaic of ideas and perspectives that shape the debates that surround environmental issues."

> world-renowned scholars from ecology and other disciplines in an effort to enhance our understanding of critical environmental challenges and potential means for addressing them. This is extremely important, extremely interesting, and extremely fun!

> Why so important? At the Beijer Institute, scholars are working on some of the most pressing problems the world faces today, including climate change, loss of biodiversity, sustainable seafood, and more generally keeping societies within the planetary boundaries that are increasingly threatened in this age of the Anthropocene. Concerns about the planet's future and the sustainability of the ecosystem services it provides overshadow shortrun economic concerns about business cycles and labor market shortages. For example, we are witnessing the impacts of climate change play out in real time through the increased heat waves, hurricanes, floods, etc., that are affecting people around the world. But addressing these challenges requires integrating an understanding of how the physical world works and how we humans interact with and impact it through the choices we make. We desperately need institutions like the Beijer Institute to bring together these various types of expertise. We will

only make progress in moving toward a more sustainable world if we know not only what needs to change but also how to make change happen, especially in a world where private interests so often compete and diverge, both within and across countries. The work at the Beijer Institute and the discussions and papers that come out of the Askö meetings are playing a really important role in bringing together the needed expertise and advancing us toward this goal.

> Why so interesting? Being at Beijer and Askö has given me an opportunity to learn from and share thoughts with many of the world's leading scholars, especially from ecology but also from other fields such as psychology, geography, political science, etc. The resulting cross-fertilization, a

cornerstone of the Beijer/Askö philosophy, is a key part of what makes the work so interesting. Seeing the world through the perspectives of other disciplines has given me a better understanding of the mosaic of ideas and perspectives that shape the debates that surround environmental issues. It has broadened my own perspective (well beyond the confines of neoclassical economics) and helped me to understand why economists sometimes "miss the mark" when talking about environmental concerns. In so doing, it has made me a better economist. The discussions and conversations often challenge my prior conceptions and stimulate me to think about problems in new ways.

And, finally, why so much fun? After a day of stimulating conversation and attempts to better understand and wrestle with some of the most important issues facing societies today, where else would you be able to raise a glass in unison, be entertained by people who can easily switch their hats from scholar to musician, and see a group of people who just a few hours ago were so serious, start singing and laughing and demonstrating that taking time to relax and enjoy the company of friends (many made at previous Beijer or Askö meetings) is also important. I always return from these meetings both re-energized and inspired. Many thanks to all the wonderful people at the Beijer Institute, including the wonderful staff, who make these meetings possible.

Kathleen Segerson Professor, University of Connecticut, USA.

Reflection of a board membe

# Appendix

# Scientific advisory board

Board members of the Beijer Institute of Ecological Economics are appointed by the Royal Swedish Academy of Sciences for a three-year period and may not be re-elected more than once, according to the standing instructions for the Beijer Institute approved by the Royal Swedish Academy of Sciences on 5 June 1991. The 31st annual board meeting was held digitally, due the prevailing circumstances of the Covid-19 pandemic. This meeting was the first for Professor Claire Kremen, University of British Columbia, Canada, and Professor Rashid Sumaila, University of British Columbia, Canada, who were welcomed as new members of the board. Chair of the Board Professor Neil Adger and board member Professor Jeroen van den Bergh reached the end of their term. The Beijer Institute wishes to express its warmest gratitude for their great efforts for the Institute as members of the board.

# Chair

Neil Adger Professor, University of Exeter, UK

#### Ex-officio members

Anne-Sophie Crépin Associate Professor, Deputy Director of the Beijer Institute

Carl Folke\* Professor, Director of the Beijer Institute

Göran K. Hansson\* (until 31 December 2021) Professor, Permanent Secretary of the Royal Swedish Academy of Sciences

Hans Ellegren\* (from 1 January 2022) Professor, Permanent Secretary of the Royal Swedish Academy of Sciences

#### Members

Elena Bennet Professor, McGill University, Canada

Reinette (Oonsie) Biggs Professor, Stellenbosch University, South Africa

Juan Camilo Cárdenas Professor, Universidad de los Andes, Colombia

Joern Fischer Professor, Leuphana University, Germany

Claire Kremen Professor, University of British Columbia, Canada

Kathleen Segerson Professor, University of Connecticut, USA

Karen Seto Professor, Yale School of the Environment, USA

Rashid Sumaila Professor, University of British Columbia, Canada

Alessandro Tavoni Associate Professor, University of Bologna, Italy

Jeroen Van den Bergh Professor, Universitat Autònoma de Barcelona, Spain

# Elke Weber

\*Members of the Royal Swedish Academyof Sciences.

# Staff members

Carl Folke Professor, Director

Anne-Sophie Crépin Associate Professor, Deputy Director

Stefan Daume PhD Researcher (also at Stockholm Resilience Centre, Stockholm University)

Gustav Engström Associate Professor, Researcher

Johan Gars PhD. Researche

Johanna Gulliksen Research Assistant

Åsa Gren Associate Professor Researcher

Patrik Henriksson PhD, Researcher (also at Stockholm Resilience Centre, Stockholm University and WorldFish. Malaysia)

Marie Huss Operations Manager

Emmy Iwarsson MSc. Research Assistant

Krisztina Jónás MA, MSc, Research Assistant

Malin Jonell. PhD, Researcher

Sofia-Kristin Kokinelis MSc, Finance and HR Administrator

Therese Lindahl PhD, Programme Director

Caroline Schill PhD, Researcher Agneta Sundin

Communications Officer Max Troell

Associate Professor, Programme Director

J. Marty Anderies

University, USA) Johan Colding

Victor Galaz Associate Professor, Programme Director (Stockholm Resilience Centre, Stockholm University)

Chuan-Zhong Li Professor, Researcher (Uppsala University, Sweden)

Timon McPhearson Professor, Researcher (The New School, USA)

Henrik Österblom Professor, Programme Director, (Stockholm Resilience Centre, Stockholm University)

Professor, Princeton University, USA

# Senior Research Fellows

Professor, Programme Director (Arizona State

Professor, Programme Director (University of Gävle)

# Belinda Reyers

Professor, Researcher (Stellenbosch University, South Africa)

#### Aart de Zeeuw

Professor Emeritus (Tilburg University, the Netherlands)

# Staff news

# During the past year, we welcomed four new colleagues:

Research assistant Johanna Gulliksen who is currently working on a project within Mistra Food Futures, where she is conducting a qualitative interview-based study on the acceptability of policy measures to reduce the environmental impact of food consumption. In parallel, she is conducting a literature study on the acceptability of policy measures, again focusing on food. Johanna is also a Master's student at Stockholm Resilience Centre, Stockholm University, and part of her work will be summarised in her Master's thesis.

Krisztina Jónás joined the Beijer Institute on 1 March 2022, to work as research assistant within the BEN programme. She holds a BA in Foreign Affairs and a MA in International Relations and European Union from the Corvinus University of Budapest: and an MSc in Social-Ecological Resilience for Sustainable Development from Stockholm Resilience Centre, Stockholm University. In previous work within different research projects at Stockholm Resilience Centre, she researched the role of anticipatory governance in aquatic ecosystems and of complex-adaptive systems in social-ecological systems.

Belinda Revers. Professor of Sustainability Science at the University of Pretoria. South Africa. has joined the Beijer Institute as an affiliated researcher Her current transdisciplinary research brings together social-ecological systems science and sustainable development practice. This work seeks to highlight and explore innovative and transformative approaches that are helping to engage with the dynamic and interconnected challenges of sustainable development. She has recently published a review of these approaches in Nature Sustainability together with colleagues at the Stockholm Resilience Centre and has used these results in her advisory role working with the UNDP Human Development Report Office in recent high-level publications on human development and human security in the Anthropocene. Her role at the Beijer Institute includes fostering and strengthening the collaboration with the Natural Capital Project at Stanford University, USA where work is ongoing to explore mutual and complementary advances and lessons in natural capital and resilience approaches and theories, while building more capacity in these topics in South Africa, Sweden and the USA. Her other area of and policy engagement around the global biodiversity crisis continues with the IPBES Transformative Change Assessment and public and private sector leadership programs in Southern Africa.

Henrik Österblom joined the Beijer Institute parttime from 1 March 2022. He is also Science Director at Stockholm Resilience Centre and he describes his role at the Beijer Institute thus:

"With a background in marine ecology and having served as strategic advisor to the Swedish government in the environmental advisory council. I have explored how diverse actors collaborate to solve complex challenges in the Southern Ocean. Drawing on these experiences, I took part in developing the SeaBOS initiative, where scientists and seafood business representatives - from Japan, Norway, Korea and Thailand - collaboratively explore solutions to ocean challenges. The SeaBOS project represents a transdisciplinary experiment that has helped me reflect on behavioural change, norms, collective action and cultural evolution, the power of firms and the market, and equity and equality. At the Beijer Institute, I will work with colleagues to explore how scientific collaboration, dialogues and new technologies can support norm changes and a transition to biosphere stewardship, with particular focus on the private sector. My work has funding from the Marianne and Marcus Wallenberg Foundation and the David and Lucile Packard Foundation."

# Awards

We congratulate Carl Folke who was awarded the 2022 Dr A.H. Heineken Prize for Environmental Sciences considered the Netherlands' most prestigious international science prize. The award ciplinary approach within sustainability science. The jury underlined that, "thanks to Carl Folke's vision, thinking about the sustainability challenge has changed to recognise that life on planet Earth is not limitless. He has been at the forefront of influential concepts such as ecological footprint, resilience and Earth stewardship. In addition, he has brought science and policy together to ensure mutual knowledge sharing and understanding."

The jury noted that "early in his career, Carl Folke realised that environmental problems cannot be solved by considering humans as external factors affecting ecosystems, as was common at the time. People are part of the ecosystems which they are changing. By linking the concept of resilience to these so-called social-ecological systems, Folke made the case that the world can only be improved by starting with ourselves. He explored how this resilience can be increased by bridging the gap between science and policy, for example by seeking sustainable solutions with various governments and companies".

Carl Folke was also awarded the 2021 Prince Albert I Grand Medal for Science by the L'Institut Océanographique of Monaco. The medal, which rewards highly qualified researchers in the field of oceanography, for their entire career, specific work or an exceptional discovery, was presented to him by Prince Albert II at an awards ceremony at the House of the Oceans in Paris on 22 November. In their justification, the jury stated: "Since the mid-1980s, Carl Folke has been at the forefront of understanding the dynamic interaction between man and nature, economics and ecology, and has developed research on social-ecological systems and reflection on the resilience of ecosystem services in the seas and on land

Congratulation also to Malin Jonell, who won the 2022 Östersjöakuten award for her research contributions to the Baltic Sea. The jury of the Östersjöakuten award commended Jonell's novel of Stockholm. Both were active in the work of the approaches to combine ecology, economics and Beijer Institute and AnnMari, together with Beijer nature resource management.

ratory, a marine research station on an island south station's 60-year jubilee in mid-June.



Recipient of the 2022 Östersjöakuten award Malin Jonell with fellow recipient Johan Eklöf (Stockholm honours his pioneering role in applying a transdis- University) and HRH Crown Princess Victoria of Sweden at Askö research station. Photo: Lisa Bergqvist



Institute founder Karl-Göran Mäler, organised one This year, the prize commemorated Professors of the first meetings to bring ecologists and eco-AnnMari Jansson and Bengt-Owe Jansson, who nomics together. The award was presented by were two of the pioneer scientists at the Askö labo- HRH Crown Princess Victoria during the research

# **Beijer Fellow Prizes, honours** and awards

#### Gretchen C. Daily

On 15 October 2021, the British Ecological Society (BES) gave Gretchen Daily honorary membership, the highest honour given by the BES, in recognition of her exceptional contributions at international level to the generation, communication and promotion of ecological knowledge and solutions. Currently, 44 scientists hold a BES honorary membership, including Beijer Fellows Paul Ehrlich and Jane Lubchenco.

#### Partha Dasgupta

On 2 September 2021, the Royal Botanic Gardens Kew awarded Sir Partha Dasgupta the 14<sup>th</sup> Kew International Medal, for his passion and commitment to protecting nature and stopping biodiversity loss, for the long-term benefit of people and the planet. He was chosen to receive the prestigious medal following the publication of his ground-breaking report The Economics of Biodiversity: The Dasgupta Review, published earlier in the year.

#### Simon A. Levin

On 16 June 2022, the 14<sup>th</sup> BBVA Foundation Frontiers of Knowledge Award in Ecology and Conservation Biology went to Simon Levin , together with fellow ecologists Lenore Fahrig and Steward Pickett, for incorporating the spatial dimension into ecosystem research, in the sense of landscape and ett have never worked together, but all three have unlimited period. made essential contributions, both theoretical and practical, in the field of spatial ecology. Levin led its mathematical development, building it into models for the analysis of complex ecosystems. The BBVA Foundation "expresses the corporate social responsibility of the BBVA (Banking) Group, in particular its commitment to the advancement of the societies where it conducts its business activity."

Simon Levin was recently elected a member of Academia Europea, which was founded in 1988 on the initiative of the UK's Royal Society. It is the only academy with individual members from the Council of Europe states and from other nations across the world

#### Johan Rockström

KTH Royal Institute of Technology in Sweden awarded Johan Rockström the KTH Great Prize (Stora Priset) for 2021. This prize is awarded annually to a Swedish citizen for contributions to the country through science, the arts or other innovative work. In its citation, the university credited Rockström with "instilling hope and urging action" on the climate.

Johan Rockström was also awarded Swedish foundation Natur & Kultur's (Nature and Culture) popular scientific prize for 2021, "for his strong voice on the climate issue, which contains deep insights from many research areas and an understanding of the role of politics and business. It also gives the issues a place in a larger story about life on earth."

#### Thomas Sterner

In 2021, Thomas Sterner was elected honorary member of the French Association of Environmental and Resource Economists. The status of honor-



Sir Partha Dasgupta receiving the 14th Kew International Medal, 2 September 2021. Photo: © Royal Botanic Gardens, Kew

ary member of the Association may be awarded to any person renowned for his/her contribution to promoting, valuing and advancing research and exits multiple scales, and bringing it to bear in the pertise works in environmental economics. Honormanagement of "coupled human-natural systems," ary members are elected by the General Assembly, in the words of the citation. Fahrig, Levin and Pick- upon proposition of the Steering Committee, for an

# **Beijer Fellows**

J. Marty Anderies Professor, Arizona State University, USA

Scott Barrett Professor, Columbia University, USA

Fikret Berkes Professor, University of Manitoba, Canada

William "Buz" Brock Professor Emeritus, University of Wisconsin, Madison, USA

Stephen R. Carpenter Professor Emeritus, University of Wisconsin,

Madison USA

USA

Stuart "Terry" Chapin III Professor Emeritus, University of Alaska Fairbanks,

Kanchan Chopra Professor Emerita, University of Delhi, India

Gretchen C. Daily Professor, Stanford University, USA

Partha Dasgupta Professor Emeritus, University of Cambridge, UK

Paul R. Ehrlich Professor Emeritus, Stanford University, USA

Sander van der Leeuw Professor, Arizona State University, USA

Lance Gunderson Professor, Emory University, USA

Michael Hoel Professor Emeritus, University of Oslo, Norway

#### Terry Hughes

Professor, ARC Centre of Excellence for Coral Reef Studies, James Cook University, Australia

Eric Lambin

Professor, Stanford University, USA and Université Catholique de Louvain, Belgium

Simon A Levin Professor, Princeton University, USA

Jane Lubchenco Professor, Oregon State University, USA

Karine Nyborg Professor, University of Oslo, Norway

Rosamond L. Naylor Professor, Stanford University, USA

Stephen Polasky Professor, University of Minnesota, USA

Johan Rockström Professor, Potsdam Institute for Climate Impact Research (PIK) and Potsdam University, Germany

Thomas Rosswall Professor Emeritus. Member of the Roval Swedish Academy of Sciences

Marten Scheffer Professor, Wageningen University & Research, the Netherlands

Jason Shogren Professor, University of Wyoming, USA

David A. Starrett Professor Emeritus, Stanford University, USA

Will Steffen Professor Emeritus, The Australian National University Australia

Thomas Sterner Professor, University of Gothenburg, Sweden

M. Scott Taylor Professor, University of Calgary, Canada

Jeffrev Vincent Professor, Duke University, USA

# Brian Walker

PhD, Honorary Post-Retirement Fellow, CSIRO, Australia

# Professor Emerita, University of Waterloo, Canada

Frances Westley

#### James Wilen

Professor Emeritus, University of California, Davis, USA

#### Anastasios Xepapadeas

Professor, Athens University of Economics and Business Greece

#### Aart de Zeeuw

Professor Emeritus, Tilburg University, the Netherlands

# Administration

# Office location

The Beijer Institute is located in a 1970's wing of the early 20<sup>th</sup> century building of the Royal Swedish Academy of Sciences at Frescati, a science and university area about 2 km north of Stockholm City. The area is situated in one of Stockholm's green belts, Ekoparken, which also includes some inlets of the Baltic Sea. Ekoparken has been declared a Royal National City Park by the Swedish parliament. The Institute's visiting address is Lilla Frescativägen 4A, Stockholm.

# Organisation

The Institute's administration is partly carried out by, or coordinated with, the Royal Swedish Academy of Sciences, for example accounting and maintenance of premises and computers. Other administrative procedures are handled independently by and management of social-ecological systems of urban systems, urban planning, design. the Beijer Institute.



# Funding

Core funding for the Beijer Institute is provided by the Kiell and Märta Beijer Foundation, founded in 1974 through a donation from Kjell and Märta Beijer. The Foundation's purpose is to support research and education, as well as supporting culture, especially design and interior decoration, and also music and literature. The Beijer Institute is its single largest beneficiary, but the Kjell and Märta Beijer Foundation also makes large donations to research in genetic science, neuroscience and pharmaceutical research at Uppsala University and to dairy cattle research at the Swedish University of study analysis and formal mathematical modelling Agricultural Sciences.

his wife Märta when she was working in the furni- or enhance resilience and robustness in socialture and design store Svenskt Tenn in Stockholm, which is renowned for classical designs and high quality. This store was later bought by the Kjell and Märta Beijer Foundation and the profits go to the Foundation

Funding for the Beijer Institute's research activities between 1 July 2021 and 30 June 2022 was also provided by:

- Mistra
- Norweigan Research Council
- Swedish Environmental Protection Agency
- Swedish Research Council • The Crafoord Foundation
- The Swedish research council for sustainable
- development, FORMAS Western Indian Ocean Marine Science Association, WIOMSA

# Teaching and training

In addition to the Master's courses organised by the Beijer Institute described below, a number of institute researchers give lectures within courses run by other institutions (see under staff member's individual activities).

# Governance and management of social-ecological systems: Economic perspectives and Theories and methods for governance of the commons

Beijer Institute researchers organise and teach, together with researchers from Stockholm Resilience Centre, two modules in the course Governance management, resilience science, social-ecological the Master's programme 'Social-Ecological Resilience for Sustainable Development' at Stockholm Resilience Centre, Stockholm University. The objective of the module Economic perspectives is to help students understand a broad spectrum of economic perspectives relevant to the governance and management of social-ecological systems. In the module Theories and methods for governance of the commons, students are introduced to different theoretical and applied approaches to understand and study the commons in the context of social-ecological systems, with a particular emphasis on the role of institutions and individual and collective behaviour.

# Staff members' publications and activities



J. Marty Anderies Professor, Behaviour, Economics and Environment (BEN), Programme Director and Senior Research Fellow

# Research focus

Robust management and robust institutional design for coupled social-ecological systems. This includes studies on a range of archaeological, historical, and present-day examples of social-ecological systems using multiple methods, including human subject experiments, qualitative caseto analyse how ecological, behavioural, social, and

Kjell Beijer was a Swedish businessman who met institutional factors generate vulnerability and/ ecological systems.

# Publications (related to Beijer Institute work) Journal articles

- Chapin, F.S., E.U. Weber, E.M. Bennett, R. Biggs, J. van den Bergh, W.N. Adger, A.-S. Crépin, S. Polasky, C. Folke, M. Scheffer, K. Segerson, J.M. Anderies, S. Barrett, J.-C. Cardenas, S.R. Carpenter, J. Fischer, N. Kautsky, S.A. Levin, J.F. Shogren, B. Walker, J. Wilen, and A. de Zeeuw. 2022. Earth stewardship: Shaping a sustainable future through interacting policy and norm shifts. Ambio 51(9):1907-1920.
- Levin, S.A., J.M. Anderies, N. Adger, S. Barrett, E.M. Bennett, J.C. Cardenas, S.R. Carpenter, A.-S. Crépin, P. Ehrlich, J. Fischer, C. Folke, N. Kautsky, C. Kling, K. Nyborg, S. Polasky, M. Scheffer, K. Segerson, J. Shogren, J. van den Bergh, B. Walker, E.U. Weber, and J. Wilen. 2021. Governance in the face of extreme events: Lessons from evolutionary processes for structuring interventions, and the need to go beyond. Ecosystems 25(3):697-711.



Johan Colding Professor, Urban Social-ecological Systems Programme Director and Senior Research Fellow

# Research focus

Urban ecology, institutions, natural resource

# Publications

# Journal articles

- Andersson, E., N.B. Grimm, J.A. Lewis, C.L. Redman, S. Barthel, J. Colding, and T. Elmqvist. 2022. Urban climate resilience through hybrid infrastructure Current Opinion in Environmental Sustainability 55.101158
- Barthel, S., J. Colding, A.-S. Hiswåls, P. Thalén, and P. Turunen. 2021. Urban green commons for socially sustainable cities and communities. Nordic Social Work Research 12(2):310-322.
- Brandt, S.A., N.J. Lim, J. Colding, and S. Barthel. 2021. Mapping flood risk uncertainty zones in support of urban resilience planning. Urban Planning 6(3):258-271.
- Colding, J., S. Barthel, R. Ljung, F. Eriksson, and S. Sjöberg. 2021. Urban commons and collective action to address climate change. Social Inclusion 10(1)
- Colding, J., K. Samuelsson, L. Marcus, Å. Gren, A. Legeby, M. Berghauser Pont, and S. Barthel. 2022. Frontiers in social-ecological urbanism. Land 11(6):929
- Hsu, A., K. Logan, M. Qadir, M.J. Booysen, A.M. Montero, K. Tong, G. Broadbent, T. Wiedmann, V. K. Sin Woon, C. Good, J. Colding, G. Foliente, and Ş. Kılkış. Opportunities and barriers to net-zero cities. One Earth. In press

# Conferences, workshop and presentations

- Yearly Academic Research Conference, University of Gävle (online), August 2021. Participant.
- Sustainability Science Research Retreat 2021, University of Gävle, September 2021. Presentation: The drama of research.
- Fairtrans kick-off meeting, The Royal Swedish Agricultural Academy (KSLA), Stockholm, September 2021. Participant.
- Incubators for Urban Commons, workshop (online), University of Gävle, November 2021. Organiser.
- Urban Commons workshop, University of Gävle (online), November 2021. Organiser.
- Urban Commons for Socially Sustainable Urban Development, Gävle Concert Hall, Organised by SFO Sustainable Urban Development and WP4 Fairtrans, University of Gäyle, December 2021. Organiser and presentation: The Urban Commons research programme.
- Fairtrans workshop on Carbon Budget and Economic Investments, Stockholm Resilience Centre, March 2022. Participant.
- Installationsföreläsning för nyblivna professorer (Installation lecture for new professors), Akademiska Högtidsdagen, University of Gävle, April 2022. Presentation: Hur jag blev forskare och forskningens dramaturgi (How I became a researcher and the dramaturgy of research).
- 'Andrum i Staden' (Breathing spaces in the city), Gävle Concert Hall, University of Gävle.; May 2022; Participant and presentation: The Urban Commons research programme.

# Teaching and training

- Main supervisor of PhD student Caroline Nilsson (University of Gävle).
- Main supervisor of Master's student Sandra Melander (University of Gävle)
- Supervisor at undergraduate level for Ammie Hellberg & Mårten Ferm (University of Gävle).
- Lecturer at undergraduate level, Environmental Technology/Environmental Strategy, University of Gävle, October 2021.
- Lecturer at graduate level, Fördjupad Miljöpsykologi (Advanced environmental psychology) University of Gävle, October 2021.
- Lecturer, Undergraduate level, Environmental Technology/Environmental Strategy, University of Gävle, October 2021.
- Lecturer at graduate level, Chalmers University of Technology, Department of Architecture and Civil Engineering, October 2021.
- · Lecturer at graduate level: Psychological perspectives on sustainable urban development, University of Gävle, December 2021.
- Chair at PhD thesis defence by Karl Samuelsson, University of Gävle, December 2021.
- · Lecturer at Master's level course in Sustainability Science, University of Gävle, December 2021.
- · Lecturer in Master's level course in Sustainability Science, University of Gäyle, January 2022.

- Lecturer at graduate level, Chalmers University Civil Engineering, February 2022.
- Lecturer in Master's level course in Sustainability Science, University of Gävle, February 2022.
- Course examiner for Master's level course in Sustainability Science, University of Gävle, 2021-2022
- · Course leader and examiner at PhD level, Re-Gävle, 2021-2022.

# Commissions

- Foundation (STERF).
- University of Gäyle • Steering board member and Node leader, Swedish Knowledge Foundation's Research School

of Gävle.

- Other cial-Ecological Urbanism".



# **Research focus**

Modelling social-ecological systems, regime shifts and economics, decisions under uncertainty, global dynamics and resilience, complex system approach on the Arctic Ocean, behavioural responses to regime shifts.

# **Publications** Journal articles

- J. van den Bergh, W.N. Adger, A.-S. Crépin, S. Polasky, C. Folke, M. Scheffer, K. Segerson, J.M. Anderies, S. Barrett, J.-C. Cardenas, S.R. Carpenter, J. Fischer, N. Kautsky, S.A. Levin, J.F. Shogren, B. Walker, J. Wilen, and A. de Zeeuw. 2022. Earth stewardship: Shaping a sustainable future through interacting policy and Norm Shifts. Ambio 51(9):1907-1920
- E.M. Bennett, J.C. Cardenas, S.R. Carpenter, A.-S. C. Kling, K. Nyborg, S. Polasky, M. Scheffer, K. er, E. U. Weber, and J. Wilen. 2021. Governance in the face of extreme events: Lessons from tions, and the need to go beyond. *Ecosystems* 25(3).697-711
- Sumaila, U.R., D.J. Skerritt, A. Schuhbauer, S.

of Technology, Department of Architecture and

search School, Future Proof Cities, University of

• Member, Scandinavian Turfgrass Research

• Co-Director, SFO-program Urban Commons,

"Företagsforskarskolan Future-Proof Cities".

Course evaluation board member, University

• Member of the research consortium "So-

• Member of the working group "Smarta hållbara städer och samhällen" (Smart sustainable cities and societies), Region Gävleborg, Sweden.

> Anne-Sophie Crépin Associate Professor,

Deputy Director

• Chapin, F.S., E.U. Weber, E.M. Bennett, R. Biggs,

• Levin, S.A., J.M. Anderies, N. Adger, S. Barrett, Crépin, P. Ehrlich, J. Fischer, C. Folke, N. Kautsky, Segerson, J. Shogren, J. van den Bergh, B. Walkevolutionary processes for structuring interven-

Villasante, A.M. Cisneros-Montemayor, H. Sinan,

D. Burnside et al. 2021. WTO must ban harmful fisheries subsidies. Science 37(6567):544-544.

# Reports

- Collste, D., P. Henriksson, S. Akbik, A.-S. Crépin, C. Folke, L. Lerpold, E. Lindkvist, P. Malmer, G. Ordenes, J. Rocha, C. Schill, and M. Schultz. 2022. The co-evolving nature of inequality. In: Galaz, V. and D. Collste (eds.). Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and the Stockholm Resilience Centre (Stockholm University), Chapter 3.
- Galaz, V., D. Collste, A.-S. Crépin, B. Crona, G. Daily, C. Folke, T. Lindahl, P. Olsson, M. Ruckelshaus, C. Schill, L. Hård af Segerstad, and T. McPhearson. 2022. From systemic risks to system opportunities. In: Galaz, V. and D. Collste (eds.) Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University), Chapter 7.
- Galaz, V., Crépin, A.-S., Fichtner, J., Hallerby, R., Jonsson, M., Kedward, K., Nessen, M., Ryan-Collins, J., Ölcer, D., Österblom, H. 2022. The Power of giants. In: Galaz V. and Collste, D. (eds). Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University). Chapter 5.
- Lindahl, T., C. Schill, D. Collste, A.-S. Crépin, C. Folke, and V. Galaz. 2022. Foundations for behavioral change. In: Galaz, V. and D. Collste (eds.) Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and the Stockholm Resilience Centre (Stockholm University), Chapter 6.

# Conferences, workshops and presentations

- Wilhelm and Else Heraeus Seminar, Paulinenhof Bad Belzig Germany, 15-18 August 2021. Invited speaker: Interacting tipping elements in the natural and social components of the Earth System.
- Workshop, 'How to connect the complexities of local implementation with outcomes in terms of global sustainability goals', Askö (online), Sweden, 10-13 September 2021. Participant.
- · Symposium on Population and Environmental Change, The Royal Swedish Academy of Sciences (online), Sweden, 23-24 September, 2021 Organiser
- IPBES 5<sup>th</sup> conference on Biodiversity and Human Wellbeing organised by the Swedish Environmental Protection Agency (online). 20 October, 2021. Invited plenary speaker.
- · Seminar: Cascading regime shifts in pollution recipients and resource systems, Frisch Center, Oslo, Norway, 10 November, 2021. Invited speaker.

- RIFO Seminar at the Swedish Parliament, Är vi förberedda på framtidens klimat? (Are we prepared for future climate?), 20 April, 2022, Co-organiser and moderator.
- Formas, Stockholm Sweden, 4 May 2022, Presentation: Decision making under great uncertainty.
- Inequality and the Biosphere project consortium meeting, Beijer Young Scholars II, Lidö and Royal Swedish Academy of Sciences, 20-25 May 2022. Resource person.
- Beijer Young Scholars Workshop, Royal Swedish Academy of Sciences Stockholm, Sweden, 10 June 2022, Resource person.
- Ulvön Conference on Environmental Economics, 21-21 June, 2022, Ulvön Sweden. Invited plenary speaker.

# Teaching and training

- Main supervisor of Master's student Alicia Björnsdotter (Stockholm Resilience Centre, Stockholm University).
- Lecturer and examiner for Master's level course in Governance and management of social-ecological systems: Challenges of environmental decision-making, Stockholm Resilience Centre, Stockholm University, spring 2021.

# Commissions

- Member of advisory board, Global Challenges Initiative, Stockholm School of Economics, Stockholm Sweden since 2016
- Co-opted member, Committee for Environment, Climate and Energy of the Royal Swedish Academv of Sciences, since 2016.
- Member, National Committee for Global Environmental Change, since 2018.
- Member Environmental Research Council of the Swedish Environmental Protection Agency (Miljöforskningsrådet för Naturvårdsverket), Stockholm, Sweden, since 2018.
- Editor, Ecological Economics, since 2019.
- Member, Council for evidence-based environmental analysis, FORMAS, since 2020.

Stefan Daume

PhD. Researcher



# Research focus

Connections between digital technologies and sustainability, promises and risks of AI and social media for public engagement with environmental challenges.

# Publications

# Book chapter

• Rocha, J.C. and S. Daume. 2021. Data mining and pattern recognition. In: Biggs, R., De Vos, A., Preiser, R., Clements, H., Maciejewski, K. and Schlüter, M. (eds.) The Routledge Handbook of Research Methods for Social-Ecological Systems. First edition. Routledge, London, pp. 241-251.

# Conferences, workshops and presentations

- Workshop on Intelligent Machines, Emotions and Our Planet, 14 January 2022 (online). Presentation: Fires, Bots and Climate Change.
- Sustainability Frontiers Conference (online), 14-15 February 2022. Keynote speech: Digitalisation, Disruptive Technologies and AI for Sustainability Science.
- ERSI (Earth Resilience and Sustainability Initiative) seminar series. Earth Resilience and Sustainability Initiative. 1 June 2022 (online). Presentation: Burning forests, bots and climate change attitudes: a study of the global diffusion dynamics of mis- and disinformation about prominent forest fires.

# Teaching and training

- Co-supervisor of Master's student Petter Biersér. (Stockholm Resilience Centre, Stockholm University)
- Co-organiser of PhD level course in R programming, Stockholm Resilience Centre, Stockholm University, from 2022.



# **Research focus**

Economic aspects of global environmental change, economics of climate, energy supply, tipping points in the climate system urban economics interaction of economy and environment.

# Teaching and training

- Co-supervisor of Master's student Petter Bjersér (Stockholm Resilience Centre, Stockholm University).
- Co-supervisor of Master's student Anne-Sophie Dietrich (Stockholm Resilience Centre, Stockholm University).

# Other

• Parental leave 1 January-30 April 2022



# **Research focus**

Social-ecological systems, resilience, ecological economics, transformations, biosphere stewardship, sustainability science, Anthropocene biosphere.

# Publications

- Journal articles
- · Chapin, F.S., E.U. Weber, E.M. Bennett, R. Biggs, J. van den Bergh, W.N. Adger, A.-S. Crépin, S. Polasky, C. Folke, M. Scheffer, K. Segerson, J.M. Anderies, S. Barrett, J.-C. Cardenas, S. R. Carpenter, J. Fischer, N. Kautsky, S.A. Levin, J.F.

Shogren, B. Walker, J. Wilen, and A. de Zeeuw. 2022. Earth stewardship: Shaping a sustainable future through interacting policy and Norm Shifts. Ambio 51(9):1907-1920

- Folke, C., S. Carpenter, T. Elmqvist, L. Gunderson, and B. Walker. 2021. Resilience: Now more than ever Ambio 50(10):1774-1777
- Folke, C., Å. Gren, J. Larsson, and R. Costanza. 2021. Cities and the Biosphere. Ambio 50(9).1634-1635
- Folke, C., L.J. Haider, S.J. Lade, A.V. Norström, and J. Rocha. 2021. Commentary: Resilience and social-ecological systems: A handful of frontiers. Global Environmental Change 71:102400.
- Folke, C. and N. Kautsky. 2021. Aquaculture and ocean stewardship. Ambio 51(1):13-16.
- Galaz, V., M.A. Centeno, P.W. Callahan, A. Causevic, T. Patterson, I. Brass et al. (2021). Artificial intelligence, systemic risks, and sustainability. Technology in Society, 67, 101741.
- Levin, S.A., J.M. Anderies, N. Adger, S. Barrett, E.M. Bennett, J.C. Cardenas, S.R. Carpenter, A.-S. Crépin, P. Ehrlich, J. Fischer, C. Folke, N. Kautsky, C. Kling, K. Nyborg, S. Polasky, M. Scheffer, K. Segerson, J. Shogren, J. van den Bergh, B. Walker, E.U. Weber, and J. Wilen. 2021. Governance in the face of extreme events: Lessons from evolutionary processes for structuring interventions, and the need to go beyond. *Ecosystems* 25(3):697-711.
- Liu, J., T. Dietz, S.R. Carpenter, W.W. Taylor, M. Alberti, P. Deadman, C. Redman, A. Pell, C. Folke, Z. Ouyang, and J. Lubchenco. 2021. Coupled human and natural systems: The evolution and applications of an integrated framework. Ambio 50(10):1778-1783
- Österblom, H., C. Folke, J. Rocha, J. Bebbington, R. Blasiak, J.-B. Jouffray, E.R. Selig, C.C. Wabnitz, F. Benatsson, B. Crona, R. Gupta, P.J. Henriksson, K.A. Johansson, A. Merrie, S. Nakayama, G.O. Crespo, J. Rockström, L. Schultz, M. Sobkowiak, P.S. Jørgensen, J. Spiikers, M. Troell, P. Villarrubia-Gómez, and J. Lubchenco. 2022. Scientific mobilization of keystone actors for biosphere stewardship. Scientific Reports 12(1).
- Rockström, J., T. Beringer, D. Hole, B. Griscom, M.B. Mascia, C. Folke, and F. Creutzig. 2021. We need biosphere stewardship that protects carbon sinks and builds resilience. Proceedings of the National Academy of Sciences 118(38).

# Book chapters

- Biggs, R., H. Clements, A. de Vos, C. Folke, A. Manyani, K. Maciejewski, B. Martín-López, R. Preiser, O. Selomane, and M. Schlüter. 2021. What are social-ecological systems and social-ecological systems research? In: Biggs, R., A. De Vos, R. Preiser, H. Clements, K. Maciejewski, and M. Schlüter (eds.) The Routledge Handbook of Research Methods for Social-Ecological Systems. First edition. Routledge, London, pp. 3-26.
- Chapin III, F.S., R. Biggs, N. Sitas, C. Folke, and G.P. Kofinas. 2022. Cross-scale social-ecological stewardship for navigating toward more sustainable and just futures. In: Gunderson. L.H., C.R. Allen, and A. Garmestani (eds.) Applied Panarchy: Applications and Diffusion across

Disciplines. Island Press, Washington DC, USA, pp. 275-288.

- Folke, C. 2021. Förord. In: Schultz, L. and E. Treijs. Kursen – Tio lektioner för ett hållbart näringsliv. Natur & Kultur, Stockholm, Sweden, pp. 5-7.
- Olsson, P., C. Folke, and M.-L. Moore. 2022. Capacities for navigating large-scale sustainability transformations: Exploring the revolt and remembrance mechanisms for shaping collapse and renewal in social-ecological systems. In: Gunderson L H C R Allen and A Garmestani (eds.) Applied Panarchy: Applications and Diffusion across Disciplines. Island Press, Washington DC, USA, pp. 155-180.

# Reports

- · Collste, D., P. Henriksson, S. Akbik, A.-S. Crépin, C. Folke, L. Lerpold, F. Lindkvist, P. Malmer, G. Ordenes, J. Rocha, C. Schill, and M. Schultz. 2022. The co-evolving nature of inequality. In: Galaz, V. and D. Collste (eds.). Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University), Chapter 3.
- Galaz, V., D. Collste, A.-S. Crépin, B. Crona, G. Daily, C. Folke, T. Lindahl, P. Olsson, M. Ruckelshaus, C. Schill, L. Hård af Segerstad, and T. McPhearson. 2022. From systemic risks to system opportunities. In: Galaz, V. and D. Collste (eds.) Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University), Chapter 7.
- Galaz, V., G. Daily, C. Folke, S. Levin, M. Ruckelshaus, W. Steffen, and P. Søgaard Jørgensen. 2022. A new planetary reality. In: Galaz, V. and D. Collste (eds.) Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University), Chapter 1.
- Lindahl, T., C. Schill, D. Collste, A.-S. Crépin, C. Folke, and V. Galaz. 2022. Foundations for behavioral change. In: Galaz, V. and D. Collste (eds.). Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University), Chapter 6.

# Conferences, workshops and presentations

- Book launch for the book Kursen (The Course) Natur och Kultur, Stockholm, Sept 2021. Dialoque participant.
- Mastercard leadership event, Grand Hotel, Stockholm, September 2021. Presentation.
- Ambio 50 years conference, Royal Swedish Academy of Sciences, September 2021, Keynote speech: Our future in the Anthropocene biosphere: The development and current status of a research field.

- Askö meeting workshop, How to connect the complexities of local implementation with outcomes in terms of global sustainability goals? (online), September 2021. Organiser and participant.
- · Beijer Foundation Day, Swedish Livestock Research Centre, Swedish University of Agricultural Sciences, Lövsta Uppland, September 2021.
- Ocean 100 dialogues, online, September 2021. Presentation: Corporate biosphere stewardship for a prosperous future.
- SeaBOS CEO annual meeting (online), October 2021. Presentation: Climate resilience
- Round table celebrating 50 years of independence for Bangladesh (online) Oct 2021. Presentation: Positioning Bangladesh on the Global Map.
- NatCap Olympics (online), Natural Capital Project, October 2021. Plenary presentation.
- (online) Oct 2021. • The Schörling Foundation, Stockholm, Nov 2021.
- The Great Medal Albert I 2021 award ceremony, Oceanographic Institute of Monaco, House of the Oceans Paris Nov 2021
- Academy Lecture, Royal Swedish Academy of Sciences, November 2021. Lecture: Our future on a human-dominated planet.

Presentation

- Fostering Water Resilience in the Anthropo-Centre, February 2022.
  - Earth Resilience workshop, PIK, Potsdam (online), March 2022,
  - Executive course alumni gathering, Stockholm Resilience Centre, April 2022.
  - SEB External Sustainability Advisory Board, May 2022, Presentation: Corporate biosphere stewardship for a prosperous future.
  - SeaBOS 5<sup>th</sup> working meeting, Skeppsholmen, Stockholm, May 2022. Presentation: Why stewardship, why SeaBOS?
  - SeaBOS Science meeting, Åkeshofs Slott, Bromma, May 2022.
  - Guided by Science, Sustainability Champions on How to Tackle the Planetary Crises, a collaboration of the Volvo Environment Prize, Tyler Prize, Blue Planet Prize and the Heinz Awards. Stockholm May 2022 Host
  - Meeting of the International Scientific Advisory Council (ISAC) (online), Stockholm Resilience Centre May 2022
  - (BEN), Beijer Institute, (online), May 2022.
    - The Ocean Seminar, Beijer Institute and Stockholm Resilience Centre at Royal Swedish Academy of Sciences, May 2022. Co-organiser.
  - Stockholm +50, launch of the report Economy and Finance for a Just Future on a Thriving Planet, Royal Swedish Academy of Sciences, 1 June 2022. Co-organiser.

- Meeting of the International Scientific Advisory Council (ISAC), Stockholm Resilience Centre
- cene, workshop, (online), Stockholm Resilience

• Workshop on Behaviour, Economics, Nature

- Beijer Young Scholars III meeting, Beijer Institute. June 2022. Presentation: Reflections.
- US-UK Scientific Forum on the Valuation of Biodiversity, Royal Society, London, June 2022. Keynote speech: Interdependence of civilisation and the living world in the Anthropocene.

# Teaching and training

- Lecturer in CEO Executive Programme in Resilience Thinking: Transformative Business Leadership for a Prosperous Planet, Stockholm Resilience Centre, Stockholm University.
- Lecturer for Lindéngruppen leadership, SEB top management of Large Corporates and Financial Institutions, Alder Nordic Investment Fund.
- Lecturer in Master's level course Resilience and Sustainable Development, International Master's Programme in Environmental Studies and Sustainability (LUMES), Lund University.
- Lecturer in Bachelor's, Master's and PhD level courses. Stockholm University.

# Commissions

- Founder Chairman of the Board Stockholm Resilience Centre
- Co-director (with Beatrice Crona), Erling-Persson Family Academy Programmes, New Approaches to the Grand Challenge: Global Finance, Global Health and the Biosphere, The Royal Swedish Academy of Sciences.
- Principal investigator (with Gretchen Daily, Stanford University), Research collaboration programme Fundamental Research in Biosphere-based Sustainability Science, Stockholm University, funded by the Marianne and Marcus Wallenberg Foundation.
- Member, Royal Swedish Academy of Sciences.
- International member, US National Academy of Sciences, Washington.
- Member, Royal Norwegian Society of Sciences and Letters (DKNVS), Trondheim,
- Member, Royal Swedish Academy of Agriculture and Forestry (KSLA).
- Member, High Council of Trustees of the Nobel Foundation (Nobelfullmäktige).
- Member, Monaco Ocean Science Federation.
- Member Earth Resilience and Sustainability Initiative, Princeton, PIK, SRC.
- Fellow, Resilience Alliance.
- Honorary Fellow, South American Institute for Resilience and Sustainability Studies (SARAS), Maldonado, Uruguay.
- · Partnership Committee, Natural Capital Project, Stanford
- Academic Advisory Board, STIAS, Stellenbosch Institute for Advanced Study, South Africa.
- SIGHT Advisory Committee (The Swedish Institute for Global Health Transformation), Royal Swedish Academy of Sciences.
- International Scientific Advisory Board, Helsinki Institute of Sustainability Science, HELSUS, University of Helsinki, Finland.

- Scientific Director, CEO Executive Programme in Resilience Thinking: Transformative Business Leadership for a Prosperous Planet, Stockholm Resilience Centre
- Advisory board, EAT and EAT Forum.
- Steering Committee, SeaBOS.
- Board member, SeaBOS Foundation.
- Senior Advisor, Ecosperity Advisory Group, Temasek, Singapore.
- Core knowledge partner, Taskforce on Nature-related Financial Disclosures (TNFD).
- Member, SEB External Sustainability Advisory Board (SESAB), Stockholm, Sweden,
- · Chair, Scientific committee of the Volvo Environment Prize
- Selection committee, Kenneth Boulding Award, International Society for Ecological Economics.
- Lord-in-Waiting (Kabinettskammarherre), Swedish Royal Court
- Advisory and editorial board member for Ambio, the Anthropocene Review, Anthropocene Science, Ecological Economics, Ecology and Society, Environment and Development Economics, Environmental Innovation and Societal Transitions, Geography and Sustainability, Global Sustainability, One Earth, Proceeding of the National Academy of Sciences USA (PNAS), and Sustainability Science.

# Other

- Recognised as Highly Cited Researcher by Thompson Reuters, 2021.
- Grande Médaille Albert ler, Science, L'Institut Océanographique de Monaco, 2021.
- Organiser (with Henrik Österblom) of a dialogue series on the ocean for HRH Crown Princess Victoria, Haga Castle, Sept, Oct, Nov 2021, March 2022.
- Steering Committee for the US-UK Scientific Forum on the Valuation of Biodiversity, National Academy of Sciences, USA and Royal Society, UK, June 2022.
- Heineken Prize for Environmental Sciences, 2022
- Collaboration with Jacob Mühlrad on music for the biosphere.
- Dialogues with Nina Stritzler-Levine and Svenskt Tenn about science, architecture and interior design



# Victor Galaz Associate professor Governance, Technology and Complexity Programme Director and Senior Research Fellow

# Research focus

Governance, institutions, Earth system governance, complex adaptive systems, networked risks, technological change, financial systems.

# Publications

# Journal articles

- Andersen, A.D., K. Frenken, V. Galaz, F. Kern, L. Klerkx, M. Mouthaan, L. Piscicelli, J.B. Schor, and T. Vaskelainen. 2021. On digitalization and sustainability transitions. Environmental Innovation and Societal Transitions 41:96-98.
- Crona, B., C. Folke, and V. Galaz. 2021. The Anthropocene reality of financial risk. One Earth 4(5):618-628.
- Folke, C., S. Polasky, J. Rockström, V. Galaz, F. Westley, M. Lamont, M. Scheffer, H. Österblom, S.R. Carpenter, F.S. Chapin, K.C. Seto, E.U. Weber, B.I. Crona, G.C. Daily, P. Dasgupta, O. Gaffney, L.J. Gordon, H. Hoff, S.A. Levin, J. Lubchenco, W. Steffen, and B.H. Walker. 2021. Our future in the Anthropocene biosphere. Ambio 50(4):834-869.
- Galaz, V. 2022. Global environmental governance in times of turbulence. One Earth 5(6):582-585
- Galaz, V., M.A. Centeno, P.W. Callahan, A. Causevic, T. Patterson, I. Brass et al. 2021. Artificial intelligence, systemic risks, and sustainability. Technology in Society 67: 101741.

# Working papers

- Galaz. V., J. Rocha, P.A. Sanchez García, T. Roukny, P. Søgaard Jørgensen, A. Dauriach and A. Golland. 2022. Beijer Discussion Paper 277: Financial dimensions of global zoonotic disease risks. Beijer Discussion Paper Series.
- Golland, A., V. Galaz, G. Engstrom, and J. Fichtner. 2022. Proxy voting for the earth system: Institutional shareholder governance of global tipping elements. SSRN Electronic Journal.
- Sanchez-García. P.A., V. Galaz, J. Rocha. 2022. Beijer Discussion Paper 278: Finance, climate and ecosystems: A literature review of domino-effects between the financial system, climate change and the biosphere. Beijer Discussion Paper Series.

# Reports

• Galaz, V. and Collste, D., 2022. Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University).

# Conferences, workshops and presentations (selection)

- Intelligent Machines, Emotions, and Our Planet (online), 13-14 January 2022. Organiser and speaker
- Co-opting Al: Climate, New York University (online), 9 March, 2022. Invited speaker.
- Economy and Finance for a Just Future on a Thriving Planet. Launch at the Royal Swedish Academy of Sciences, 1 June 2022. Organiser and speaker.
- Economy and Finance for a Just Future on a Thriving Planet. Official side-event at Stockholm+50, 2 June 2022. Organiser, moderator and speaker.

# Commissions

- · Member, Governing Board, Swedish International Development Cooperation Agency (Sida), Stockholm, Sweden, since 2021.
- Co-Editor-in-Chief, Current Opinion in Environmental Sustainability (COSUST), Elsevier, since 2021.
- Member, ISC-UNDRR Expert Review Group (ERG), United Nations Office for Disaster Risk Reduction, 2021.

# Other

- Galaz, V. 2022. Stockholm+50: Sweden hosts major UN environment conference, yet is losing its own green credentials, The Conversation, Published May 31, 2022.
- Two interviews in Swedish Finance newspaper Dagens Industri
- · Seven essayes in Swedish daily newspaper Svenska Dagbladet



# **Research focus**

Economics of natural resource use, global environmental problems

# Conferences, workshops and presentations

• Biodiversity and Finance – Why and What. Swesif webinar. September 16, 2021. Participant and presentation: Biodiversity and the global economy, based on analysis tool WALRAS.

# Teaching and training

- Co-supervisor of Master's student Anne Dietrich (Stockholm Resilience Centre, Stockholm University).
- Lecturer and module leader. Master's level course Governance and Management of Social-Ecological Systems: Economic Perspectives, Stockholm Resilience Centre, Stockholm University, spring 2021

# Commissions

• Journal Reviewer for Environmental and Resource Economics, Ecological Economics, Nature Food.

# Other

• Opinion piece: "Putin tiänar miliarder på EU:s sänkta bränsleskatter" (Translated title: "Putin makes billions from lowered fuel taxes in the EU"), DN 22/4-2022. Authors: Johan Gars (Beijer Institute of Ecological Economics), Daniel Spiro (Uppsala University) and Henrik Wachtmeister.



# **Research focus**

Sustainable urban planning and design in relation to meeting the UN sustainable development goals.

# **Publications** Journal article

• Rostang, O., A. Gren, A. Feinberg, and M. Berghauser Pont. 2021. Promoting resilient and healthy cities for everyone in an urban planning context by assessing green area accessibility. Frontiers in Built Environment 7:797179.

# Teaching and training

- Co-supervisor of Master's student Steven L.J. Reich (Department of Earth Sciences, Uppsala University).
- Lecturer in Master's level course Sustainable Development and the Design Professions (Chalmers Technological University), autumn 2021.
- Lecturer at Bachelor's level, Environmental Science (Department of Environmental Sciences. Stockholm University), autumn 2021.
- · Lecturer in course Ecosystem Service Management (Department of Physical Geography, Stockholm University), autumn 2021.
- · Lecturer in Master's level course School of Architecture (Royal School of Technology), autumn 2021
- Lecturer in Master's level course Environment and decision making (University of Gävle), spring 2022.

# Commissions

• Member, Editorial board of Sustainability, since 2021.



# Research focus

The interface between environmental governance and social psychology, understanding the role of norms and attitudes for sustainability transformations Currently working on a project within Mistra Food Futures, where she is conducting a qualitative interview-based study on acceptability of policy measures to reduce the environmental impact from food consumption. She is also conducting a literature study on acceptability of policy measures, again focused on food.



# **Research focus**

Aquaculture, seafood, sustainable aquaculture practices, modelling life cycle assessments of food commodities, understanding inequalities role for the biosphere, detailing antimicrobial use in aquaculture.

# **Publications**

Journal articles

- Gephart, J.A., P.J.G. Henriksson, R.W.R. Parker, A. Shepon, K.D. Gorospe, K. Bergman, G. Eshel, C.D. Golden, B.S. Halpern, S. Hornborg, M. Jonell, M. Metian, K. Mifflin, R. Newton, P. Tyedmers, W. Zhang, F. Ziegler, and M. Troell. 2021. Environmental performance of blue foods. Nature 597(7876):360-365.
- Graells, T., I.A. Lambraki, M. Cousins, A. Léger, K. Lillepold, P.J.G. Henriksson, M. Troell, C.A. Carson, E.J. Parmley, S.E. Majowicz, D. Wernli, and P.S. Jørgensen. 2022. Studying factors affecting success of antimicrobial resistance interventions through the lens of experience: A thematic analysis. Antibiotics 11(5):639.
- Henriksson, P.J.G., M. Troell, L.K. Banks, B. Belton, M.C.M. Beveridge, D.H. Klinger, N. Pelletier, M.J. Phillips, and N. Tran. 2021. Interventions for improving the productivity and environmental performance of global aquaculture for future food security. One Earth 4(9):1220-1232.
- Lambraki, I.A., M. Cousins, T. Graells, A. Léger, P. Henriksson, S. Harbarth, M. Troell, D. Wernli, P. Søgaard Jørgensen, A.P. Desbois, C.A. Carson, E.J. Parmley, and S.E. Majowicz. 2022. Factors influencing antimicrobial resistance in the European food system and potential leverage points for intervention: A participatory One Health study. PLOS ONE 17(2):e0263914.
- Österblom, H., C. Folke, J. Rocha, J. Bebbington, R. Blasiak, J.-B. Jouffray, E.R. Selig, C.C.C. Wabnitz, F. Bengtsson, B. Crona, R. Gupta, P.J.G. Henriksson, K.A. Johansson, A. Merrie, S. M. Sobkowiak, P.S. Jørgensen, J. Spijkers, M. Troell, P. Villarrubia-Gómez, and J. Lubchenco. 2022. Scientific mobilization of keystone actors for biosphere stewardship. Scientific Reports 12(1).1-17
- Shepon, A., T. Makov, H.A. Hamilton, D.B. Müller, J.A. Gephart, P.J.G. Henriksson, M. Troell, and C.D. Golden. 2022. Sustainable optimization of stantially narrow the nutrient gap. Resources, Conservation and Recycling 181:106260.
- Troell, M., P.J.G. Henriksson, A.H. Buschmann, T. Chopin, and S. Quahe. Farming the ocean-sea-Fisheries Science and Aquaculture. In press
- Wiloso, E.I., M. Romli, B.A. Nugraha, A.R. Wiloso, A.A.R. Setiawan, and P.J.G. Henriksson. 2022. Life cycle assessment of Indonesian canned crab (Portunus pelagicus). Journal of Industrial Ecology 2030:1-14.

### Patrik J.G. Henriksson PhD. Researche

Nakayama, G.O. Crespo, J. Rockström, L. Schultz,

global aquatic omega-3 supply chain could sub-

weeds as a quick fix for the climate? Reviews in

• Zhang, W., B. Belton, P. Edwards, P.J.G. Henriksson, D.C. Little, R. Newton, and M. Troell. 2022. Aquaculture will continue to depend more on land than sea Nature 603(7900):E2-E4

# Book chapters

• Basset-Mens, C., A. Avadí, C. Bessou, I. Acosta-Alba, Y. Biard, S. Payen, P.J.G. Henriksson, S. Gheewala, J. Aubin, E. I. Wiloso, J. Hanafi, A. Benoist, and T. Tran. 2022. Part 3: Overcoming the challenges for robust agri-food LCA in developing and emerging economies. In: C. Basset-Mens, A. Avadí, C. Bessou, I. Acosta-Alba, Y. Biard, and S. Payen (eds.) Life Cycle Assessment of Agri-Food Systems. An Operational Guide Dedip, p. 213.

# Report

· Collste, D., P. Henriksson, S. Akbik, A.-S. Crépin, C. Folke, L. Lerpold, E. Lindkvist, P. Malmer, G. Ordenes, J. Rocha, C. Schill, and M. Schultz. 2022. The co-evolving nature of inequality. In: Galaz, V. and D. Collste (eds.). Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University), Chapter 3.

# Conferences, workshops and presentations

- HESTIA kick-off meeting, workshop, Oxford University, UK, 7-10 2022. Participant.
- · Inequality and the Biosphere project consortium meeting, Beijer Young Scholars II, Lidö and Royal Swedish Academy of Sciences, May 2022. Co-organiser and participant.

# Teaching and training

• Co-supervisor of PhD student Oskar Nyberg (Marine Ecotoxicology, DEEP, Stockholm University).

# Commissions

- Editor, Sustainability Science
- Expert advisor, WinWin Award



Marie Huss Operations Manager

Co-ordinates the Beijer Institute's operational activities. This includes planning and organising international research meetings and structuring the internal and operational work at the institute, administration of travel and meetings, archiving and responsibility for the administration of an international environmental award.



Emmy Iwarsson MSc, Research Assistant

# Research focus

Research assistant within the Inequality and Biosphere project, assisting in research on inequality-biosphere interactions and in the project coordination.

# Conferences, workshops and presentations

• Inequality and the Biosphere project consortium meeting, Beijer Young Scholars II, Lidö and KVA, May 2022. Co-organiser and participant.



# **Research focus**

Human behaviour, governance, biosphere (Behaviour Economics and Nature programme), inequality and the biosphere (Inequality and the Biosphere project), anticipatory governance, aquatic ecosystems, just sustainability transformations.



#### Research focus

Food systems, sustainable aquatic production and the role of private regulatory mechanisms in transforming food production and consumption.

# Publications

# Journal articles

- Gephart, J.A., P.J.G. Henriksson, R.W.R. Parker, A. Shepon, K.D. Gorospe, K. Bergman, G. Eshel, C.D. Golden, B.S. Halpern, S. Hornborg, M. Jonell, M. Metian, K. Mifflin, R. Newton, P. Tyedmers, W. Zhang, F. Ziegler, and M. Troell. 2021. Environmental performance of blue foods. Nature 597(7876):360-365.
- Luthman, O., M. Jonell, P. Rönnbäck, and M. Troell. 2021. Strong and weak sustainability in Nordic aquaculture policies. Aquaculture 550:737841.
- Macura, B., Y. Ran, U.M. Persson, A. Abu Hatab, M. Jonell, T. Lindahl, and E. Röös. 2022. What evidence exists on the effects of public policy interventions for achieving environmentally sustainable food consumption? A systematic map protocol. Environmental Evidence 11(1):1-9.
- Naylor, R.L., A. Kishore, U. R. Sumaila, I. Issifu, B.P. Hunter, B. Belton, S.R. Bush, L. Cao, S. Gelcich, J.A. Gephart, C.D. Golden, M. Jonell, J.Z. Koehn, D.C. Little, S.H. Thilsted, M. Tigchelaar, and B. Crona. 2021. Blue food demand across geographic and temporal scales. Nature Communications 12(1):1-14.
- Tigchelaar, M., J. Leape, F. Micheli, E. H. Allison, X. Basurto, A. Bennett, S.R. Bush, L. Cao, W.W.L. Cheung, B. Crona, F. DeClerck, J. Fanzo, S. Gelcich, J.A. Gephart, C.D. Golden, B.S. Halpern, C.C. Hicks, M. Jonell, A. Kishore, J.Z. Koehn, D.C. Little, R.L. Naylor, M.J. Phillips, E.R. Selig, R.E. Short, U.R. Sumaila, S.H. Thilsted, M. Troell, and C.C.C. Wabnitz, 2022. The vital roles of blue foods in the global food system. *Global Food* Security 33:100637.

# Reports

- Metson, G.S., W. Brownlie, J. C. Bausch, M. Jonell, K. Matsubae, F. Mnthambala, C. Schill, and E. Tilley. 2022. Consumption: The missing link towards phosphorus security. In: W.J. Brownlie. M.A. Sutton, K.V. Heal, D.S. Reay, B.M. Spears. (eds.) Our Phosphorus Future. UK Centre for Ecology and Hydrology, Edinburgh, Chapter 8.
- Conferences, workshops
- and presentations • Baltic Sea Day, Race for the Baltic and Skansen, seminar, Stockholm, Sweden, 28 August 2021, Invited speaker: Från Tellus till tallriken (From Tellus to the plate).
- Blue eco forum 2021 (online) 22 October 2021, Invited speaker: Blue Food Assessment, Building healthy, equitable and sustainable food systems.
- Conference, Sjømat Norge Årskonferense 2022, Bodø, Norway, 4 April 2022, Keynote speaker: Blue Food Assessment.

# Teaching and training

- Lecturer in Bachelor's level course Sustainability perspectives on contemporary fisheries - where have all the fishes gone?, Swedish University of Agricultural Sciences, autumn 2022.
- Main supervisor of PhD student Abigayil Blandon (Stockholm Resilience Centre, Stockholm University).
- Co-supervisor of Master's student Johanna Gulliksen (Stockholm Resilience Centre, Stockholm University).

# Commissions

• Expert reviewer, World Economic Forum The Blue Food Innovation Challenge, July 2021.

# Other

- Interview: Now This, Could eating more seafood be better for the planet?, (online) 4 October 2021
- Recipient of the Östersjöakuten prize 2022, honouring Professor AnnMari Jansson.

# New funding

• ReSus" Retail for Sustainability - Mid-value chain engagement for food system transformation ' Formas, SEK 7 999 052 for 2022-2025, Project lead: Jonell



Works for both the Beijer Institute of Ecological Economics and the Global Economic Dynamics and the Biosphere Programme (GEDB) at the Royal Swedish Academy of Sciences. Deals with accounting, financial reporting and budgeting, and also provides support and financial information to researchers about their projects and assists them with budgeting and financial reporting. In her role as HR administrator, she prepares staff contracts and assists staff members with different issues.

Due to the research collaboration between the Beijer Institute and Stockholm Resilience Centre, her work tasks also require close cooperation with the administration team at SRC.



# **Research focus**

Environmental and resource economics, dynamic welfare analysis, sustainability, energy economics, resilience studies.

# Publications

# Journal articles

- Löfgren, K.G. and C.Z. Li. 2021. Envelope theorems in economics: Historical development and modern cost-benefit applications. Frontiers of Economics in China 16: 377-404
- Wei, C., Y. Xu, and C.-Z. Li. 2022. Recent advances in China's sustainable transition studies. Letters in Spatial and Resource Sciences.
- Wu, S., C. Li, and C. Wei. 2022. Electricity consumption as a new indicator of inequality. Energy Research & Social Science 90:102677.

# Conferences, workshops and presentations

• The PACE Conference on Resource and Environmental Economics, Hangzhou, China, June 17-19, 2022. Keynote speaker: The economics of tippina points.

# Commissions

- Reviewer for Ecology and Society, China Economic Review, Review of Environmental Economics and Policy.
- Guest editor for China Economic Review, Letters in Spatial and Resource Sciences; Resources, Conservation and Recycling.



# Research focus

Human behaviour in social-ecological systems, influence of ecosystem dynamics on resource users' exploitation and cooperation behaviour and implications for natural resource management, attitudes and perceptions towards the environment and towards environmental policy, methods for changing behaviour.

# **Publications** Journal articles

- Lindahl, T. and R. Jarungrattanapong. Avoiding catastrophic collapse in small-scale fisheries through inefficient cooperation: evidence from a framed field experiment. Environment and Development Economics. In press.
- Lindahl, T. 2022. Limited and unlimited wants

examined. Nature Sustainability 5:641–642.

- Macura, B., Y. Ran, U. M. Persson, A. Abu Hatab, M. Jonell, T. Lindahl, and E. Röös. 2022. What evidence exists on the effects of public policy interventions for achieving environmentally sustainable food consumption? A systematic map protocol. Environmental Evidence 11(1):17.
- Wijermans, N., C. Schill, T. Lindahl, and M. Schlüter. 2022. Combining approaches: Looking behind the scenes of integrating multiple types of evidence from controlled behavioural experiments through agent-based modelling. International Journal of Social Research Methodology 25(4):569-581.

# Reports

• Lindahl, T., C. Schill, D. Collste, A.-S. Crépin, C. Folke, and V. Galaz. 2022. Foundations for behavioral change. In: Galaz, V. and D. Collste (eds.). Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University), Chapter 6.

# Conferences, workshops and presentations

- Vad är ett hållbart livsmedelssystem? (What is a sustainable food system?) (online), Mistra Food Futures, Autumn 2021. Participant and presenter.
- Al. Emotions and the Planet (online). Beijer Institute of Ecological Economics, Royal Swedish Academy of Sciences. January 2022. Session chair.
- Economics seminar series, seminar, Grenoble Applied Economics Lab, University of Grenoble, Grenoble, France, Spring 2022. Invited speaker: What factors influence the choice between fish and meat among grocery shoppers? Insights from a failed nudge intervention.
- Spaceship Earth, workshop, Beijer Institute of Ecological Economics, Royal Swedish Academy of Sciences, Spring 2022. Organiser and chair.
- On the Design of Sustainable Cities: Recycling, Social Norms and Economic Policies. Workshop, Beijer Institute of Ecological Economics, Royal Swedish Academy of Sciences, Spring 2022. Participant and presenter.

#### Teaching and training

- Co-supervisor of PhD student Noah Linder (Environmental Psychology, Department of Building, Energy, and Environmental Engineering University of Gäyle)
- Co-supervisor of PhD student Lina Isacs (Division of Environmental Strategies Research, KTH Royal Institute of Technology).
- Co-supervisor of Bachelor student Sandra Melander (Department of Building, Energy, and Environmental Engineering, University of Gävle).
- Main supervisor of Master's student Johanna Gulliksen (Stockholm Resilience Centre, Stockholm University).

- Lecturer in Bachelor's level course Ekologisk Centre, Stockholm University, autumn 2021.
- Lecturer in Bachelor's level course Environmental management in planning, Department of Physical Geography, Stockholm University, autumn 2021.
- Lecturer in Bachelor's level course Världens eko (World's eco). Stockholm University, autumn 2021
  - sity, spring 2022.
- Lecturer in Master's level course Governance and management of social-ecological systems: Challenges of environmental decision-making, sity, spring 2022.
- Lecturer in Master's level course Behavioural economics and experimental economics (online), Faculty of Economics, Khon Kaen University, Thailand, spring 2022,

# Commissions

- SARAS Associate, South American Institute for since 2018.
  - Guest editor, PNAS.
  - Journal reviewer for Nature Sustainability, Ecological Economics and Environmental and Resource Economics.

# Other

- Participant in a TV panel about climate change National television (SVT) 24 October, 2021.
  - Author of blog post within the Mistra Food Futures program: Vad tycker vi medborgare om att bli styrda? (How do we citizens feel about being steered?).



# Research focus

Studies the interacting social-ecological and technological processes that drive urban system dynamics and impact human wellbeing in order to plan and design more equitable, resilient, and sustainable cities.

# Publications (related to Beijer Institute work)

# Journal articles

• Branny, A., M.S. Møller, M, S. Korpilo, T. McPhearson, N. Gulsrud, A.S. Olafsson, C.M. Raymond, and E. Andersson. 2022. Smarter greener cities through a social-ecological-technological systal Sustainability 55:101168.

• McPhearson, T., E. Cook, M. Berbés-Blázquez,



ekonomi (Ecological economics), Department of Physical Geography and Stockholm Resilience

• Lecturer in Master's level course Quantitative methods for studying social-ecological systems, Stockholm Resilience Centre, Stockholm Univer-

Stockholm Resilience Centre, Stockholm Univer-

Resilience and Sustainability Studies (SARAS).

and food on the programme Agenda, Swedish

Timon McPhearson Professor, Senior Research Fellow

tems approach. Current Opinion in Environmen-

N. Grimm, C. Cheng, O. Barbosa, D. Chandler, H. Chang, M. Chester, D. Childers, H. Eakin, P. Groffman, R. Hale, D. Iwaniec, A. Lugo, S. Markolf, M. Matzler, L. McPhillips, T. Miller, E. Rosi, D. Swindell, R. Roy Chowdhury, and T. Troxler. A social-ecological-technological systems framework for urban ecosystem services. One Earth 5(5):505-518

- Grêt-Regamey, A., M. Switalski, N. Fagerholm, S. Korpilo, S. Juhola, M. Kyttä, N. Käyhkö, T. McPhearson, M. Nollert, T. Rinne, N- Soininen, T. Toivonen, A. Räsänen, E. Willberg, and C. Raymond. 2021. Harnessing sensing systems towards urban sustainability transformation. Npj Urban Sustainability 1(1):1–9.
- Rienow, A., A. Mustafa, L. Krelaus, C. Lindner. 2021. Modeling urban regions: Comparing random forest and support vector machines for cellular automata. *Transactions in GIS* 25(3):1625-1645.

# Conferences, workshops and presentations (related to Beijer Institute work)

- Seminar: Department of Planning and Design, Graduate School of Design, Harvard University, March 2022. Invited lecture: Urban Planning for Climate Resilience and Equity through Big Data and Spatial Analytics.
- Conference: Intelligent Machines, Emotions and Our Planet, organised by "Al, People & Planet" and Beijer Institute of Ecological Economics (online). Speaker: Deep Dive - Empathy, Ecology and Machines.



**Belinda Revers** Professor, Senior Research Fellow

# **Research focus**

Social-ecological systems perspective in sustainable development: research and practice.

# Publications

# Journal articles

- Chaigneau, T., S. Coulthard, T. M. Daw, L. Szaboova, L. Camfield, F.S. Chapin, D. Gasper, G.G. Gurney, C.C. Hicks, M. Ibrahim, T. James, L. Jones, N. Matthews, C. McQuistan, B. Reyers, and K. Brown. 2022. Reconciling well-being and resilience for sustainable development. Nature Sustainability 5(4):287-293.
- Revers, B., M.-L. Moore, L.J. Haider, and M. Schlüter. 2022. The contributions of resilience to reshaping sustainable development. Nature Sustainability 5:657-664.
- Schlüter, M., G. Caniglia, K. Orach, Ö. Bodin, N. Magliocca, P. Meyfroidt, and B. Reyers. 2022. Why care about theories? Innovative ways of theorizing in sustainability science. Current Opinion in Environmental Sustainability 54:101154.
- Watson, R.T., K. Sebunya, L.A. Levin, N. Eisenhauer, S. Lavorel, T. Hickler, C. Lundquist, M. Gasalla, and B. Reyers. 2021. Post-2020 aspirations for biodiversity. One Earth 4(7):893-896.

# Book chapter

• Bennett, E., and Reyers, B. 2022. Navigating the dynamics of people-planet relationships: A social-ecological systems perspective. In: Passarelli, D and Day, D (eds.): Reimagining the Human-Environment Relationship. UN University and UN Environment Programme.

# Conferences, workshops and presentations

- Global Dialogue on Biodiversity Law And Governance (online), Transformative Pathways To Living In Harmony With Nature, by Centre for Environmental Law, Macquarie University, Research Institute of Environmental Law, Wuhan University (China) and the Environmental Studies Program of the Colorado University Boulder (United States), July 2021. Keynote speech: Social-ecological interdependencies: Blurring boundaries in research and policy.
- Resilience thematic workshop and working group, International Summit on SDGs in Africa by the University of Cape Town, South Africa (online), September 2021. Design and participant.
- Rethinking the link between development and security, Session at the World Bank's 2022 Fragility Forum, March 2022. Panellist.
- High-Level Dialogue on Re-defining Resilience in the African Context – concept, dimensions, measuring, and way forward, Nairobi, Kenya. 23-25 May 2022. Invited presentation: The contributions of resilience to reshaping development.
- Reimagining the human-environment relationships, A Stockholm+50 Associated Event. Hosted by UNU-CPR and the UN Environment Programme, June 2022. Invited presentation and panellist.

# Commissions

- Member, Advisory Group for the Welcome Trust-funded: Sustainable and Healthy Food Systems (SHEFS), UK, South Africa and India, since 2018
- Subject Editor, Current opinion in environmental sustainability, since 2019.
- Member of the Scientific Council, Montpellier University's Advanced Knowledge Institute on Transitions (MAK'IT), since 2019.
- Advisory board member, United National Development Program – Human development report 2021.
- High-Level Advisory Panel (HLAP) for the Special Report on Human Security by the UN Human Development Report Office (HDRO), 2021
- Editorial board member, Global Environmental Change 2021
- Review Editor of the Global Assessment of the Intergovernmental Science Policy Platform for Biodiversity and Ecosystem Services: Transformative change assessment, 2022.
- Examiner for PhD theses, Stellenbosch University, South Africa.
- Assembly member, Future Earth.
- Reviewer for grants and promotions: Swedish

EPA, Finnish Research Council, University of Turku, Finland.

- Faculty member: Cambridge Institute for Sustainability Leadership Program (Business leaders Africa).
- Lecturer: Swedish Institute Catalysing Change Faculty (Africa public sector focus).

#### Other

- Rethink Talks Podcast: Re.Think Talks/In the SDGs, where have biodiversity and ecosystem services gone? 2021.
- April 2022: Interviewed and quoted in: Global biodiversity is in crisis, but how bad is it? It's complicated. Mongabay
- Advisor for Beijer Institute research project Inequality and the Biosphere, Beijer Young Scholars II



#### Research focus

Human behaviour in complex and intertwined social-ecological systems, shaping of human behaviour in different social-ecological contexts, commons, collective action, sustainability in contexts of environmental change and uncertainty.

# Publications Journal articles

- Chaigneau, T. and C. Schill. 2022. Environmental behaviours within ecological and social limits: integrating well-being with behavioural research for sustainability. Current Opinion in Environmental Sustainability 57:101201.
- Lindkvist, E., K.E. Pellowe, S.M. Alexander, E. Drury O'Neill, E.M. Finkbeiner, A. Girón Nava, B. González Mon, A.F. Johnson, J. Pittman, C. Schill, N. Wijermans, Ö. Bodin, S. Gelcich, and M. Glaser. 2022. Untangling social-ecological interactions: A methods portfolio approach to tackling contemporary sustainability challenges in fisheries. Fish and Fisheries:faf.12678.
- Wijermans, N., C. Schill, T. Lindahl, and M. Schlüter. 2022. Combining approaches: Looking behind the scenes of integrating multiple types of evidence from controlled behavioural experiments through agent-based modelling. International Journal of Social Research Methodoloav 25(4):569-581.

#### Book chapters

• Lindahl, T., M.A. Janssen, and C. Schill. 2021. Controlled behavioural experiments. In: The Routledge Handbook of Research Methods for Social-Ecological Systems. First edition. Routledge, London, pp. 295-306.

# Reports

• Collste, D., P. Henriksson, S. Akbik, A.-S. Crépin, C. Folke, L. Lerpold, E. Lindkvist, P. Malmer, G. Ordenes, J. Rocha, C. Schill, and M. Schultz. 2022. The co-evolving nature of inequality. In:

Galaz, V. and D. Collste (eds.) Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University), Chapter 3.

- · Galaz, V., D. Collste, A.-S. Crépin, B. Crona, G. Daily, C. Folke, T. Lindahl, P. Olsson, M. Ruckelshaus, C. Schill, L. Hård af Segerstad, and T. McPhearson. 2022. From systemic risks to system opportunities, In: Galaz, V., and D. Collste (eds.), Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University), Chapter 7.
- Lindahl, T., C. Schill, D. Collste, A.-S. Crépin, C. Folke, and V. Galaz, 2022, Foundations for behavioral change. In: Galaz, V. and D. Collste (eds.). Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University). Chapter 6.
- Metson, G.S., W. Brownlie, J. C. Bausch, M. Jonell. K Matsubae E Mnthambala C Schill and E Tilley. 2022. Consumption: The missing link towards phosphorus security. In: W.J. Brownlie. M.A. Sutton, K.V. Heal, D.S. Reay, B.M. Spears. (eds.) Our Phosphorus Future. UK Centre for Ecology and Hydrology, Edinburgh, Chapter 8.

# Conferences, workshops and presentations

- · Inequalities in social-ecological systems workshop, organised by Interacting Complexities research theme in collaboration with Stewardship and transformative futures research theme, Stockholm Resilience Centre and online, November 2021. Co-organiser.
- Careoperative annual meeting, Rotterdam and online, November 2021. Participant.
- Agent-based modelling and controlled behavioural experiments (AgentEx-II) project workshop, Sigtunastiftelsen, December 2021. Participant.
- Workshop for Stockholm +50 report, *Economy* and Finance for a Just Future on a Thriving Planet, December 2021. Participant.
- Intelligent Machines, Emotions, and Our Planet conference (online), Al People & Planet initiative, online, January 2022. Participant and moderator of panel session: To regulate or not regulate? A conversation about regulation and law of AI and emotions.
- Stockholm Resilience Centre Science Retreat, Högberga Gård, Lidingö, March 2022. Participant.
- Exhibition Feedbacks | Inequality and the Biosphere, collaboration between Beckmans College of Design, Svenskt Tenn and the Beijer Institute, Svenskt Tenn, April 2022. Opening reflections.
- Inequality and the Biosphere project consortium meeting, Beijer Young Scholars II, Lidö and KVA, May 2022. Co-organiser and participant.

- Stockholm Resilience Centre theme leader retreat, Hotel Hasselbacken, Djurgården, May 2022. Participant.
- Launch of Report for Stockholm +50. "Economy and Finance for a Just Future on a Thriving Planet", KVA, June 2022. Presentation of report chapter: Foundations for behavioural change.

# Teaching and training

- · Module leader, lecturer and examiner for Master's level course Governance and management of social-ecological systems: Theories and methods for governance of the commons, Stockholm Resilience Centre, Stockholm University, spring 2022.
- Main supervisor of Master's student Ylva Skoogh (Social-Ecological Resilience for Sustainable Development, Stockholm Resilience Centre, Stockholm University).
- Main supervisor of Master's student Jesús Manuel Jiménez Torres (Sustainable Territorial Development, University of Magdalena, Santa Marta, Colombia).
- Co-supervisor of Master's student Emelie Elfvengren (Sustainable Development, Uppsala University).
- Expert reviewer for Master's thesis, Johanna Gulliksen (Social-Ecological Resilience for Sustainable Development, Stockholm Resilience Centre, Stockholm University).
- Lecturer in graduate level course in visual communication. Feedbacks | Inequality and the Biosphere, Beckmans College of Design, online, spring 2022.
- Tutor of four students in visual communication, Beckmans College of Design, Feedbacks | Inequality and the Biosphere, collaboration between Beckmans, Svenskt Tenn and the Beijer Institute, spring 2022.

### Commissions

- Theme leader, Interacting Complexities research theme (together with Emilie Lindqvist and Juan C. Rocha), Stockholm Resilience Centre, Stockholm University, since August 2020.
- · Journal reviewer for Current Opinion in Environmental Sustainability, Ecological Economics, Global Sustainability.

# Other

- Leadership training for Stockholm Resilience Centre theme leaders, Stockholm, April 2022. Participant
- · Member of the Careoperative (leadership collective experiment for sustainability transformations), since 2019.
- Parental leave: July-December 2021 (10%)

Tasks include developing and editing the website and the annual report and administering the Beijer publication series, as well as organising and moderating workshops, seminars and other events. A member of Stockholm Resilience Centre's (SRC) communications team, she is involved in activities arranged jointly with SRC. During the past year. among other things she moderated the symposium Population and Environmental Change on 23-24 September 2021; she was Beijer Institute project leader for the course for students at the Beckman School of Design in February-March and the subsequent exhibition Feedbacks in April 2022; and she co-organised the Beijer Young Scholars workshop 7-10 June 2022. Agneta also works part time for the GEDB Academy programme.



# **Research focus**

Sustainability of global seafood system, aquaculture, capture fisheries, governance of coastal and marine ecosystems, coastal livelihoods, ecosystem functions and services, mangroves, biodiversity, resilience, regime shifts, food systems, nutrition and food security, integrated aquaculture, food/ seafood trade dynamics, sustainability metrics, life-cycle analysis, seafood certification standards, antibiotic resistance

# **Publications**

Journal articles

- Tagliabue, A. and M. Troell. 2021. Compound climate risks threaten aquatic food system benefits. Nature Food 2(9):673-682.
- Gephart, J.A., P.J.G. Henriksson, R.W. Parker, A. Shepon, K.D. Gorospe, K. Bergman, G. Eshel, C. D. Golden, B.S. Halpern, S. Hornborg, M. Jonell, M. Metian, K. Mifflin, R. Newton, P. Tyedmers, W. Zhang, F. Ziegler and M.Troell. 2021. Environmental performance of blue foods. Nature 597(7876): 360-365.
- Giri, S., T.D. Daw, S. Hazra, M. Troell, S. Samanta, O. Basu, C.L. Marcinko, and A. Chanda, 2022. Economic incentives drive the conversion of agriculture to aquaculture in the Indian Sundarbans: Livelihood and environmental implications of different aquaculture types. Ambio 18: 1-15.
- E.J. Parmley, S.E. Majowicz, D. Wernli, and P.S. Jørgensen. 2022. Studying factors affecting success of antimicrobial resistance intervenanalysis. Antibiotics 11(5):639.
- Henriksson, P.J.G., M. Troell, L.K. Banks, B. J. Phillips, N. Tran. 2021. Interventions for

# Agneta Sundin Communications officer

Associate Professor, Aquaculture and Sustainable Seafood Programme Director

• Graells, T., I.A. Lambraki, M. Cousins, A. Léger, K. Lillepold, P.J.G. Henriksson, M. Troell, C.A.Carson, tions through the lens of experience: A thematic

Belton, M.C.M. Beveridge, H. KLinger, N. Pelletier,

improving the productivity and environmental performance of global aquaculture for future food security. One Earth 4(9):1220-1232.

- Luthman, O., M. Jonell, P. Rönnbäck and M. Troell. 2022. Strong and weak sustainability in Nordic aquaculture policies. Aquaculture 550: 737841
- Mangano, M.C., M. Berlino, L. Corbari, G. Milisenda, M. Lucchese, S. Terzo, M. Bosch-Belmar MS Azaza JME Babarro R Bakiu BR Broitman, A.H. Buschmann, R. Christofoletti, Y. Dong, B. Glamuzina, O. Luthman, P. Makridis, A.J.A. Nogueira, M.G. Palomo, R. Dineshram, P. Sanchez-Jerez, H. Sevgili, M. Troell, K.Y. Abouel-Fadl MN Azra P Britz F Carrington I Celić F Choi, C. Qin, M.A. Dionísio, T. Dobroslavić P. Galli, D. Giannetto, J.H. Grabowski, B. Helmuth, M.J.H. Lebata-Ramos, P.T. Lim, Y. Liu, S.M. Llorens, S. Mirto, M. Pécarević, C. Pita, N. Ragg, E. Ravagnan, D. Saidi, K. Schultz, M. Shaltout, S.H. Tan, V. Thiyagarajan and G. Sarà. 2022. The aquaculture supply chain in the time of covid-19 pandemic: Vulnerability, resilience, solutions and priorities at the global scale. Environmental Science & Policy 127:98-110.
- Österblom, H., C. Folke, J. Rocha, J. Bebbington, R. Blasiak, J.-B. Jouffray, E.R. Selig, C.C.C. Wabnitz, F. Bengtsson, B. Crona, R. Gupta, P.J.G. Henriksson, K.A. Johansson, A. Merrie, S. Nakavama, G.O. Crespo, J. Rockström, L. Schultz. M. Sobkowiak, P.S. Jørgensen, J. Spijkers, M. Troell, P. Villarrubia-Gómez, and J. Lubchenco. 2022. Scientific mobilization of keystone actors for biosphere stewardship. Scientific Reports 12(1):3802
- Shepon, A., T. Makov, H.A. Hamilton, D. B. Müller, J.A. Gephart, P.J.G. Henriksson, M. Troell, and C.D. Golden 2022 Sustainable optimization of global aquatic omega-3 supply chain could substantially narrow the nutrient gap. Resources, Conservation and Recycling 181:106260.
- Stetkiewicz, S., R.A. Norman, E.H. Allison, N.L. Andrew G Ara G Banner-Stevens B Belton M Beveridge, J.R. Bogard, S.R. Bush, P. Coffee, M. Crumlish, P. Edwards, M. Eltholth, L. Falconer, J.G. Ferreira, A. Garrett, I. Gatward, F.U. Islam, A.M. Kaminski, M. Kjellevold, F. Kruijssen, W. Leschen A-A Mamun B McAdam R Newton B. Krogh-Poulsen, A. Pounds, B. Richardson, N. Roos, E. Röös, A. Schapper, T. Spence-Mc-Connell, S.K. Suri, S.H. Thilsted, K.D. Thompson, M.F. Tlusty, M.F. Troell, R. Vignola, J.A. Young, W. Zhang, and D.C. Little. 2022. Seafood in food security: A call for bridging the terrestrial-aquatic divide. Frontiers in Sustainable Food Svstems 5:703152.
- Sumaila, U.R., D.J. Skerritt, A. Schuhbauer, S. Villasante A.M. Cisneros-Montemayor H. Sinan D. Burnside et al. 2021. WTO must ban harmful fisheries subsidies. Science 37(6567):544-544.
- Tigchelaar, M., W.W.L. Cheung, E.Y. Mohammed, M.J. Phillips, H.J. Payne, E.R. Selig, C.C.C. Wabnitz, M.A. Oyinlola, T.L. Frölicher, J.A. Gephart, C.D. Golden, E.H. Allison, A. Bennett, L. Cao, J. Fanzo, B.S. Halpern, V.W.Y. Lam, F. Micheli, R.L. Navlor UR Sumaila M Troell PJG Henriksson, A.H. Buschmann, T. Chopin, and S. Quahe. Farming the ocean - seaweeds as a quick fix

for the climate? *Reviews in Fisheries Science* & Aquaculture: In press.

• Zhang, W., B. Belton, P. Edwards, P.J.G. Henriksson, D.C. Little, R. Newton, and M. Troell, 2022. Aquaculture will continue to depend more on land than sea. Nature 603(7900):E2-E4.

# Conferences, workshops and presentations

- Workshop Series on Antimicrobial Assessment on Global Aquaculture Production, Workshop 4: Methodology, Feb 2, 2021, Monterey Bay Aquarium, Seafoodwatch and Worldbank. Invited expert.
- MASMA, Research application evaluation, 3 February 2021. Evaluator
- Workshop Series on Antimicrobial Assessment on Global Aquaculture Production, Workshop 3: Antimicrobial Resistance and Aquaculture, September 23, 2021, Monterey Bay Aquarium, Seafoodwatch and Worldbank. Invited expert.
- Big Fish Seminar Series Blue Food: A Food Systems Solution?, Stirling University, 29 September, 2021. Co-organiser.
- Global Conference on Aquaculture Millennium + 20 (GCA +20), 23-24 September 2021, in Shanghai, China. Panellist and presentation: Transforming aquaculture to achieve SDGs.
- SeaBOS, Task force 3; Antibiotics, October 5-6, 2021. Presenter.
- MASMA Grantee meeting, Project reviews and support, 24-25 November 2021. Evaluator.
- SUCCeSS seminar on Sustainable Food Untapped power of by-products for the food system, 22 April, 2022, Stockholm University. Presenter
- SeaBOS workshop, 10-14 May, Stockholm. Participant
- Workshop, AMR-plattformar/initiativ i Sverige, Axfoundation och KSLA 12 Maj, 2022.
- Seafood within a Circular Bioeconomy, 20-22 June, 2022, Stockholm. Workshop organiser.
- MASMA, Workshop Application reviews, June 2022. Evaluator.

# Teaching and training

- Co-supervisor PhD student Ola Luthman (Södertörns University) since 2019.
- Lecturer, Belmont Forum Project, Anthropocene and oceans and Aquaculture, February 7 and 10 2022
- Member, Evaluation committee, PhD thesis defence "Patterns of Small-scale Coastal Fisheries and Local Fisheries Management in Tanzania: Adaptation to a Changing Climate", PhD student: Mathew Silas, Stockholm University, 22/4-22.
- MOOC Lecturer\_SDGs and Low-trophic Aquaculture. AquaVitae EU Project, 1 April, 2022.

# Commissions

• Research reviewer and programme supporter. MASMA Programme Committee. Western Indian Ocean Marine Science Association program committee, since 2007.

- Member, UN Action Track 3, Preparation working group for Food Summit, 2021.
- · Researcher responsible for joint work on Antibiotics SeaBOS
- Review editor for Journal of Aquaculture Environment Interactions (AEI), Frontiers in Marine Science
- Editorial board, Western Indian Ocean Journal of Marine Science
- Journal reviewer for Marine Policy: Ecosystem Health and Sustainability, Journal of Applied Aquaculture
- Reviewer for China Fisheries, in "East Asia Forum". Economics. Politics and Public Policy in East Asia and the Pacific.
- Expert group, Axfoundation. "Kriterier och frågebatteri för ansvarsfull användning av antibiotika till livsmedelsproducerande diur Version 20" (Criteria and questions for responsable use of antibiotics for food producing animals 2.0)
- Member of steering committee, Blue Food Assessment. Joint collaboration between Stanford University, Stockholm Resilience Centre and FAT 2019-2022
- Member, FAO working group: Aquaculture and the SDGs. Preparation for world symposium Shanghai, September 2021.
- Member, "Aquatic/Blue Food Action Coalition". since 2021
- Member, Action Track 3: Boost nature-positive production Preparation for Food Summit 2021 September or November, New York, 2021.

# Other

• Lecture for the Swedish Crown Princess on Antibiotikaresistens - en utmaning för hållbar sjömat och mänskligheten (Antibiotic resistance - a challenge for sustainable deafood and for humanity), Stockholm, October 12, 2021.



# Research focus

Collaboration for biosphere stewardship with particular interest in using science to mobilise the private sector in transformative change.

# Publications during the period Journal articles

- Österblom H. Bebbington J. Blasiak R. Sobkowiak M, Folke C. Transnational Corporations, Biosphere Stewardship, and Sustainable Futures. Annual Review of Environment and Resources. In press
- Österblom, H. C. Folke, J. Rocha, J. Bebbington, R. Blasiak, J.-B. Jouffray, E.R. Selig, C.C.C. Wabnitz, E Bengtsson B Crona R Gupta PJG Henriksson, K.A. Johansson, A. Merrie, S. Nakayama,

Appendix

G. Ortuno Crespo, J. Rockström L. Schultz, M. Sobkowiak, P.S.Jørgensen, J. Spijkers, M. Troell, P. Villarubia-Gómez, and J. Lubchenco. 2022. Scientific Mobilization of Keystone Actors for Biosphere Stewardship. Scientific Reports 12:3802.

# Reports

• Galaz, V., Crépin, A.-S., Fichtner, J., Hallerby, R., Jonsson, M., Kedward, K., Nessen, M., Ryan-Collins, J., Ölcer, D., Österblom, H. 2022. The Power of giants. In: Galaz V. and Collste, D. (eds). Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University). Chapter 5.

# Other

• Paasche, Ø., H. Österblom. 2022. The Utopia of a Sustainable Planet. Elephant in the Lab doi:10.5281/zenodo.6556477

# Conferences, workshops and presentations

- Ocean Seminar. The Royal Swedish Academy of Sciences. Stockholm, 3 May, 2022. Organiser and chair.
- SeaBOS working meeting. Stockholm, 10-12 May, 2022. Co-organiser.
- Beijer Young Scholars II workshop. Beijer Institute, the Royal Swedish Academy of Sciences. Stockholm, 20 May, 2022.
- 2022 US-UK Scientific Forum on bringing nature into decision making. London, 16-17 June, 2022. Invited presentation: Seafood Business for Ocean Stewardship

# Commissions

- Chair, SeaBOS fundraising foundation
- Member, Race for the Baltic Fundraising Foundation

# Publications

# Journal articles

- Andersen, A.D., K. Frenken, V. Galaz, F. Kern, L. Klerkx, M. Mouthaan, L. Piscicelli, J.B. Schor, and T. Vaskelainen. 2021. On digitalization and sustainability transitions. Environmental Innovation and Societal Transitions 4196-98
- Andersson, E., N.B. Grimm, J.A. Lewis, C.L. Redman, S. Barthel, J. Colding, and T. Elmqvist. 2022. Urban climate resilience through hybrid infrastructure. Current Opinion in Environmental Sustainability 55:101158.
- Barthel, S., J. Colding, A.-S. Hiswåls, P. Thalén, and P. Turunen, 2021. Urban green commons for socially sustainable cities and communities. Nordic Social Work Research 12(2):310-322.
- Brandt, S.A., N.J. Lim, J. Colding, and S. Barthel. 2021. Mapping flood risk uncertainty zones in support of Urban Resilience Planning. Urban Planning 6(3):258-271.
- Chaigneau, T., S. Coulthard, T.M. Daw, L. Szaboova, L. Camfield, F.S. Chapin, D. Gasper, G.G. Gurney, C.C. Hicks, M. Ibrahim, T. James, L. Jones, N. Matthews, C. McQuistan, B. Revers,

and K. Brown. 2022. Reconciling well-being and resilience for sustainable development. Nature Sustainability 5(4):287-293.

- Chaigneau, T. and C. Schill, 2022, Environmental behaviours within ecological and social limits: Integrating well-being with behavioural research for sustainability. Current Opinion in Environmental Sustainability 57:101201.
- · Chapin, F.S., E.U. Weber, E.M. Bennett, R. Biggs, J. van den Bergh, W.N. Adger, A.-S. Crépin, S. Polasky C Folke M Scheffer K Segerson J.M. Anderies, S. Barrett, J.-C. Cardenas, S.R. Carpenter, J. Fischer, N. Kautsky, S.A. Levin, J.F. Shogren, B. Walker, J. Wilen, and A. de Zeeuw. 2022. Earth stewardship: Shaping a sustainable future through interacting policy and Norm Shifts. Ambio 51(9):1907-1920.
- Colding, J., S. Barthel, R. Ljung, F. Eriksson, and S. Sjöberg. 2021. Urban Commons and collective action to address climate change. Social Inclusion 10(1)
- Colding, J., K. Samuelsson, L. Marcus, Å. Gren, A. Legeby, M. Berghauser Pont, and S. Barthel. 2022. Frontiers in social-ecological urbanism. Land 11(6):929
- Folke, C., S. Carpenter, T. Elmqvist, L. Gunderson, and B. Walker. 2021. Resilience: Now more than ever Ambio 50(10):1774-1777
- Folke, C., Å. Gren, J. Larsson, and R. Costanza. 2021. Cities and the biosphere. Ambio 50(9) 1634-1635
- Folke, C., L.J. Haider, S.J. Lade, A.V. Norström, and J. Rocha. 2021. Commentary: Resilience and social-ecological systems: A handful of frontiers. Global Environmental Change 71:102400.
- Folke, C. and N. Kautsky. 2021. Aquaculture and ocean stewardship. Ambio 51(1):13-16.
- Galaz, V. 2022. Global environmental governance in times of turbulence. One Earth 5(6):582-585.
- · Galaz, V., M.A. Centeno, P.W. Callahan, A. Causevic. T. Patterson, I. Brass et al. 2021. Artificial intelligence, systemic risks, and sustainability. Technology in Society 67:101741.
- Gephart, J.A., P.J.G. Henriksson, R.W.R. Parker, A. Shepon, K.D. Gorospe, K. Bergman, G. Eshel, C.D. Golden, B.S. Halpern, S. Hornborg, M. Jonell, M. Metian, K. Mifflin, R. Newton, P. Tyedmers, W. Zhang, F. Ziegler, and M. Troell. 2021. Environmental performance of blue foods. Nature 597(7876):360-365.
- Giri, S., T.D. Daw, S. Hazra, M. Troell, S. Samanta, O Basu CL Marcinko and A Chanda 2022 Economic incentives drive the conversion of agriculture to aquaculture in the Indian Sundarbans: Livelihood and environmental implications of different aquaculture types. Ambio 18:1-15.
- Graells, T., I.A. Lambraki, M. Cousins, A. Léger, K. Lillepold, P. J. G. Henriksson, M. Troell, C.A. Carson, E.J. Parmley, S.E. Majowicz, D. Wernli, and P.S. Jørgensen. 2022. Studying factors affecting success of antimicrobial resistance interventions through the lens of experience: A thematic analysis Antibiotics 11(5):639
- Henriksson, P.J.G., M. Troell, L.K. Banks, B. Belton, M.C.M. Beveridge, D.H. Klinger, N. Pelletier,

M.J. Phillips, and N. Tran. 2021. Interventions for improving the productivity and environmental performance of global aquaculture for future food security. One Earth 4(9):1220-1232.

- Lambraki, I.A., M. Cousins, T. Graells, A. Léger, P. Henriksson, S. Harbarth, M. Troell, D. Wernli, P. Søgaard Jørgensen, A.P. Desbois, C.A. Carson, E.J. Parmley, and S.E. Majowicz. 2022. Factors influencing antimicrobial resistance in the European food system and potential leverage points for intervention: A participatory, One Health study. PLOS ONE 17(2):e0263914.
- Levin, S.A., J.M. Anderies, N. Adger, S. Barrett, E.M. Bennett, J.C. Cardenas, S.R. Carpenter, A.-S. Crépin, P. Ehrlich, J. Fischer, C. Folke, N. Kautsky, C. Kling, K. Nyborg, S. Polasky, M. Scheffer, K. er, E.U. Weber, and J. Wilen. 2021. Governance in the face of extreme events: Lessons from tions, and the need to go beyond. *Ecosystems* 25(3).697-711
- Lindahl, T. 2022. Limited and unlimited wants examined. Nature Sustainability 5:641-642.
- Lindkvist F K F Pellowe SM Alexander F Drury O'Neill, E.M. Finkbeiner, A. Girón Nava, B. González Mon, A.F. Johnson, J. Pittman, C. Schill, N. Wijermans, Ö. Bodin, S. Gelcich, and M. Glaser. 2022. Untangling social-ecological interactions: A methods portfolio approach to tackling contemporary sustainability challenges in fisheries. Fish and Fisheries.
- Liu, J., T. Dietz, S.R. Carpenter, W.W. Taylor, M. Alberti, P. Deadman, C. Redman, A. Pell, C. Folke, Z. Ouyang, and J. Lubchenco. 2021. Coupled human and natural systems: The evolution and applications of an integrated framework. Ambio 50(10):1778-1783.
- Löfgren, K.G. and C.Z. Li. 2021. Envelope theorems in economics: Historical development and modern cost-benefit applications. Frontiers of Economics in China 16: 377-404..
- Luthman, O., M. Jonell, P. Rönnbäck, and M. Troell. 2021. Strong and weak sustainability in Nordic aquaculture policies. Aquaculture 550.737841
- Macura, B., Y. Ran, U.M. Persson, A. Abu Hatab, M. Jonell, T. Lindahl, and E. Röös. 2022. What evidence exists on the effects of public policy protocol. Environmental Evidence 11(1):1-9.
- Mangano, M.C., M. Berlino, L. Corbari, G. Milisenda, M. Lucchese, S. Terzo, M. Bosch-Belmar, M.S. Azaza, J.M.F. Babarro, R. Bakiu, B.R. Broitman, A.H. Buschmann, R. Christofoletti, Y. Dong, B. Glamuzina, O. Luthman, P. Makridis, A.J.A. Nogueira, M.G. Palomo, R. Dineshram, P. Sanchez-Jerez, H. Sevgili, M. Troell, K.Y. Abouel-Fadl, M.N. Azra, P. Britz, E. Carrington, I. Celić, E Choi C Qin M A Dionísio T Dobroslavi c P Galli, D. Giannetto, J.H. Grabowski, B. Helmuth, M.J.H. Lebata-Ramos, P.T. Lim, Y. Liu, S.M. Llorens, S. Mirto, M. Pécarević, C. Pita, N. Ragg, E. Ravagnan, D. Saidi, K. Schultz, M. Shaltout, S.H. Tan, V. Thiyagarajan and G. Sarà. 2022. The

Segerson, J. Shogren, J. van den Bergh, B. Walkevolutionary processes for structuring interven-

interventions for achieving environmentally sustainable food consumption? A systematic map

aquaculture supply chain in the time of covid-19

pandemic: Vulnerability, resilience, solutions and priorities at the global scale. Environmental Science & Policy 127:98-110.

- Navlor, R.L., A. Kishore, U.R. Sumaila, I. Issifu, B.P. Hunter, B. Belton, S.R. Bush, L. Cao, S. Gelcich, J.A. Gephart, C.D. Golden, M. Jonell, J.Z. Koehn, D.C. Little, S.H. Thilsted, M. Tigchelaar, and B. Crona. 2021. Blue food demand across geographic and temporal scales. Nature Communications 12(1):1-14.
- Österblom, H., C. Folke, J. Rocha, J. Bebbington, R. Blasiak, J.-B. Jouffray, E.R. Selig, C. C. Wabnitz, F. Bengtsson, B. Crona, R. Gupta, P.J. Henriksson, K.A. Johansson, A. Merrie, S. Nakayama, G.O. Crespo, J. Rockström, L. Schultz, M. Sobkowiak. P.S. Jørgensen, J. Spijkers, M. Troell, P. Villarrubia-Gómez, and J. Lubchenco. 2022. Scientific mobilization of Keystone Actors for Biosphere Stewardship. Scientific Reports 12(1).
- Reyers, B., M.-L. Moore, L.J. Haider, and M. Schlüter, 2022. The contributions of resilience to reshaping sustainable development. Nature Sustainability 5:657-664.
- Rockström, J., T. Beringer, D. Hole, B. Griscom, M.B. Mascia, C. Folke, and F. Creutzig, 2021. We need biosphere stewardship that protects carbon sinks and builds resilience. Proceedings of the National Academy of Sciences 118(38).
- Rostang, O., A. Gren, A. Feinberg, and M. Berghauser Pont. 2021. Promoting resilient and healthy cities for everyone in an urban planning context by assessing green area accessibility. Frontiers in Built Environment 7:797179.
- Shepon, A., T. Makov, H.A. Hamilton, D.B. Müller, JA Genhart PJG Henriksson M Troell and C.D. Golden, 2022. Sustainable optimization of global aquatic omega-3 supply chain could substantially narrow the nutrient gap. Resources, Conservation and Recycling 181:106260.
- Schlüter, M., G. Caniglia, K. Orach, Ö. Bodin, N. Magliocca, P. Meyfroidt, and B. Reyers. 2022. Why care about theories? Innovative ways of theorizing in sustainability science. Current Opinion in Environmental Sustainabilitv 54·101154
- Stetkiewicz S R A Norman E H Allison N I Andrew, G. Ara, G. Banner-Stevens, B. Belton, M. Beveridge, J.R. Bogard, S.R. Bush, P. Coffee, M. Crumlish, P. Edwards, M. Eltholth, L. Falconer, JG Ferreira A Garrett I Gatward FU Islam A.M. Kaminski, M. Kjellevold, F. Kruijssen, W. Leschen, A.-A. Mamun, B. McAdam, R. Newton, B. Krogh-Poulsen, A. Pounds, B. Richardson, N Roos E Röös A Schapper T Spence-Mc-Connell, S.K. Suri, S.H. Thilsted, K.D. Thompson, M.F. Tlusty, M.F. Troell, R. Vignola, J.A. Young, W. Zhang, and D.C. Little. 2022. Seafood in food security: A call for bridging the terrestrial-aquatic divide. Frontiers in Sustainable Food Systems 5:703152
- Sumaila UR DJ Skerritt A Schubbauer S Villasante, A.M. Cisneros-Montemayor, H. Sinan, D. Burnside et al. 2021. WTO must ban harmful fisheries subsidies. Science 37(6567):544-544.
- Tigchelaar, M., J. Leape, F. Micheli, E.H. Allison, X. Basurto, A. Bennett, S.R. Bush, L. Cao, W.W.L. Cheung, B. Crona, F. DeClerck, J. Fanzo, S.

- Gelcich, J.A. Gephart, C.D. Golden, B.S. Halpern, C.C. Hicks, M. Jonell, A. Kishore, J.Z. Koehn, D.C. Little, R.L. Naylor, M.J. Phillips, E.R. Selig, R.E. Short, U.R. Sumaila, S.H. Thilsted, M. Troell, and C.C.C. Wabnitz. 2022. The vital roles of blue foods in the global food system. *Global Food Security* 33:100637.
- Watson, R.T., K. Sebunya, L.A. Levin, N. Eisenhauer, S. Lavorel, T. Hickler, C. Lundquist, M. Gasalla, and B. Reyers. 2021. Post-2020 aspirations for biodiversity. *One Earth* 4(7):893-896.
- Wei, C., Y. Xu, and C.-Z. Li. 2022. Recent advances in China's sustainable transition studies. *Letters in Spatial and Resource Sciences*.
- Wijermans, N., C. Schill, T. Lindahl, and M. Schlüter. 2022. Combining approaches: Looking behind the scenes of integrating multiple types of evidence from controlled behavioural experiments through agent-based modelling. *International Journal of Social Research Methodology* 25(4):569-581.
- Wiloso, E.I., M. Romli, B.A. Nugraha, A.R. Wiloso, A.A.R. Setiawan, and P.J.G. Henriksson. 2022. Life cycle assessment of Indonesian canned crab (Portunus pelagicus). *Journal of Industrial Ecology* 2030:1-14.č
- Wu, S., C. Li, and C. Wei. 2022. Electricity consumption as a new indicator of inequality. *Energy Research & Social Science* 90:102677.
- Zhang, W., B. Belton, P. Edwards, P.J.G. Henriksson, D.C. Little, R. Newton, and M. Troell. 2022. Aquaculture will continue to depend more on land than sea. *Nature* 603(7900):E2–E4.

# Book chapters

- Bennett, E., and Reyers, B. 2022. Navigating the dynamics of people-planet relationships: A social-ecological systems perspective. In: Passarelli, D. and D. Day (eds.) *Reimagining the Human-Environment Relationship*. UN University and UN Environment Programme.
- Biggs, R., H. Clements, A. de Vos, C. Folke, A. Manyani, K. Maciejewski, B. Martín-López, R. Preiser, O. Selomane, and M. Schlüter. 2021. What are social-ecological systems and social-ecological systems research? In: Biggs, R., A. De Vos, R. Preiser, H. Clements, K. Maciejewski, and M. Schlüter (eds.) *The Routledge Handbook of Research Methods for Social-Ecological Systems*. First edition. Routledge, London, pp. 3-26.
- Chapin III, F.S., R. Biggs, N. Sitas, C. Folke, and G.P. Kofinas. 2022. Cross-scale social-ecological stewardship for navigating toward more sustainable and just futures. In: Gunderson, L.H., C.R. Allen, and A. Garmestani (eds.) Applied Panarchy: Applications and Diffusion across Disciplines. Island Press, Washington DC, USA, pp. 275-288.
- Folke, C. 2021. Förord. In: Schultz, L. and E. Treijs (eds). *Kursen – Tio lektioner för ett hållbart näringsliv*. Natur & Kultur, Stockholm, Sweden, pp. 5-7.
- Lindahl, T., M.A. Janssen, and C. Schill. 2021. Controlled behavioural experiments. In: Biggs, R., A. De Vos, R. Preiser, H. Clements, K. Maciejewski, and M. Schlüter (eds.) *The Routledge Handbook of Research Methods for Social-Ecological*

*Systems.* First edition. Routledge, London, pp. 295-306.

- Olsson, P., C. Folke, and M.-L. Moore. 2022. Capacities for navigating large-scale sustainability transformations: Exploring the revolt and remembrance mechanisms for shaping collapse and renewal in social-ecological systems. In: Gunderson, L., C.R Allen and A. Garmestani (eds.) Applied Panarchy: Applications and Diffusion across Disciplines. Island Press, Washington DC, USA, pp. 155-180.
- Rocha, J.C. and S. Daume. 2021. Data mining and pattern recognition. In: Biggs, R., A. De Vos, R. Preiser, H. Clements, K. Maciejewski, and M. Schlüter (eds.) The Routledge Handbook of Research Methods for Social-Ecological Systems. First edition. Routledge, London, pp. 24-251.

# **Beijer Discussion Papers**

- Galaz. V., J. Rocha, P.A. Sanchez García, T. Roukny, P. Søgaard Jørgensen, A. Dauriach, and A. Golland. 2022. Beijer Discussion Paper 277: Financial dimensions of global zoonotic disease risks. Beijer Discussion Paper Series.
- Sanchez-García. P.A., V. Galaz, and J. Rocha. 2022. Beijer Discussion Paper 278: Finance, climate and ecosystems: A literature review of domino-effects between the financial system, climate change and the biosphere. *Beijer Discussion Paper Series*.

# Reports/report chapters

- Basset-Mens, C., A. Avadí, C. Bessou, I. Acosta-Alba, Y. Biard, S. Payen, P.J.G. Henriksson, S. Gheewala, J. Aubin, E.I. Wiloso, J. Hanafi, A. Benoist, and T. Tran. 2022. Part 3: Overcoming the challenges for robust agri-food LCA in developing and emerging economies. In: Basset-Mens, C., A. Avadí, C. Bessou, I. Acosta-Alba, Y. Biard, and S. Payen (eds.) Life Cycle Assessment of Agri-food Systems. An Operational Guide Dedicated to Developing and Emerging Economies. éditions Quae, Versailles, France, p. 213.
- Collste, D., P. Henriksson, S. Akbik, A.-S. Crépin, C. Folke, L. Lerpold, E. Lindkvist, P. Malmer, G. Ordenes, J. Rocha, C. Schill, and M. Schultz.
   2022. The co-evolving nature of inequality. In: Galaz, V. and D. Collste (eds.). *Economy and Finance for a Just Future on a Thriving Planet*. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and the Stockholm Resilience Centre (Stockholm University), Chapter 3.
- Galaz, V. and D. Collste (eds). 2022. Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University).
- Galaz, V., D. Collste, A.-S. Crépin, B. Crona, G. Daily, C. Folke, T. Lindahl, P. Olsson, M. Ruckelshaus, C. Schill, L. Hård af Segerstad, and T. McPhearson. 2022. From systemic risks to system opportunities. In: Galaz, V. and D. Collste (eds.) Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm

Resilience Centre (Stockholm University), Chapter 7.

- Galaz, V., Crépin, A.-S., Fichtner, J., Hallerby, R., Jonsson, M., Kedward, K., Nessen, M., Ryan-Collins, J., Ölcer, D., Österblom, H. 2022. The Power of giants. In: Galaz V. and Collste, D. (eds). Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50. Beijer Institute of Eco-logical Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University). Chapter 5.
- Galaz, V., G. Daily, C. Folke, S. Levin, M. Ruckelshaus, W. Steffen, and P. Søgaard Jørgensen.
   2022. A new planetary reality. In: Galaz, V. and D. Collste (eds.) *Economy and Finance for a Just Future on a Thriving Planet*. Report for Stockholm+50. Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and Stockholm Resilience Centre (Stockholm University), Chapter 1.
- Lindahl, T., C. Schill, D. Collste, A.-S. Crépin,
  C. Folke, and V. Galaz. 2022. Foundations for behavioral change. In: Galaz, V. and D. Collste (eds.) Economy and Finance for a Just Future on a Thriving Planet. Report for Stockholm+50.
   Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences) and the Stockholm Resilience Centre (Stockholm University), Chapter 6.
- Metson, G.S., W. Brownlie, J.C. Bausch, M. Jonell, K. Matsubae, F. Mnthambala, C. Schill, and E. Tilley. 2022. Consumption: The missing link towards phosphorus security. In: Brownlie, W.J., M.A. Sutton, K.V. Heal, D.S. Reay, and B.M. Spears (eds.) *Our Phosphorus Future*. UK Centre for Ecology and Hydrology, Edinburgh, *Chapter 8*.

# Working papers

 Golland, A., V. Galaz, G. Engstrom, and J. Fichtner. 2022. Proxy voting for the Earth System: Institutional shareholder governance of global tipping elements. SSRN Electronic Journal.

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