



The Beijer Institute of Ecological Economics

Annual report 2018/2019

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Annual report 1 July 2018 – 30 June 2019

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.

The Beijer Institute of
Ecological Economics

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Director's column



DURING THE PAST YEAR, there has been an amazing increase in awareness of global environmental change in general, and climate change in particular. It has become apparent that solutions based on incremental tweaking and business-as-usual for a planet in peril are backward looking and a hindrance to progress and prosperity. It is almost as though a new era of enlightenment is emerging, an awakening moving us out of the industrial revolution into novel, unknown terrain where transformations towards sustainable futures are increasingly called for.

Although the concept of sustainable development is far from new, the context in which it must be achieved is new. The Anthropocene – the recent geological epoch where humanity is driving the future on Earth – presents us with a new context of an intertwined planet of people and nature, a big world on a small planet undergoing dynamic change.

Clearly, science is needed more than ever in confronting uncertainty, tensions and turbulence, and in helping guide societies towards sustainable futures. Here, the Beijer Institute's collaborative work across disciplines

continues to inspire and form new research frontiers, drawing on more than 25 years of experience.

These are exciting times to serve as director of the Beijer Institute! Our interdisciplinary work, often curiosity driven, aims at generating evidence-informed understanding, as a foundation for actions towards sustainability. The collaboration with internationally leading researchers and institutions and the close interactions with the Global Economic Dynamics and the Biosphere (GEDB) Academy programme and the Stockholm Resilience Centre make our research cluster a very special node in the world.

The Beijer Foundation is key, providing exceptional long-term core support to the Royal Swedish Academy of Sciences for its Beijer Institute. We are truly grateful to Anders Wall and the Beijer Foundation for their trust in our work and for the unique relationship we share, which has made possible the interdisciplinary discoveries that influence science, teaching and training, and simultaneously serve policy, practice and business. The Foundation's support has made it possible to firmly establish the Beijer Young Scholars programme. This spring we started the third group of scholars,

”It is the future we are looking into, searching for new scientific understanding by combining human behaviour, innovation and biosphere dynamics and building new skills and competencies.”

quite an amazing group of some twenty researchers who came to expand horizons, build collaborations and prepare for challenges and opportunities in science for sustainability.

Yes, it is the future we are looking into, searching for new scientific understanding by combining human behaviour, innovation and biosphere dynamics and building new skills and competencies. We are dedicated to this, as reflected in our research programmes and workshops, our publications and our engagements in the science-practice-policy-business interface.

The Beijer Institute is in good shape, I dare to say, thanks to the fantastic work of my colleagues and collaborators. I hope you enjoy reading about our work and achievements.

A handwritten signature in black ink, reading 'Carl Folke'.

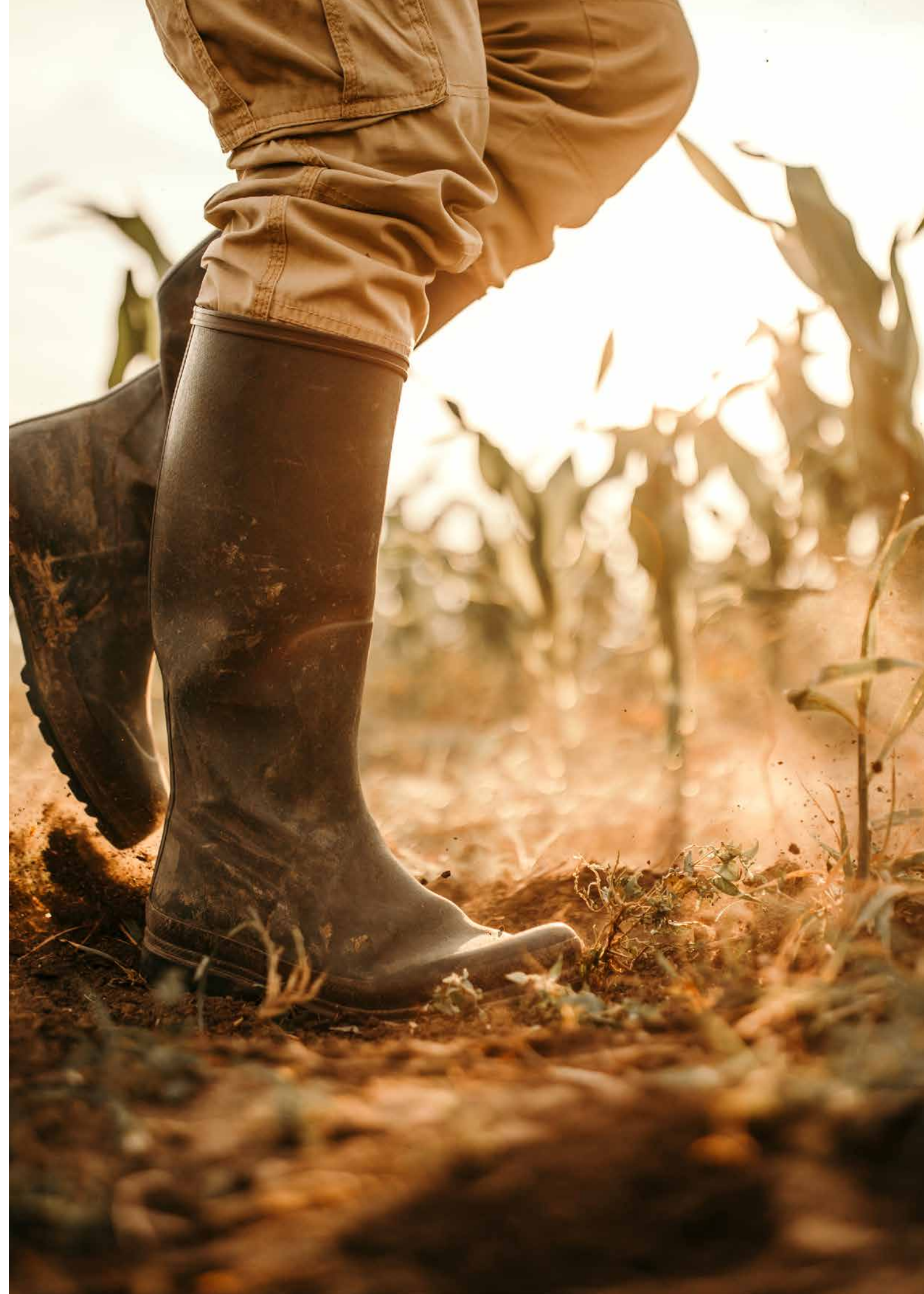
Carl Folke
Director of the Beijer Institute
Stockholm, July 2019

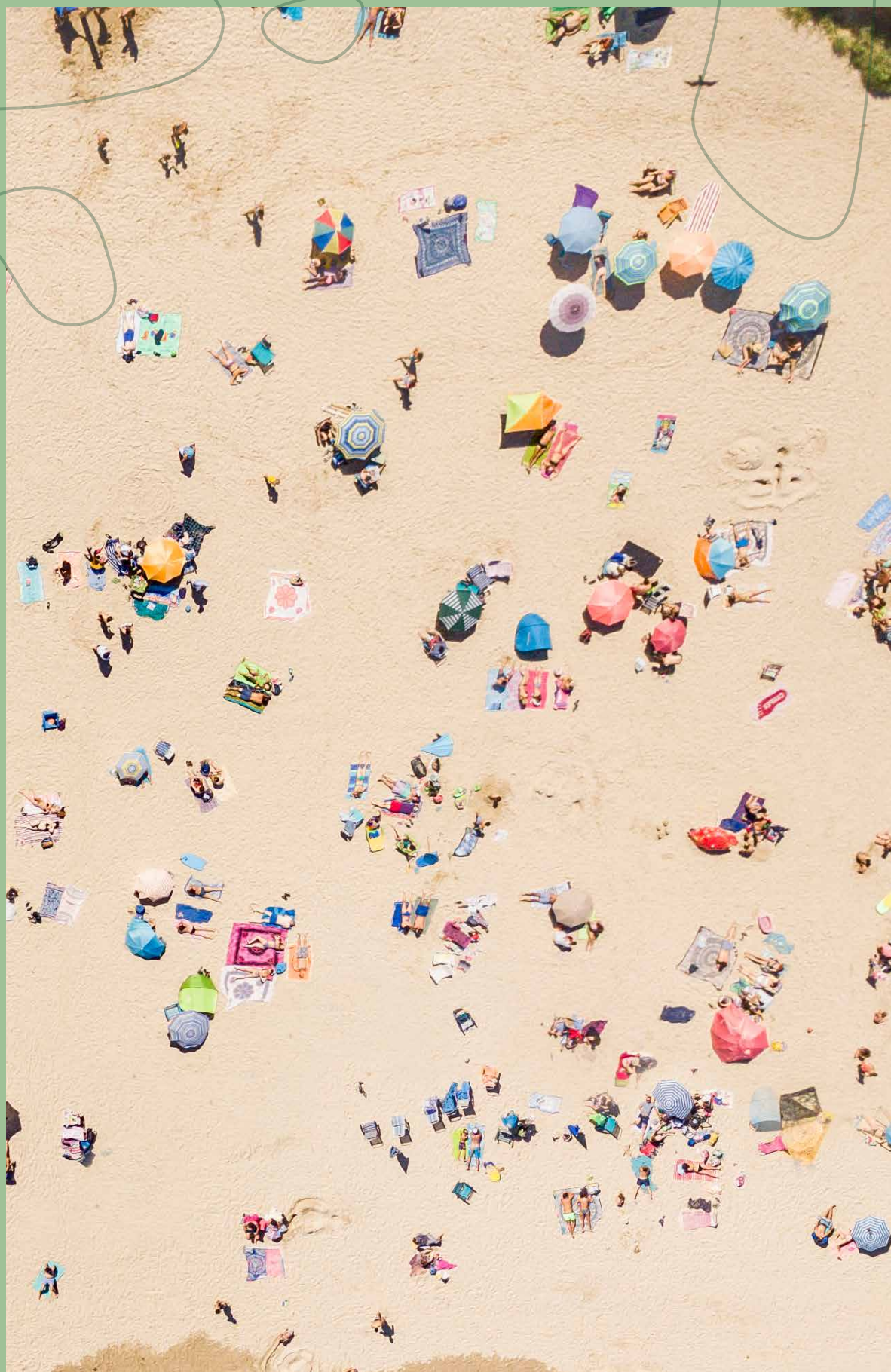
Research programmes x 4

Work at the Beijer Institute strives to create research frontiers at the interface of ecology, economics and related disciplines, in order 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. The situation is different from just a few decades ago. Now, 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 international scientific advisory board, we discuss, assess and modify our research programmes to better capture and understand the 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.

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Research programmes

Behaviour, Economics and Nature

As the scale of human activities increases and society becomes more globalised, humans are now a main driving force of global environmental change, giving rise to what some call a new geological epoch, the Anthropocene. Human systems are exerting impacts on an increasing number of Earth system processes, through global warming, biodiversity loss and pollution. Ensuring a livable planet and wellbeing for current and future generations will require fundamental changes in infrastructure, governance and, not least, human behaviour. Given the profound significance of human behaviour in shaping future pathways towards sustainability, a richer understanding of human behaviour is required. It must take into account the fact that human behaviour is embedded in an economic, social, cultural and ecological context, and that behaviour continuously co-evolves with these changing contexts. The overall mission of the *Behaviour, Economics and Nature (BEN)* research programme is to contribute to this new understanding.

Programme directors
J. Marty Anderies and
Therese Lindahl

Broadening the focus

BEN has been very successful in advancing social-ecological systems research focusing on human behaviour at individual and community scales, while building on and integrating expertise and insights primarily from behavioural sciences. The programme is currently building capacity to address behavioural questions at larger scales.

As a first step in this work, BEN hosted a workshop in 2018 on the topic '*Understanding Humans as Encultured Actors in the Governance of Shared Resources*'. In summary, the workshop was extremely productive, with several interesting ideas and potential long-term collaborations emerging (see last year's annual report).

While we continue to advance our social-ecological research on individual and community levels, below we summarise our efforts to build on and extend the ideas that emerged from last year's workshop.

"Compelling stories can create new meanings and have a powerful influence on attitudes and behaviour"

Towards a more dynamic understanding of human behaviour

We have synthesised some of the insights gained through our various collaborations over the years in a manuscript entitled 'Towards a more dynamic understanding of human behavior in the Anthropocene' (under revision before resubmission to *Nature Sustainability*). In the manuscript, we advocate a complex adaptive systems (CAS) approach for understanding and studying human behaviour. Such an approach acknowledges that people take decisions that are embedded in, and affected by, their social-cultural environment and the biosphere upon which they are ultimately dependent. Furthermore, a CAS approach allows interactions between different levels of behaviour to be studied. For example, it can reveal how certain behavioural norms emerge through local interactions between individuals and evolve in a specific time and place, or how different behavioural norms can emerge depending on context (e.g. cultural, economic and ecological).

A CAS approach also enables study of how larger-scale processes and phenomena, such as trade, technological change and climate change, give rise to certain behavioural responses at the individual and community levels, which in turn can give rise to certain patterns and outcomes. We argue that connecting human behaviour and context through a CAS lens is critically important for informing environmental governance and management actions for sustainability, and ultimately for better understanding the dynamics of the Anthropocene itself.

Project members:

Therese Lindahl, Caroline Schill, Carl Folke and Anne-Sophie Crépin, the Beijer Institute; J. Marty Anderies, Arizona State University and the Beijer Institute, Stephen Polasky, University of Minnesota, Juan Camilo Cárdenas, Universidad de los Andes, Colombia, Marco Janssen, Arizona State University, Jon Norberg, and Maja Schlüter, Stockholm Resilience Centre.

Narratives for a sustainable future

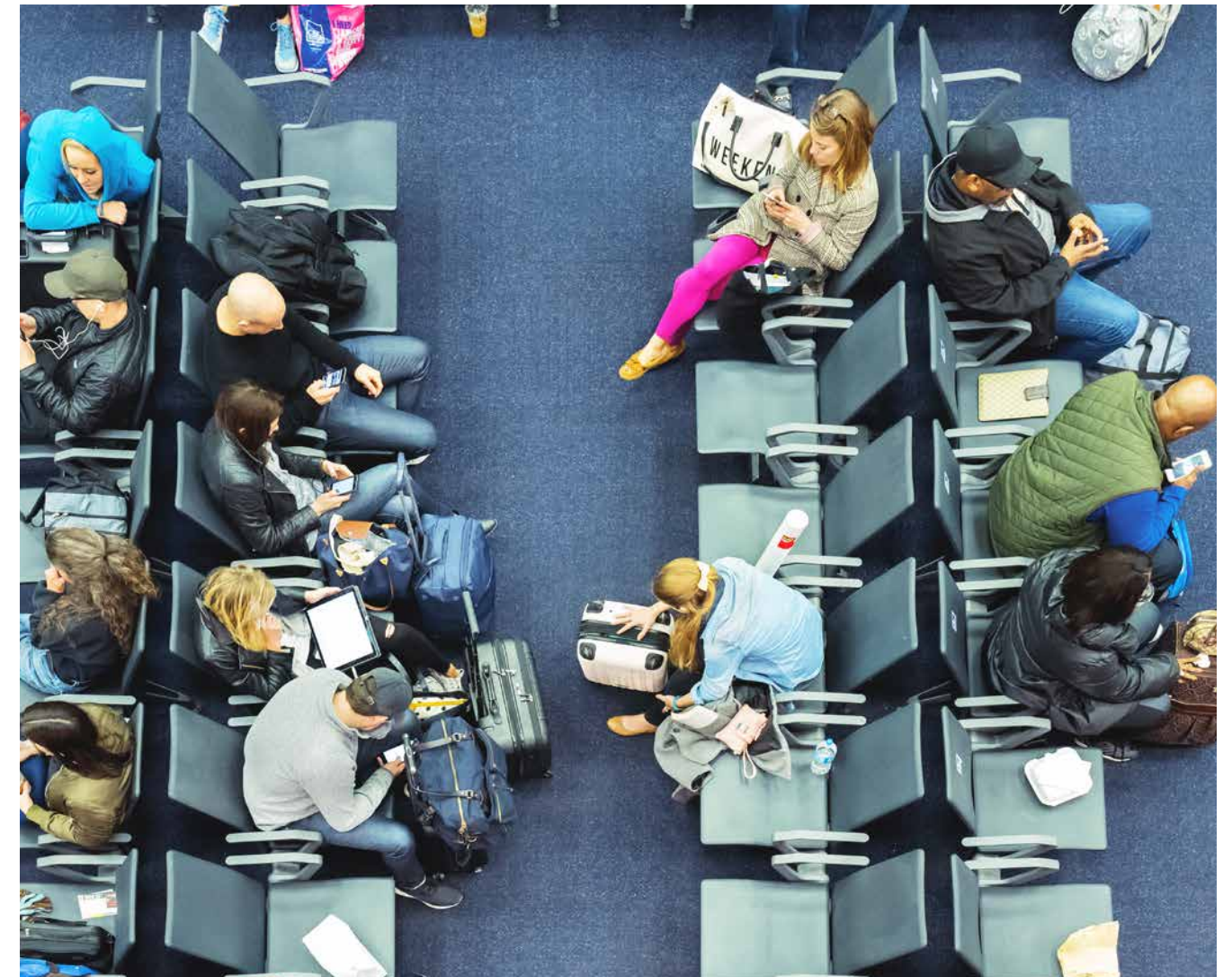
People in many places are facing turbulent times in many different dimensions. However, many still feel disengaged from the Earth and do not recognise how Earth systems support their lives or the impact of their actions on the Earth. The emergence of new meanings and 'narratives of hope' is an essential element of a livable Anthropocene. These should include narratives in which humans are considered part of the planet and embedded within its biosphere. The understanding gained can help redirect actions towards just and sustainable futures consistent with biosphere capaci-

ty. Compelling stories can create new meanings and have a powerful influence on attitudes and behaviour, but their actual influence depends on a wide range of factors, such as socio-cultural contexts. Commitment to sustainability must thus be made meaningful and effective in mobilising different audiences.

To advance this field of research, the Beijer Institute hosted the workshop '*Imaginaires and the Biosphere*' on 27–28 May, 2019. This workshop brought together for the first time scholars from sustainability science and scholars with a deep understanding of psychological, social and cultural processes underlying meaning creation, the emergence of 'new meanings' and social movements. The whole group expressed excitement about contributing to this new area of research and about continuing to develop the collaboration.



Back row: Caroline Schill, Marty Anderies, Carl Folke. **Middle Row:** Therese Lindahl, Manjana Milkoreit, Frances Westley, Francesca Polletta, Wendy Espeland, Michele Lamont. **Front row:** Henrik Österblom, Perna Singh, Nanda Wijermans, Hazel Markus
Photo: Christina Leijonhufvud.



Modelling behaviour

In the grand challenge of exploring the interplay between diverse interacting humans and the contexts in which they live, formal models can play a key role. However, to drive research forward in this area, we need to move beyond very abstract or very case-specific models and develop classes of models, derived from empirical studies and expert knowledge, that capture the essential features of human behaviour within different contexts. These models can help explore and increase understanding of how specific factors, e.g. an external shock or a policy intervention, can interact with contextual factors and give rise to certain patterns and outcomes. We have some ongoing research efforts. For example, we are currently planning a series of field experiments in different fishing communities where we will systematically explore the role of specific contextual factors (social-economic, cultural and ecological) for individual and collective resource extraction when fishers face increasing resource scarcity and variability (see also last year's report). The empirical and experimental data obtained will be fed into agent-based

models that allow us to systematically explore how diverse resource users, in different social settings and in different contexts, manage to respond and adapt to more challenging resource conditions, e.g. increasing resource scarcity and resource variability.

In parallel, we are developing a generalised modelling framework to understand how diversity in livelihood options, skill and education levels, preferences and life experiences impacts the capacity of groups to self-organise and generate governance structures to address natural resource dilemmas, and thereby overcome overexploitation. The modelling framework is intended to be general, while still capturing the essential features of individual human behaviour related to biophysical, economic and social contexts that shape decision making.

Project members:

Therese Lindahl and Caroline Schill, the Beijer Institute, Maja Schlüter and Nanda Wijermans, Stockholm Resilience Centre.



Research programmes

Aquaculture and sustainable seafood

A fundamental challenge facing humanity today is providing healthy diets for a growing world population in a sustainable and inclusive way. Fish and shellfish comprise an estimated 17 % of the global animal-based protein supply and are the primary source of animal protein for billions of people. The *Aquaculture and Sustainable Seafood* programme provides insights for governance of the seafood system so that fish and shellfish can continue to play an important role for our global food portfolio.

Programme director
Max Troell

[1]
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A “Blue food” year

Increasing seafood production, as part of the broader “Blue growth” agenda of international agencies, can generate a variety of new income opportunities and resources, including food and animal feed, especially in developing countries. This increase will mainly have to come from aquaculture. The EAT-Lancet report¹, released in early 2019, and an associated article in *Nature*², both with contributions from this programme, explored options for keeping healthy diets within planetary environmental limits and highlighted the important future role of seafood. A scoping report³ by the Beijer Institute and partner GEDB analysed in depth how seafood can contribute to health and environmental sustainability. It also investigated challenges and future prospects for increased sea food production. These questions were discussed at a special session. *Expanding Aquaculture within the Planetary Boundaries*, organised by the programme at the 2018 World Aquaculture Society in Montpellier.

“Uneven distribution of the benefits from marine aquaculture (mariculture) is a global problem. In parallel, there is a disconnect between the demands by those involved in mariculture and how these are captured at policy level.”

In addition, Beijer Institute researchers are playing a leading role in setting up a new international platform to develop and mobilise broad support for science-based strategies to achieve sustainable blue food transition. This *Blue Food platform* is part of Friends of Ocean Actions convened by the World Economic Forum, and is a collaboration between EAT/Stockholm Resilience Centre, the FAO, Stanford University and the World Resources Institute. Its first workshop for structuring a “Blue Food Assessment” was held back-to-back with the Stockholm EAT Forum 2019 and included more than 20 international experts and seafood policy representatives. Specific topics included different aspects of environmental sustainability, health, equity and transformation trajectories.

Species vary in nutrition and footprint

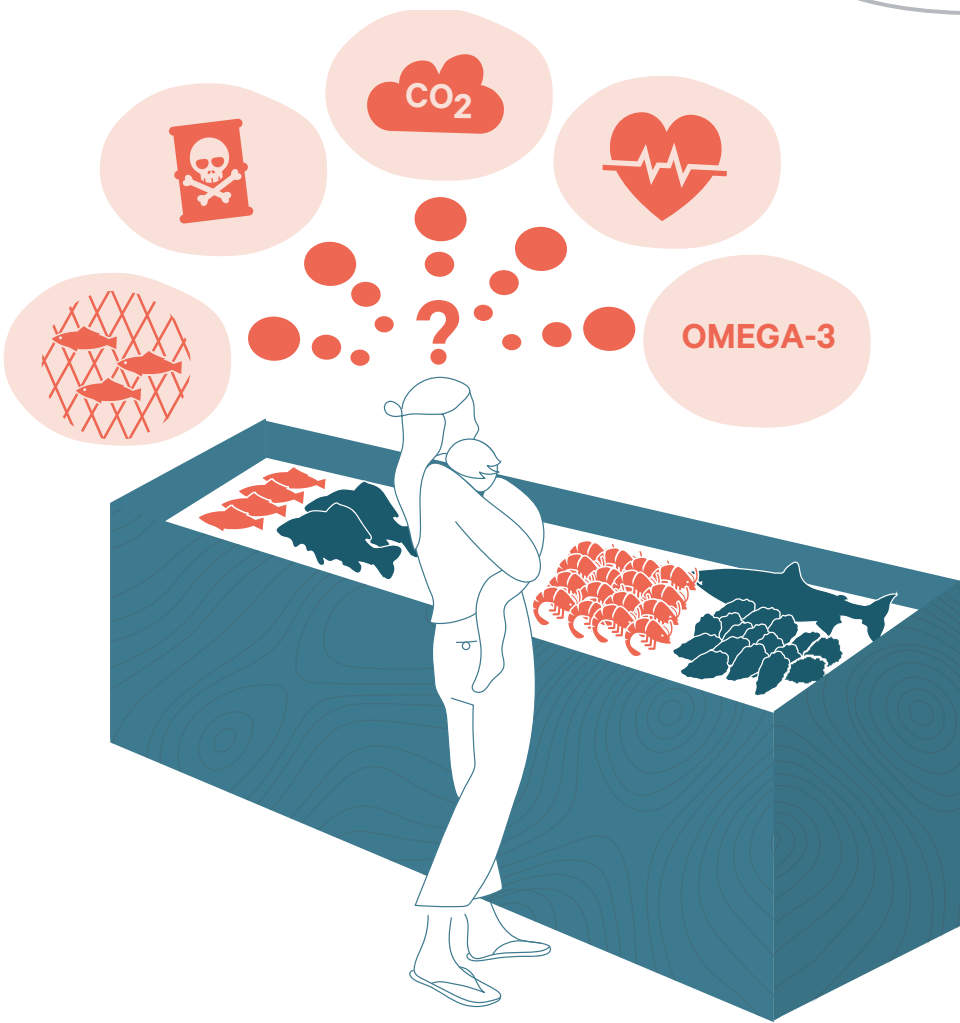
Seafood is a diverse food commodity comprising >2500 species from capture fisheries and >600 species from aquaculture with widely different production methods. The report “*Improved Human Health from Seafood Consumption Without Risks*”⁴, produced within the Beijer Institute-led project SEAWIN, was presented at a Royal Swedish Academy of Sciences symposium in early 2019. The report scrutinises dietary advice, in-

cluding recommendations to increase consumption of seafood based on health benefits. It collates available information on health risks and benefits of Swedish seafood consumption and combines this with carbon footprint data. Around 40 seafood products consumed in Sweden were analysed and the nutritional content and carbon footprint were found to differ vastly between species. The report provides a foundation for further data collection to enable combined assessments of the nutritional risks, benefits, and environmental sustainability of seafood.

Seafood certification – a drop in the ocean?

Market-based tools such as eco-certification are one of the main sustainability mechanisms used in the sustainable seafood movement. A recent article⁵ led by SRC and Beijer researcher Malin Jonell reviews existing aquaculture certification schemes and discusses challenges and potential methods for monitoring the effectiveness of these schemes in reducing negative environmental and social impacts. The potential of eco-certification schemes to transform the seafood sector at global scale is also discussed and barriers are highlighted.

An article in *Marine Policy*⁶ by Ola Luthman of Södertörn University, a former Beijer researcher, together with Malin Jonell and Max Troell, compares the Aquaculture Stewardship Council (ASC) standard to national or regional conventional regulations/standards for salmon farming in Chile, Norway, UK and Canada. It shows that the ASC standard currently has three strong advantages, relating to: escape numbers allowed, antibiotic usage, and fish resources used in feed. Inclusion of these in national/regional regulations would significantly improve sustainability in uncertified salmon farming.



Based on Illustration by:
Azote.

Inclusive mariculture development

Uneven distribution of the benefits from marine aquaculture (mariculture) is a global problem. In parallel, there is a disconnect between the demands by those involved in mariculture and how these are captured at policy level. This ‘people-policy gap’ must be closed if mariculture is to achieve sustained and inclusive economic growth. A diagnostic framework⁷ developed jointly by the Australian Centre for International Agricultural Research (ACIAR), Worldfish and Western Indian Ocean Marine Science Association (Wiomsa), with Max Troell on the team, can be a useful tool in coastal management decision-making and mariculture planning and policy.

Antibiotic use in seafood

The programme continues to be involved in the SeabOS initiative, which connects the global seafood industry to science, wild capture fisheries to aquaculture,

and European and North American companies to Asian companies. The programme’s contribution relates to antibiotic use, a focal area for SeabOS. A background brief on current antibiotic use and resistance is under development and will provide comprehensive background knowledge for a dialogue in Phuket later in 2019.

Read more: keystonedialogues.earth

Upscaling aquaculture

Expectations for future aquaculture expansion are high, but few have considered the practical and environmental implications of upscaling different systems. A series of parallel studies on upscaling issues has been initiated, with the programme as partner. Preliminary results from one study led by Patrik Henriksson show that a set of national-scale interventions would allow Indonesia to double its production within its current environmental footprint.

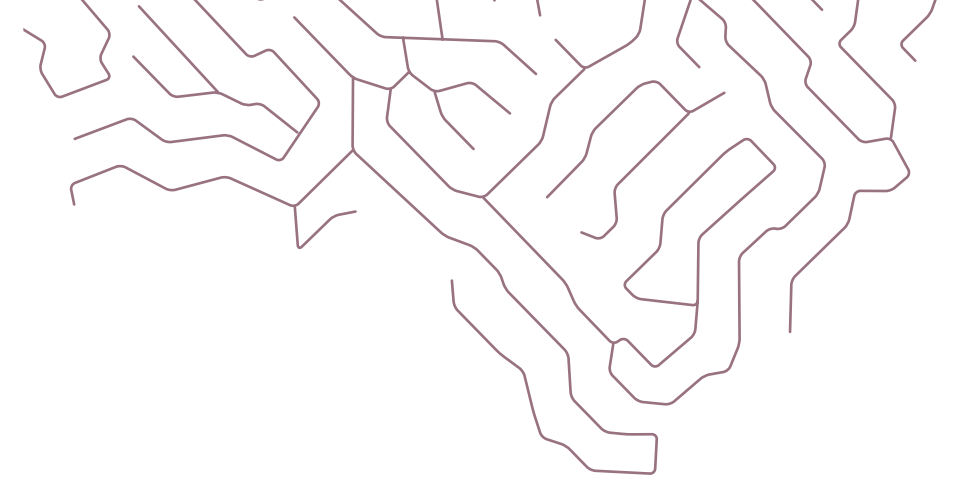
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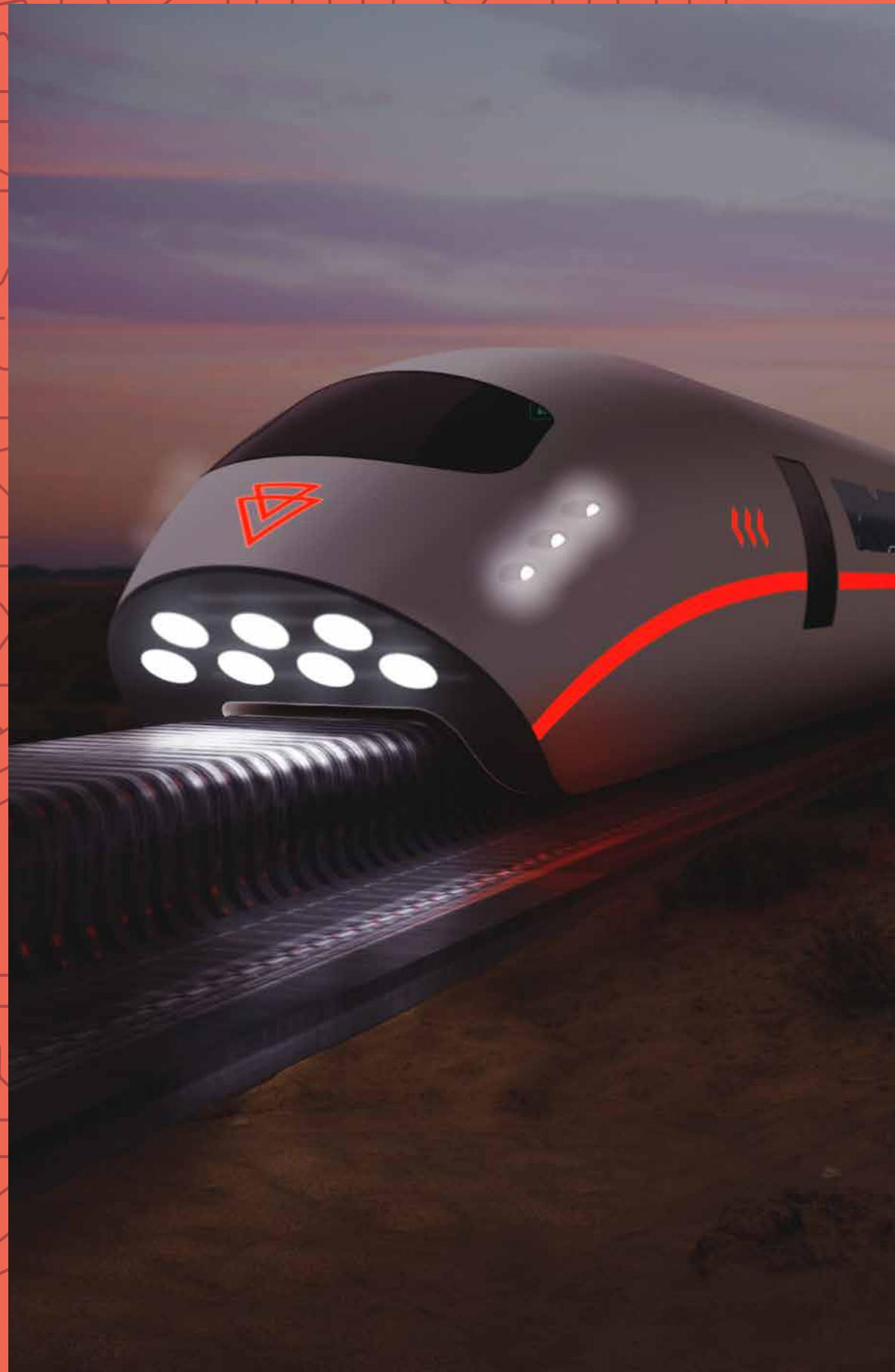


Research programmes

Governance, Technology and Complexity

The speed and scope of climate, environmental, technological and socio-economic change pose serious challenges to the problem-solving capacities of norms, institutions and legal systems world-wide. This is exacerbated by the fact that, due to globalisation and technological change, the world can be viewed as increasingly shaped by the behaviour of complex systems: emergence, connectivity, surprise, non-linear changes and poorly understood interactions across regions and sectors in society. Governing complexity is one of the most difficult challenges facing decision-makers around the world today. The Beijer programme *Governance, Technology and Complexity* is a long-term commitment to advancing interdisciplinary insights into these important issues, which are of high relevance for society and sustainability.

Programme director
Victor Galáz



The programme is being run in close collaboration between the Beijer Institute, Stockholm Resilience Centre (SRC), Princeton University and a suite of international collaborators. The emphasis is on how societal complexity interacts with complex systems of the biosphere, and on governance issues associated with these interactions. The ambition is to continue to identify opportunities for cross-fertilisation and build partnerships with scholars from different fields such as finance, law, economics, political economics, computer sciences, and risk studies. The programme strives to combine important theoretical insights with novel and grounded empirical research.

In its first year, the programme clarified its niche and built strategic collaborations. Future work will focus on the interface between advances in artificial intelligence, the biosphere and governance.

Opportunities and risks with artificial intelligence

Algorithms – step-by-step sequences of operations that solve specific computational tasks – are transforming the world around us. They support sophisticated search engines, voice recognition software, online transactions, data compression, targeted advertising and self-driving cars. However, algorithmic systems also shape our biosphere, not least since they are critical ingredients in devices and services that affect what people buy and consume, and how they travel. Algorithms and increasing access to data also underpin almost all environmental monitoring technologies and support the global infrastructure networks continually extracting natural resources such as rare minerals, fossil fuels and living marine resources. In addition, algorithms conduct millisecond automatic trades with financial instruments for commodities such as wheat, rice and soybeans.

To address these new developments, the *Governance, Technology and Complexity* programme is investigating how innovative technology such as increasingly advanced algorithmic systems (e.g. machine learning and artificial intelligence) could support or undermine transformations to sustainability.

As part of this research, the programme hosted a workshop at Princeton University, in collaboration with the Princeton Institute for International and Regional Studies (PIIRS), on 11–12 January 2019. The workshop explored the possible risks of increased use of artificial intelligence in sectors connected to the biosphere, such as agriculture, forestry and marine fisheries. The organising team is currently bringing together insights in a synthesis paper to be submitted by the end of the year. Read more under the section ‘Frontier workshops’.

As part of the ambition to build strategic partnerships, in June 2019 the programme, along with Stockholm Resilience Centre (SRC), became an official partner to the new AI Innovation of Sweden centre, a national initiative designed to “serve as an engine in

the Swedish AI ecosystem”. This will ensure that Beijer Institute and SRC research connects to leading AI-thinkers and doers in Sweden.

Challenges for governance

A book entitled “*Global Challenges, Governance, and Complexity – Applications and Frontiers*” will be published by Edward Elgar (UK/US) in late 2019. The book, edited by Victor Galaz, includes contributions from leading scholars in a wide variety of disciplines, ranging from ecology, philosophy and sociology to economics, law and the cognitive sciences. It presents the state of the art of this new emerging research field. The book argues that governing complexity requires a deep understanding of how complex adaptive systems behave and describes the key properties of adaptive modes of governance and how mental models, leadership and alliances can be used to achieve transformative change.

In connection with this stream of research, computational social scientist David Garcia (Vienna Complexity Hub) was invited to Stockholm to share his work about using social media data to track changes in social values after traumatic national events (such as terror attacks). This is also part of emerging research that explores the role of online disinformation on issues related to food, health and climate. The event was the start of a joint project, which will result in a first paper on these topics in late 2019.

Research on complexity, economics and resilience

The Beijer Institute has a long tradition of research focusing on the complex interactions between the biosphere and the economy in local and global contexts. This type of research is key to identifying potential ways to improve the governance of complex systems. During the year, Beijer researchers Anne-Sophie Crépin, Chuan-Zhong Li and Carl Folke published a review paper entitled “*The economics of resilience*”². The paper, published in the *International Review of Environmental Resource Economics*, looks at resilience and economic models, theories and cases, with special reference to social-ecological systems and regime shifts (large, abrupt, persistent changes to a system). The authors address the basic sciences of regime shifts and resilience in different settings linked to empirical cases, and review the related economic models.

Beijer Institute researchers Daniel Ospina (also at SRC) and Anne-Sophie Crépin, together with Garry Peterson, SRC, published an article in *Environmental Research Letters*³ in which they propose a model that links forest regrowth, land to city migration and remittances. The model displays regime shifts and can explain substantial parts of the dynamics documented in the literature.

The research project ‘*Introducing additional earth system processes into a climate-economy growth framework*’ (2015–2019) aims to model the global interac-

tions between macroeconomic and biophysical processes of the earth system. Rather than focusing only on interactions between the climate and the economy in the tradition of Nordhaus, this project extends to other types of planetary boundaries, in particular those related to food production and energy. The project is led by Gustav Engström in collaboration with Johan Gars (also at GEDB) and Chandra Kiran Krishnamurthy (also at Swedish University of Agricultural Sciences), and it is funded by the Ragnar Söderberg Foundation.

A direct potential implication of this type of research is to contribute policy advice better adapted to the dynamics of the Anthropocene, a subject addressed the publication ‘*Policy design for the Anthropocene*’ led by Beijer Fellow Thomas Sterner, University of Gothenburg and published in *Nature Sustainability*⁴ with Anne-Sophie Crépin and Gustav Engström together with several Beijer fellows on the author team.

Future activities

A Stockholm Seminar with Professor Markus Reichstein about applications of AI for climate modelling, entitled “Deep learning and process understanding for data-driven Earth system science”, will be held on 21 August 2019.

The programme is planning a larger event on 15 October 2109 in a new initiative led by the Beijer Institute, Princeton University and Stockholm Resilience Centre entitled “AI, People and the Planet”. It will take place at the official Swedish Residence in New York and will be hosted by the Swedish Consulate General in New York. The event will combine a closed scientific workshop and an open event with participants from US and Swedish academia, policy-making, business and UN organisations. The ambition is to build an international alliance of organisations interested in exploring the risks and opportunities to the biosphere created by applications of artificial intelligence.



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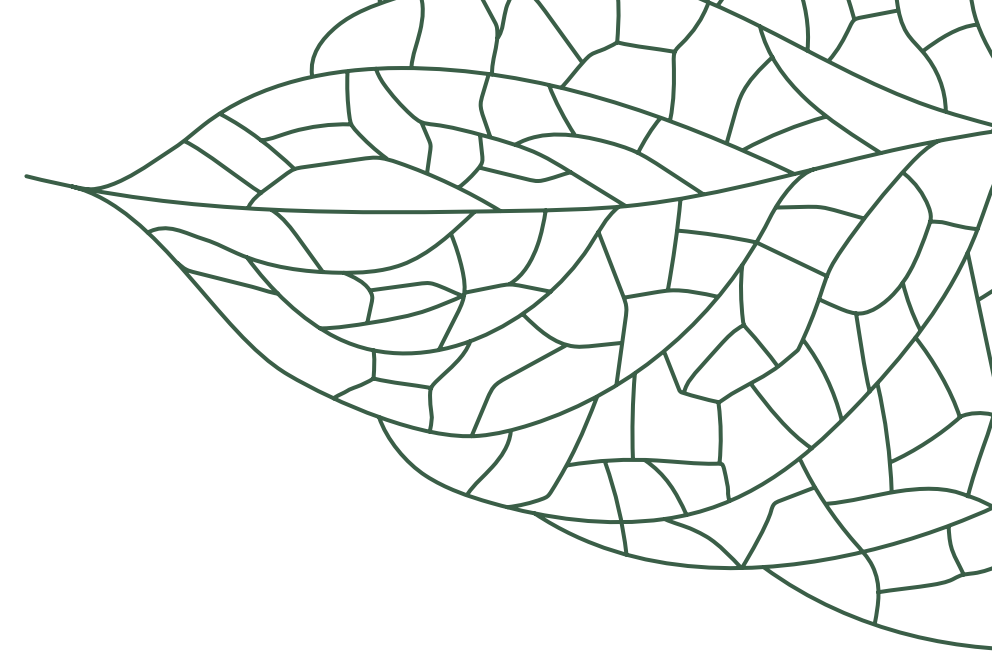
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Research programmes

Urban Social-Ecological Systems

The world is urbanising at an unprecedented rate. Cities currently account for around 70 % of both the world's energy use and greenhouse gas emissions, and contribute to environmental degradation on a global scale. The highest rates of urban growth are in regions that are currently relatively undisturbed by urban development. In the *Urban Social-Ecological Systems* research programme, we are studying how cities could become more reconnected to the biosphere. This involves research on how ecosystems promote urban resilience building, human health and wellbeing, and create suitable conditions for both humans and nature. The interplay between ecosystem services, governance institutions, human behaviour and design of the built environment is viewed as critical for creating more sustainable and climate-change resilient cities.

Programme director
Johan Colding





“urbanisation is now changing the dynamics of species traits and ecosystem functions”

Smart urban development

Besides submission of several new research applications, a central programme activity over the year has been to screen the popular notion of ‘smart cities’, which is an influential development paradigm in urban planning and governance. While ‘smart’ may take different meanings, the programme’s intention is to scrutinise the rationales behind the digitalisation and densification of cities, with the aim of ensuring more resilience-oriented urban growth that takes greater account of climate-change adaptation/mitigation and nature-based solutions in urban governance.

A two-day seminar on smart cities and digitalisation was held in the city of Gävle, 25–26 October 2018. The event was co-organised by the Beijer Institute and the University of Gävle, and brought together leading researchers from Europe and Sweden. Four themes were addressed, ranging from the politics of the smart city to smart tools and smart architectural design in urban planning.

This seminar was followed by a second gathering, held in Gothenburg, Sweden, 18–19 June 2019, organized by the dep. of Architecture and Civil Engineering at Chalmers University of Technology. The focus of this international seminar was the balancing act between dense and green urban development. One of the conclusions was that urbanisation is now changing the dynamics of species traits and ecosystem functions. Another was that the answer to the problems of smart growth does not lie in building less dense cities, but in embracing different degrees of density that maximise the advantages and counteract the disadvantages of densification. Urban greening also needs to be part of the solution. The research consortium agreed on a need for new concepts and new images that can position density in a systems perspective and include both social and ecological processes.

In the project ‘*Understanding smart city development from a resilience perspective*’, carried out in collaboration with scholars affiliated to the Urban Studio at the University of Gävle, a publication on environmental psychology was released in spring 2019 in the *Journal of Environmental Psychology*¹. It shows that people tend to exaggerate the benefits of small greenhouse gas emission cuts.



Smart Growth, a popular concept for sustainable cities, lacks scientific proof

At a seminar honouring the Volvo Environment Prize laureate 2018, held Xuemei Bai, at the Academy in November 2018, programme researcher Åsa Gren presented a new programme publication² that takes a closer look at the Smart Growth concept, which views densification as an environmentally desirable way of building cities. In their review, the author team, including colleagues from Chalmers University and the University of Gävle, analysed the scientific literature on the concept and found that surprisingly few studies have actually examined the environmental rationales behind Smart Growth. In fact, 34 percent of the studies reviewed reported negative consequences of applying a Smart Growth strategy, particularly for biodiversity. The studies that did report positive outcomes focused on a limited number of environmental parameters, such as reduced Co₂ emissions due to less private transportation. These studies lacked a broader perspective, failing to take into account important aspects such as leisure travel. The authors do not argue against the Smart Growth concept per se, but consider it an “unfortunate time in history” for strong scientific knowledge and consensus to be still lacking concerning this concept, considering the amount of cities being built. They call for more research on Smart Growth.

Social-ecological systems revisited

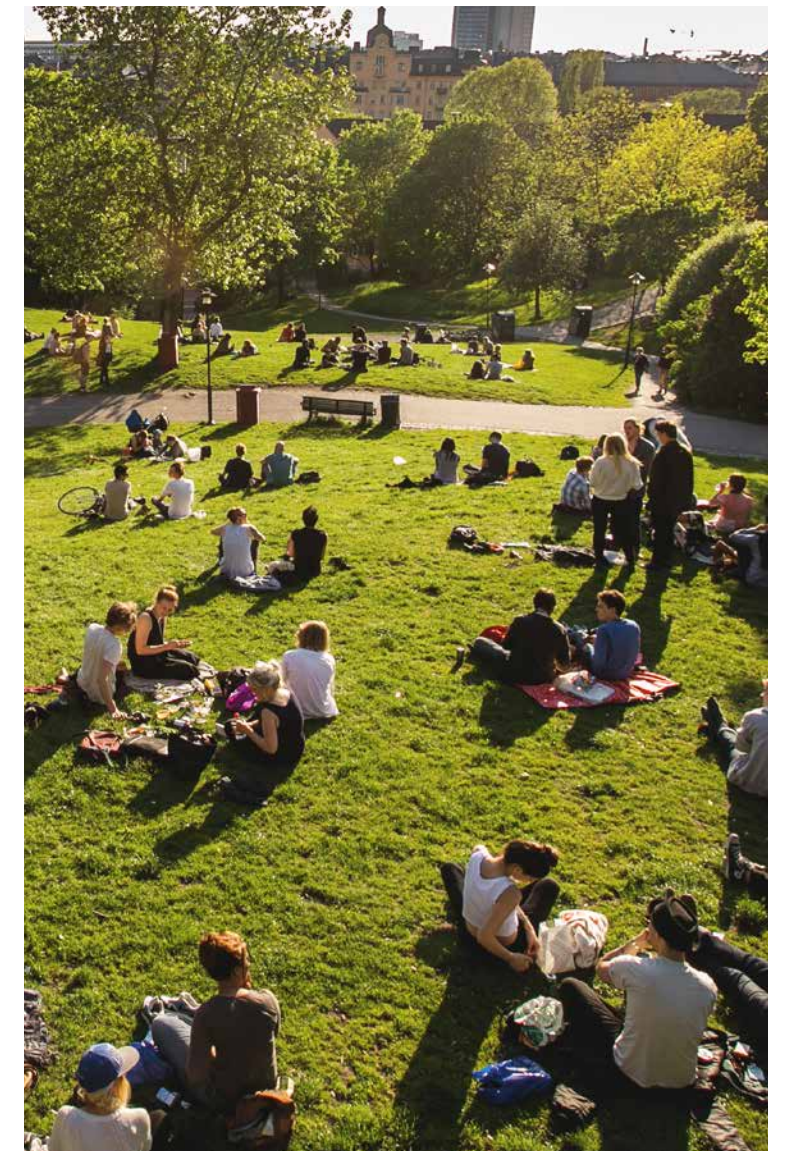
Social-ecological systems thinking addresses the interplay between social groups, cultures and societies, and their relationship and interplay with the surrounding physical environment. The concept originated in research by Carl Folke, Fikret Berkes and Johan Colding on local communities with a long track record of conferring resilience in local natural resource systems. It revealed a high degree of interlinkage between socio-cultural and ecological systems that is expressed in local institutions, world views, social mechanisms and different ecosystem management practices. This research later developed into a descriptive framework for studying social-ecological linkages. It has been used e.g. for analysing urban systems in the Millennium Ecosystem Assessment. A programme article in the journal *Ecology & Society*³ explores the 20-year evolution of the social-ecological systems (SES) framework. It shows that interest in the field has rocketed, with nearly 13,000 scientific publications to date. It also lists a number of limitations that need to be overcome for SES research to continue to prosper.

Cities from the resident’s perspective

An article in the journal *Landscape and Urban Planning*⁴ by researchers at the Beijer Institute and Stockholm Resilience Centre addresses the difficulty in balancing urban development and residents’ experience

of their city. It looks at the interactions of different relationships between urban environments and well-being. Using Stockholm, Sweden, as a case study, the authors apply ‘resilience principles’ as a guide, and develop typologies for how residents use the city space. The findings could help urban developers, planners and city officials understand how residents use space, and could also promote designs for more healthy and attractive cities.

From another angle, a study in *PloS one*⁵, co-authored by Beijer Institute researcher Gustav Engström, advances understanding of how and why city residents value green space. Taking Stockholm as a case study, the authors use a sociotope map and real estate data to determine public willingness to pay for areas with particular attributes. They show that green spaces with aesthetic, social and nature characteristics increase property values. Studying green spaces in terms of multifunctionality can provide more detailed information to city planners about the type of green spaces people value.



[1]
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[2]
Reference
Gren, Å., J. Colding, M. Berghäuser-Pont, and L. Marcus. 2018. How smart is smart growth? Examining the environmental validation behind city compaction. *Ambio* 48 (6): 580–589.

[3]
Reference
Colding, J., and S. Barthel. 2019. Exploring the social-ecological systems discourse 20 years later. *Ecology and Society* 24 (1): 2.

[4]
Reference
Samuelsson, K., J. Colding, and S. Barthel. 2019. Urban resilience at eye level: spatial analysis of empirically defined experiential landscapes. *Landscape and Urban Planning* 187: 70–80.

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Reference
Czebrowski, P., E. Łaszkiewicz, J. Kronenberg, G. Engström, and E. Andersson. 2019. Valuing individual characteristics and the multifunctionality of urban green spaces: The integration of sociotope mapping and hedonic pricing. *PloS one*, 14 (3): e0212277.



Selected publications

Contagious collapses

ECOSYSTEMS SOMETIMES CHANGE in such dramatic and substantial ways that they cross a tipping point. Scientists call such largely irreversible changes “regime shifts”. For example, a rainforest can shift abruptly to dry savannah due to the combined effect of deforestation and climate change.

A group of researchers from the Beijer Institute and Stockholm Resilience Centre (SRC) teamed up with Beijer Fellow and Princeton University ecologist Simon Levin to study how such regime shifts can be better managed and prepared for. Their results, published in *Science*, suggest that more attention should be paid to how regime shifts are connected and how those connections could be managed.

“Regime shifts pose challenges to ecological management and governance because they are difficult to predict and reverse, and substantially alter the availability of benefits that people receive from nature,” explains lead author and former Beijer researcher Juan Rocha, SRC.

The group of researchers specifically studied the potential for some regime shifts to trigger or increase the risk of other regime shifts occurring, so-called cascading regime shifts. One such example is the connection between Arctic ice sheets and boreal forests. When ice sheets melt, reflection of the sun’s heat diminishes, so the temperature of the Earth rises. This increases the risk of forest fires, which discharge carbon into the air, and this adds to the greenhouse effect, melting more ice.

Hundreds of case studies

The study was based on systematic network analysis of more than 300 case studies and 30 types of regime shifts documented in the Regime Shifts Database (regimeshifts.org). The researchers divided the regime shifts into two different types of cascading effects, “domino effects” and “hidden feedbacks”. The first type is rather straight-forward and occurs when one regime shift gives rise to subsequent regime shifts in a nearby or dis-

tant ecosystem, whereas the other “hidden” type is the result of two-way interactions that cannot be identified by studying one regime shift at a time.

When regime shifts are interconnected over large distances, the authorities or individuals making decisions on management are not necessarily those who have to deal with the impacts. This is the case e.g. for mechanisms that connect distant ecosystems through climate change, fire, nutrient inputs or trade.

Moisture recycling is another interesting example. It is a key underlying factor in the regime shift from rainforest to savannah in the Amazon, but also has the potential to cascade to ecosystems far beyond the forest that depend on moisture recycling as an important water source. In this way, changes in moisture recycling can affect mountain forests in the Andes or nutrient cycling in the ocean by affecting sea surface temperature, causing regime shifts in marine food webs.

Avoiding regime shifts

For managers, it is of key importance to avoid regime shifts, as they can have substantial impacts on human economies and societies and are often difficult and costly to reverse. Development of early warning signals that also take coupled regime shifts into account is therefore urgently required.

Another important aspect put forward in the study is the need to identify common drivers for several different regime shifts. This could result in management strategies that target specific “bundles of drivers”, increasing the chances of preventing several regime shifts simultaneously.

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Rocha, J.C., G. Peterson, Ö. Bodin and S. Levin. 2018.
Cascading regime shifts within and across scales. *Science* 362 (6421), 1379-1383.

Selected publications

Planet at risk of heading towards “Hothouse Earth” state

KEEPING GLOBAL WARMING to within 1.5–2°C may be more difficult than previously anticipated. In a paper in Proceedings of the National Academy of Sciences (PNAS), an international team of scientists, including Beijer Institute director Carl Folke, claim that even if the carbon emission reductions called for in the Paris Agreement are met, there is a risk of Earth entering what these scientists call “Hothouse Earth” conditions.

In the long term, the “Hothouse Earth” climate will stabilise at a global average of 4–5°C above pre-industrial temperatures, with sea levels 10–60 m higher than today, according to the study. This means that it is now imperative to greatly accelerate the transition towards an emission-free world economy.

“Human emissions of greenhouse gases are not the sole determinant of temperature on Earth. Our study suggests that human-induced global warming of 2°C may trigger other Earth system processes, often called “feedbacks”, that can drive further warming – even if we stop emitting greenhouse gases,” says lead author and Beijer Fellow Will Steffen from the Australian National University and Stockholm Resilience Centre. “Avoiding this scenario requires a redirection of human actions from exploitation to stewardship of the Earth system.”

Currently, global average temperatures are just over 1°C above pre-industrial levels and rising at 0.17°C per decade.

Places on Earth will become uninhabitable

The authors consider natural feedback processes, some of which are “tipping elements” that lead to abrupt change if a critical threshold is crossed. These feedbacks could turn from being a “friend” that stores carbon to a “foe” that emits it uncontrollably in a warmer world. These feedbacks are: permafrost thaw, loss of methane hydrates from the ocean floor, weakening land and ocean carbon sinks, increasing bacterial respiration in the oceans, Amazon rainforest dieback, boreal forest dieback, reduction of northern hemisphere snow cover, loss of Arctic summer sea ice, and reduction of Antarctic sea ice and polar ice sheets.

According to the paper, it is uncertain whether the climate system can be safely ‘parked’ near 2°C above pre-industrial levels, as the Paris Agreement envisages, or whether, once pushed that far, it will accelerate towards a hothouse planet, making places on Earth uninhabitable. Research must assess this risk as soon as possible, the authors argue.

Cutting greenhouse gases is not enough

Maximising the chances of avoiding “Hothouse Earth” requires reductions in carbon dioxide and other greenhouse gas emissions and enhancement and/or creation of new biological carbon stores, for example through improved forest, agricultural and soil management, biodiversity conservation and technolo-



gies that remove carbon dioxide from the atmosphere and store it underground. Critically, the study emphasises that these measures must be underpinned by the fundamental societal changes required to maintain a “Stabilized Earth” where temperatures are ~2°C warmer than the pre-industrial levels.

“We humans are now impacting the dynamics of the Earth system not only locally and regionally, but also at the global level. Such impacts can be shifted into active, conscious stewardship of our relationship with the biosphere and help stabilise the Earth in conditions conducive for sustainable societal development. This study identifies some of the levers in this direction,” says co-author Carl Folke.

Reference:
Steffen, W., Rockström, J., Richardson, K., Lenton, T.M., Folke, C., Liverman, D., Summerhayes, C.P., Barnosky, A.D., Cornell, S.E., Crucifix, M., Donges, J.F., Fetzer, I., Lade, S.J., Scheffer, M., Winkelmann, R., and Schellnhuber, H.J. (2018). Trajectories of the Earth System in the Anthropocene. *Proceedings of the National Academy of Sciences (USA)* 115 (33) 8252-8259.

Impact
The search engine Altmetric track a unique range of online sources to capture the conversations relating to research outputs, including media, blogs, and social media (e.g. twitter, facebook). Altmetric tracks about 10 million research outputs annually, from all research field and produces a collection of Top 100 research papers in terms of media impact. In 2018, this article was number 4 in the world. The paper had over 470 media reports within 24 hours of release, 10 Aug 2018.

The planetary health diet

With more than 3 billion people malnourished and food production driving climate change, biodiversity loss and pollution, transformation of the global food system is urgently needed.

THE REPORT OF the EAT-Lancet Commission on Healthy Diets from Sustainable Food Systems, released in early 2019, provides the first scientific targets for a healthy diet from sustainable food production that operates within planetary boundaries. The report promotes varied diets containing plant-based foods, low amounts of animal-based foods, refined grains, highly processed foods and added sugars, and unsaturated rather than saturated fats.

The report is a collaborative effort by 37 experts (representing 16 countries) in health, nutrition, environmental sustainability, food systems, economics and political governance. Stockholm Resilience Centre (SRC) was scientific coordinator and Beijer and SRC researchers Malin Jonell, Therese Lindahl and Max Troell contributed.

Food links health and environment

Human diets inextricably link health and environmental sustainability and can nurture both. However, current diets are pushing the Earth beyond its planetary boundaries, while causing ill health, placing people and the planet at risk. Providing healthy diets from sustainable food systems is an immediate challenge with the global population projected to reach 10 billion people by 2050 and become wealthier, likely increasing consumption of animal-based foods. Meeting this challenge requires dietary change, combined with improved food production and reduced food waste. The report calls for unprecedented global collaboration and commitment, to immediate changes such as refocusing agriculture to produce varied, nutrient-rich crops and increased governance of land and ocean use.

Scientific targets for a healthy diet

Increasing food production has improved life expectancy and reduced hunger, infant and child mortality rates and global poverty over the past 50 years, but these benefits are being offset by global shifts towards diets high in calories, sugar, refined starches and animal-based foods, and low in fruits, vegetables, whole grains, legumes, nuts, seeds and fish. Based on best available evidence, the report proposes a dietary pattern that meets

nutritional requirements, promotes health and allows the world to stay within planetary boundaries.

Compared with current diets, adoption of the new dietary pattern by 2050 will require global consumption of foods such as red meat and sugar to decrease by >50% and global consumption of nuts, fruits, vegetables and legumes to double. Global targets will need to be applied locally, e.g. countries in North America eat almost 6.5 times the recommended amount of red meat, while countries in South Asia eat only half the recommended amount. All countries are eating too much starchy vegetables (potatoes, cassava), with intake ranging from 1.5 times (South Asia) to 7.5 times (sub-Saharan Africa) the recommended level.

Seafood can be an important part of a future healthy diet. A scoping study by the Beijer Institute and partner GEDB analysed how seafood can contribute to health and environmental sustainability and investigated challenges and prospects for increased sea food production.

“Farmed seafood, both in the sea and on land, can play a bigger role in the future. But there is a need to include differences between sea food products in the models, related to health and environmental impacts”, says Max Troell, director of the Beijer programme *Aquaculture and Sustainable Seafood*.

“The food group intake ranges that we suggest allow flexibility to accommodate various food types, agricultural systems, cultural traditions, and individual dietary preferences – including numerous omnivore, vegetarian, and vegan diets,” says co-lead commissioner Walter Willett from Harvard University.

The authors estimate that widespread adoption of the diet would improve intake of most nutrients. Modelling of potential effects on deaths from diet-related diseases indicated that adopting the new diet globally could prevent 10.9–11.6 million premature deaths per year, reducing adult mortality by 19–23.6%.

Food sustainability

Since the mid-1950s, the pace and scale of environmental change have accelerated. Food production is the largest source of environmental degradation. Sustainable food production must keep within food-related planetary boundaries for climate change, biodiversity loss, land and water use, and nitrogen and



Fruit, vegetables, legumes and nuts play a central part in a sustainable diet.

phosphorus cycles. It must also be high enough to meet the food demands of a growing global population.

“The shift towards sustainable food production will require decarbonising agricultural production by eliminating the use of fossil fuels and turning land use into a net carbon sink. In addition, we need to safeguard existing biodiversity, have no net expansion of cropland, and develop drastic improvements in fertiliser and water use efficiencies,” says commission co-author Line Gordon, SRC director.

Using these boundary targets, the authors modelled various scenarios for a sustainable food system and healthy diets by 2050. Staying within planetary boundaries will require major dietary change, improved food production through enhanced agriculture and technology changes, and reduced food waste in production and consumption. The findings are also reported in an associated article in *Nature*, with Max Troell on the author team.

EAT-Lancet proposes:

- 1) *Encouraging people to choose healthier diets* by improving availability and accessibility to healthy food. This may increase consumer costs, so social protection may be required to improve nutrition in low-income groups.
- 2) *Refocusing agriculture from high-yielding monocultures* to producing varied, nutrient-rich crops. Globally, agriculture policies should incentivise producers to grow nutritious, plant-based foods, support diverse production systems and fund research on increased nutrition and sustainability.
- 3) *Sustainably intensifying agriculture* while taking into account local conditions, to help apply appropriate agricultural practices and generate sustainable, high-quality crops.
- 4) *Preserving natural ecosystems and ensuring food supplies*, e.g., by protecting intact natural areas, prohibiting land clearing, restoring degraded land, removing harmful fishing subsidies and closing at least 10% of marine areas to fishing (to create fish banks).
- 5) *Halving food waste*. Most food waste in low- and middle-income countries occurs during food production due to poor planning and lack of market access, storage and processing infra-

structure. Investment in agricultural technology and education is needed. Most food waste in high-income countries occurs at consumer level.

Richard Horton, editor-in-chief at The Lancet, concludes:

“The transformation that the commission calls for is not superficial or simple, and requires a focus on complex systems, incentives, and regulations, with communities and governments at multiple levels having a part to play in redefining how we eat. Our connection with nature holds the answer, and if we can eat in a way that works for our planet as well as our bodies, the natural balance of the planet’s resources will be restored.”

Outreach and media

Since its synchronised launch at 37 sites world-wide, the EAT-Lancet report has generated around 5800 articles in 118 countries, with over one million shares on social media. Based on media impact, the report is already in the top 5% of all research outputs in the Altmetric database. Launches were organised on 37 places across the globe, where the results were put in a local perspective and local media and stakeholders had the chance to ask questions (read about the Stockholm launch at page 37). A summary of the report is available in eight languages and six briefs directed at different sectors in society were produced. The report and all other material are available for downloading at eatforum.org/eat-lancet-commission/

References:

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Springmann, M., M. Clark, D. Mason-D'Croz, K. Wiebe, B. L. Bodirsky, L. Lassaletta, W. de Vries, S. J. Vermeulen, M. Herrero, K.M. Carlson, M. Jonell, M. Troell, F. DeClerck, L. J. Gordon, R. Zurayk, P. Scarborough, M. Rayner, B. Loken, J. Fanzo, H. C. J. Godfray, D. Tilman, J. Rockström and W. Willett. 2018. Options for keeping the food system within environmental limits. *Nature* 562:519-525.

Troell, M., M. Jonell, and B. Crona. 2019. The role of seafood for sustainable and healthy diets - The EAT-Lancet commission report through a blue lens. *Beijer Discussion Paper Series* No. 266.

Linking social inequalities and environmental change

RISING INEQUALITIES AND accelerating environmental change are two of the most significant challenges of the twenty-first century. But how are they linked?

A paper in the journal *Annual Review of Environment and Resources* presents a literature review of the links between social inequality and changes in the environment. It is the work of the second group in the Beijer Young Scholars programme, which consists of 19 interdisciplinary early-career scholars from around the world, including researchers at the Beijer Institute and its partner Stockholm Resilience Centre (read more on page 34). Their review shows that most research is one-directional, i.e. focusing on the specific effects of a social inequality on the environment, and fails to seek a more complex understanding of how inequality and the biosphere interact with each other.

“Previous analyses have mainly focused on economic inequality and its effect on a specific environmental variable, such as resource degradation or pollution, often using national-level data,” explains lead author Maike Hamann, University of Minnesota.

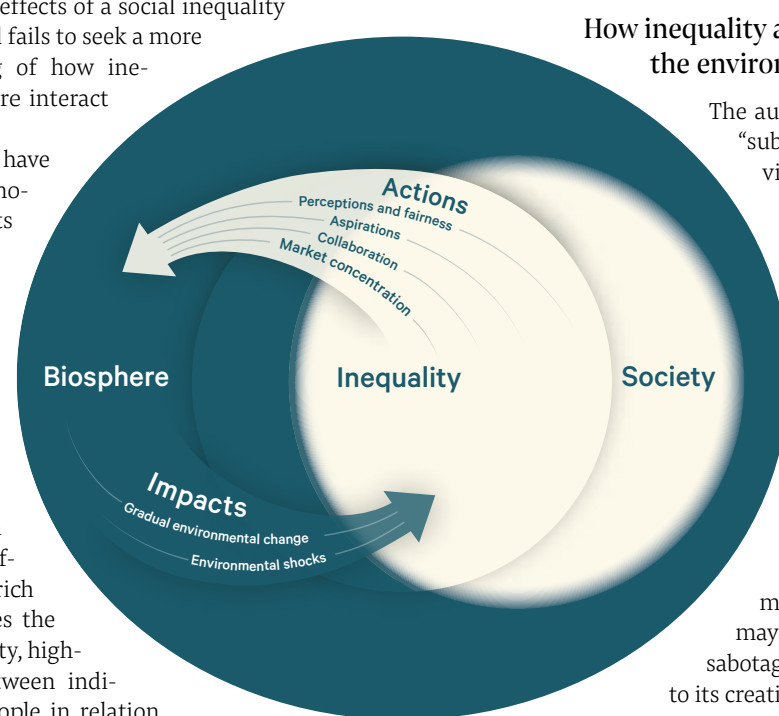
“Inequality is much more than financial differences between the rich and the poor, it includes the whole spectrum of society, highlighting differences between individuals or groups of people in relation to gender, or ethnicity for instance”, says co-author Caroline Schill, the Beijer Institute. “This study also looks at how drastic and gradual changes in the environment affect inequality in different ways”.

Interactions between inequality and the biosphere in social-ecological systems

The biosphere is naturally unequal. Not all places on Earth are equally endowed with access to energy resources, freshwater reserves or appropriate conditions for large-scale agricultural production. This has led to inequality in opportunities for societal development and economic expansion in different parts of the world. However, natural disasters such as storms, floods,

droughts and epidemics tend to hit low-income communities hardest, as exemplified by Hurricane Katrina in 2005 and the West Africa Ebola epidemic in 2014–15.

More gradual environmental change can also have a strong impact. Take fisheries, for example. Many of the world’s least developed countries that are most vulnerable to impacts of climate change are also heavily reliant on seafood and marine resources. In these countries, climate change is likely to reinforce economic hardship and hamper development and poverty alleviation. It may also exacerbate inequalities on a local level.



How inequality affects the environment

The authors of the study argue that “subjective inequality”, an individual’s perception of existing inequalities and beliefs about what is just and fair, can be a significant driver of how they behave towards the environment. For example, perceptions of inequality, fairness and even jealousy have played an important role in the success or failure of marine protection areas. If people feel they have been treated unfairly in getting access to a marine protection area, jealousy may lead some to encroach or even sabotage it, even if they were positive to its creation in the first place.

In many parts of the world, aspirations to achieve a higher living standard and status are leading to behavioural changes, such as an increase in meat consumption. This is having significant impacts on land use, e.g. with conversion of natural habitat to pastures for livestock.

Collaboration and collective action is one way in which shared natural resources can be sustainably managed. However, if there is inequality within the group that is managing a shared resource, this may lead to an erosion of trust, less cooperation and unsustainable use of the resource.

Finally, market concentration can cause inequality, which can benefit or harm a natural resource. The global seafood industry, where a small number of actors have a disproportionately strong influence on the management of the resources, is a fitting example.

Illustration: Hamann M, et al. 2018. *Annu. Rev. Environ. Resour.* 43:61-83

A first step

In the study, the authors show that environmental change and inequality must be looked at in more depth. Together with her co-authors, Caroline Schill calls for more research into these feedbacks, calling their review a “first step toward a more systemic, cross-scale and multidimensional understanding” of the interactions between inequality and the environment.

References:

Hamann, M., K. Berry, T. Chaigneau, T. Curry, R. Heilmayr, P. J. G. Henriksson, J. Hentati-Sundberg, A. Jina, E. Lindkvist, Y. Lopez-Maldonado, E. Nieminen, M. Piaggio, J. Qiu, J. C. Rocha, C. Schill, A. Shepon, A. R. Tilman, L. van den Bijgaart, and T. Wu. 2018. Inequality and the Biosphere. *Annual Review of Environment and Resources* 43 (1): 61-83.



Frontier Workshops

Workshops on central topics, often exploring new interfaces and frontiers and engaging internationally leading researchers, are a key feature of the Beijer Institute’s mode of operation. These workshops are often part of the institute’s research programmes and they sometimes provide unique emerging opportunities for new discoveries.

Human-Machine-Ecology

Princeton University, 11–12 January, 2019

The Beijer Institute, its partner Stockholm Resilience Centre and the PIIRS GRS Research group at Princeton University teamed up to organise a seminar and workshop in January 2019 at Princeton University, to address growing concerns about the world of artificial intelligence (AI). The central focus was on how emerging AI systems shape the way in which we perceive and respond to environmental change, and how AI could fundamentally alter the ways in which humans modify ecosystems around the world and impact human wellbeing. With the goal of fostering fruitful discussion and eventually a published work, this multi-disciplinary workshop brought together around twenty scholars from computer sciences, ecology, political science and other fields, and actors from the information technology (IT) sector, where AI systems are currently being developed and tested on the ground. The effort is an initiative within the Beijer Institute research programme Governance, Technology and Complexity, led by Victor Galaz.



Back row: Baolong Han, Zhiyun Ouyang, Nancy Grimm, Daniel Ospina, Dagmar Haase, Johan Colding, Steve Polasky, Timon McPhearson, Kelley Langhans, Carl Folke, Eric Lambin. **Seated:** Xuemei Bai, Erik Andersson, Sander van der Leeuw, Karen Seto. **Photo:** Christina Leijonhufvud

Urbanisation in the Anthropocene – in support of a liveable planet

Royal Swedish Academy of Sciences, 27–30 January, 2019

Together with Stanford University (Gretchen Daily), in January the Beijer Institute (Carl Folke) and Stockholm Resilience Centre (Thomas Elmqvist, Erik Andersson) organised a workshop focusing on sustainable urbanisation, rather than sustainability within cities. The purpose was to explore the role of urbanisation as a central process of the Anthropocene and how it shapes the biosphere.

Issues addressed included whether rapid urbanisation is a result or a driver of the great acceleration; the key features changing urban-rural dynamics; major changes in human relations brought about by urbanisation in a globalised world; whether the connectivity of cities is becoming a force on its own in governing human affairs and in shaping the biosphere; and the role of cities in shifting global development towards more attractive trajectories. The workshop gathered fifteen leading researchers in the urban sphere, publications are in the pipeline and the plan is to continue collaborations on this central topic.

Imaginaries and the Biosphere

Royal Swedish Academy of Sciences, 26–28 May, 2019

Social resilience is of great significance for the capacity of individuals, groups, communities and nations to secure favourable outcomes (material, emotional and symbolic) under changing circumstances. Social resilience may have to be achieved even when it entails significant modifications to behaviour or to the social frameworks that structure and give meaning to behaviour. Cultural narratives of hope seem to be of significance in exploring transformative pathways towards just and sustainable futures.

Based on initial discussions between Michele Lamont at Harvard University and Carl Folke, the idea emerged to develop a new creative interdisciplinary space focusing on so-called imaginaries (i.e. networks of shared stories, or inter-subjective realities, that become “real” by virtue of the fact that they are collectively agreed upon, such as the value of money or nation states or religion) and the biosphere. For this purpose, a handful of leading scholars were invited, with a deep understanding of psychological, social and cultural processes underlying identity

and meaning creation, together with a few experts on human behaviour, resilience and stewardship of the biosphere.

Marine Mammals Health Index

Royal Swedish Academy of Sciences, 5–7 June, 2019

There is increasing interest in quantifying aspects of ocean health due to concerns about over-exploitation of marine resources and climate change, but marine mammals are generally ignored in such efforts. Marine mammals are highly visible components of ocean ecosystems frequently cited as “ecosystem sentinels”. They are long-lived, feed at high trophic levels, have fat stores that accumulate anthropogenic toxins and are vulnerable to many of the same pathogens and toxins as humans. Changes in their health reflect ecosystem changes that could impact human health. There is no broad assessment of the status of marine mammal health globally.

Therefore, in collaboration with Princeton University, the Beijer Institute organised a workshop at the Academy focusing on marine mammal health (MMH). The purpose was to develop a global characterisation of MMH that in turn will identify trends and data gaps, highlight areas of ecosystem services and public health concern, and allow more effective targeting of mitigation measures for the conservation of marine mammals.

The workshop gathered specialists on marine mammals in different parts of the world, their health and their roles in marine ecosystems. Andy Dobson, Princeton University, Frances Gulland, Marine Mammals Centre and UC Davies, and Carl Folke, initiated this effort. The workshop discussions will result in high-level scientific and policy papers that lay out what we currently know about trends in MMH and the major threats to long-term viability of marine mammals living in a human-dominated ocean.



Michele Lamont, Caroline Schill and Therese Lindahl.
Photo: Christina Leijonhufvud

The inspiring workshop in this largely unexplored interdisciplinary interface demonstrated the potential and significance of improving understanding of social and cultural processes in transformations towards sustainability. Work was initiated to start identifying social processes supporting the emergence of narratives that can lead to shared cultural repertoires strengthening social resilience and emphasising our interdependence with the biosphere. Analytical frameworks developed by the Successful Societies programme of the Canadian Institute for Advanced Research, the Beijer Institute and Stockholm Resilience Centre provided the foundation for the workshop. Further workshops and collaborations will follow.



Back row: Carl Folke, Jason Baker, Madeleine Dietrich, Ursula Siebert, Isabel Avila, Simone Panigada, Olof Olsson, Henrik Österblom, Kevin Lafferty
Front Row: Sue Moore, Ailsa Hall, D. McAlouse, Frances Gulland, Andy Dobson, Marcela Uhart, Sam Simmons, Gianna Minton, Samantha Strindberg.
Photo: Christina Leijonhufvud

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 the space for such research.

The third edition start-up

This year, the third BYS cohort (BYS3) came together for the first time on May 20–24, for a week-long workshop at the Royal Swedish Academy of Sciences in Stockholm and the island of Ekskåret in the Stockholm Archipelago. The 20 early-career researchers invited to join the BYS3 network were nominated by Beijer Board members and Beijer Fellows. Group members have a variety of academic backgrounds, including economics, ecology and political science. The group is also geographically diverse, as its young researchers come from Europe, Africa, Asia and the Americas. This diversity is fitting given the topic chosen for the first meeting: Globalisation and the Biosphere, a deliberately broad topic that sparked both exciting discussions and daunting confusion. As in previous years, the workshop was supported by senior researchers. On this occasion, Carl Folke and Anne-Sophie Crépin were joined by

“This was the first meeting that forced me as an individual to integrate at a personal level how to capitalise on some of the synergistic aspects of our work”

Neil Adger (University of Exeter), Lisen Schultz and Maria Tengö (Stockholm Resilience Centre). Christina Leijonhufvud and Agneta Sundin organised and facilitated the workshop.

The first day was intended to provide participants with an understanding of each other’s research focus and approach. This was enriched with input by the senior researchers on the practice of interdisciplinary research. Importantly, the group

also took the time to openly share their expectations about the network. This is illustrative of the strong emphasis that was placed on process facilitation and how to navigate and harness the diversity of the group.

On the following days the workshop became more dynamic, alternating between plenary sessions and discussions in smaller groups. This interplay was useful to maintain a balance between



Photo: Agneta Sundin



Photo: Agneta Sundin



The third generation Beijer Young Scholars

Back row: Elsa Ordway, Anne-Sophie Lafuite, Eyal Frank, Jean-Baptiste Jouffray, Daniel Ospina, Scott Janzwood, Jessica Cockburn, Usman Mirza, Joao Vaz, Carl Folke. **Middle Row:** gnetta Sundin, Mingyue Zhao, Jeffrey Smith, Aleah Bowie, Tamma Carleton, Aisa Manlosa, Jamila Haider, Anouch Missirian. **Seated:** Neil Adger, Odi Selomane, Lan Wang Erlandsson, Eugenie Dugoua, Kimberly Lai Oremus, Christina Leijonhufvud

creativity and progress. The facilities in Ekskåret provided an ideal setting for these activities, with indoor and outdoor meeting spaces and recreation facilities, all gracefully designed to blend into the landscape.

As the workshop approached its end, some of the research and non-research ideas became more concrete, and the BYS3 group also agreed on a strategy to continue working together until next year’s meeting. The group opted for writing a perspective piece on the challenges and opportunities that globalisation poses for sustainability, with the focus on the biosphere.

The closing session was a candid and heartfelt round of personal reflections on this first BYS3 meeting. Some of the comments from participants:

“I learned the value of patience. I had to stop and listen, as we might be using the same words but not communicating in the same way”

“We are doing different things but there is a similar goal, and this can foster more creativity and the sense of importance of your work”.

Overall, the third generation of Beijer Young Scholars showed great respect for each other’s views and ideas and an enthusiastic drive for interdisciplinary sustainability science, in the spirit of the Beijer Institute.

How inequality affects the Sustainable development goals

The second cohort (2016–2018) of Beijer Young Scholars (BYS2) re-convened in Stockholm this year to advance their work on inequality and the biosphere. The group had secured a SEK 2 million pre-proposal grant from the Swedish Research Council for sustainable development (Formas) in 2018, to explore the theme of trade-offs and synergies between Sustainable Development Goals (SDGs), with specific focus on the central role that inequality plays in these interactions. During three days on Ekskåret in early May, BYS2 further developed research ideas emerging from their review paper published in the *Annual*

Review of Environment and Resources in October 2018 (read more at pages 30–31).

In addition, the group planned and hosted a full-day stakeholder workshop at the Museum of Ethnography in Stockholm, to explore different perspectives on inequality and how it might interact with other SDGs. Rich discussions among workshop participants provided novel insights into inclusion of different voices and values in the SDG debate, questions of scale across space and time, and the importance of governance when considering inequality and its role in trade-offs and synergies between SDGs. These emerging themes will be taken into account in future research proposals by the BYS2 team which will be developed in a workshop in Stockholm in December 2019.

The workshop was an important opportunity to identify emerging research priorities in sustainable development. It also represented the first of many engagements that aim to build an international network of stakeholders interested in the role of inequality in sustainability.

Extended support

Based on the good results of the Beijer Young Scholars programme so far, the Beijer Foundation, which is the core funder of the Beijer Institute, has decided to extend its support for the programme. This support is in line with the Foundation’s other support for students and young researchers to explore sustainability challenges together in international and interdisciplinary settings.



The second Beijer Young Scholars group (2016–2018).

Back row: Maike Hamann, Tom Chaigneau, Juan Carlos Rocha, Andrew Tilman, Kevin Berry. **Middle row:** Tong Wu, Robert Heilmayr, Yolanda Lopez, Patrik Henriksson, Tracie Curry, Caroline Schill (with Talvi), Jiangxiao Qiu, Inge van den Bijgaart. **Seated:** Alon Shepon. **Photo:** Daniel Ospina

Mäler Scholars

THE MÄLER SCHOLARSHIP is intended for researchers from the Regional Networks in Environmental Economics. Through this scholarship, the Beijer Institute aims to support the networks in creating increased capacity in their respective regions to use ecological economics in analysing environmental and development issues. The scholarship allows researchers to spend up to six months at the Beijer Institute preparing manuscripts based on their existing research and developing new projects in collaboration with Beijer Institute researchers.

The Mäler Scholarship is named after Karl-Göran Mäler, Professor of Economics specialising in Environmental and Resource Economics and Director of the Beijer Institute 1992–2007. During Karl-Göran's leadership, the Beijer Institute worked intensely with capacity building in environmental and resource economics in developing countries, and was instrumental in creating three regional networks in environmental economics in Latin America, Asia and Africa: LACEEP, SANDEE and CEEPA/RANESA.

Amare Teklay Hailu

Mäler Scholar 2019 is Dr. Amare Teklay Hailu, who visited the Beijer Institute between 15 September 2018 and 15 March 2019. He holds a PhD in Economics from the Norwegian University of Life Sciences (NMBU). His PhD thesis focuses on incentivised forest conservation for Reducing Emissions from Deforestation and forest Degradation (REDD+).

During his stay he started to work on an agent-based model based on results from behavioural experiments he conducted with farmers in Ethiopia. In these experiments he evaluated interventions aiming to reduce deforestation. He also reworked the papers in his PhD thesis for publication.

Amare attended a course at the Beijer Institute in 2014, which was part of a PhD course at the University of Gothenburg, and it influenced his research: "Of all the

PhD courses I took in different Universities in Europe, what I learned during the Beijer course had the highest impact – I wrote three of my four PhD papers using its experimental methods. Although the scope of my PhD limited my research to only experimental data, my interests in complex adaptive systems and complexity thinking were also greatly influenced," said Amare. He went on to describe his experiences at the Beijer Institute:

"As a Mäler scholar, I benefited in many different ways. First, I met experienced and inspiring people who are open to share their knowledge and committed to help. In that respect I am particularly grateful to Therese Lindahl and Caroline Schill, who gave me very detailed and constructive comments on one of my papers. Inspired by AgentEx, a nexus between experiment and agent-based modelling (ABM), which Therese and Caroline wrote with colleagues at SRC, I started applying ABM to my experimental data and I learnt much about ABM during my stay.

The second benefit was being able to meet Prof. Brian Arthur, who visited the institute. His ideas on complexity economics resonated with me and my inclination to look for nonlinearities and 'Black Swan' situations has increased dramatically. I see my future career in modelling such phenomena.

Third, I was able to meditate on possible future career paths. The timing of the scholarship was perfect for me, as I had just finished my studies and was transitioning to the job market.

Finally, I have to mention the pleasant work environment at the Beijer Institute. Chatting with friends during fika [coffee

breaks] and attending staff meetings were all moments of inspiration and education for me."

Since his Mäler Scholarship stay, Amare has started a post-doctoral position at the Swedish University of Agricultural Sciences in Umeå.



Yana Jin

Mäler Scholar 2018 was Dr. Yana Jin, who returned for a postponed second visit on 26 March–26 August 2019. After her first visit, Yana took up a post-doctoral position at the College of William and Mary in Virginia, USA. Her research focuses on energy and environmental policy, particularly as they pertain to human health and climate impacts (she is portrayed in more depth in last year's report).

During her stays, Yana has collaborated with Beijer Institute researchers Åsa Gren and Johan Colding and colleagues at Stockholm Resilience Centre on the project 'Closing the unequal health gap: A socio-economic analysis of health benefits from urban ecosystems'.

With this project, the research group seeks to improve understanding of the relationship between accessibility to human health-related urban ecosystem services and socio-economic parameters, such as age, level of education, cultural background and purchasing power. Project leader Åsa Gren is very happy about the collaboration made possible by the Mäler Scholarship:

"With her great experience in working with socio-economic optimisation models in relation to public health data, Dr Yana Jin is imperative in this endeavour and her ability to analyse data in a social-ecological systems context has proven essential in designing a robust and constructive methodology for exploring the issue at hand."

Science in Society

Water as the bloodstream of the Biosphere

If the pressure on the water cycle at local, regional or global scale becomes too great, it can lead to unpredictable and potentially irreversible changes. In recent years the functions and importance of "green" water (soil moisture from precipitation) to plants are becoming better understood. Studies on how the water "bloodstream" is globally connected show that local land-use changes can cause rainfall modifications in faraway areas.

On this year's World Water Day and celebrating the 200th Stockholm Seminar, three generations of water resilience researchers at Stockholm Resilience Centre shared their research and reflections on the multiple ways in which freshwater sustains the biosphere and human development. The research presented included the lifework of the winner of the Blue Planet Prize 2018, Prof. Malin Falkenmark, describing water's fundamental role for Earth's life support system, innovating the understanding of water scarcity, and propelling the recognition of green water as a valuable and manageable resource.

Other presentations were on centre director Dr. Line Gordon's decade-long research unravelling the critical roles of "invisible" water for social-ecological resilience and Dr. Lan Wang-Erlandsson's account of the newest advances towards a revised freshwater planetary boundary that acknowledges all facets of water for supporting a stable and habitable Earth. Louise Hård af Segerstad, Albaeco, moderated this half-day seminar, arranged together with Albaeco, Future Earth and SRC. Read more about the Stockholm Seminars on page 50.



Line Gordon, Malin Falkenmark and Lan Wang-Erlandsson. Photo: Agneta Sundin



Beatrice Crona. Photo: Ashley Pearl, SRC

Swedish launch of the EAT Lancet report on Food, Planet and Health

The Swedish launch of the report *Our Food in The Anthropocene: the EAT-Lancet Commission on Healthy Diets From Sustainable Food Systems*, organised by the Beijer Institute, GEDB and SRC, was held on 18 January at the Royal Swedish Academy of Sciences.

The report brought together more than 30 world-leading scientists from across the globe to reach scientific consensus on what defines a healthy and sustainable diet (presented on pages 28–29). It was introduced to a broad audience from the Swedish food industry, health community and policy makers, and the results were explained and put in a Nordic context. Among other things, the health benefits were highlighted and recommendations for meat consumption were discussed and compared to those in other scientific reports. The half-day event ended with questions to the participating researchers from the very engaged audience.

In addition to this event, Beijer Institute researchers took part in several op-eds in Swedish newspapers explaining the results. Therese Lindahl held a separate presentation of the report for the multinational home appliance manufacturer Electrolux.



Science in Society

Photo: Therese Öreteg, Future Earth.

Cities—the frontlines for global sustainability

In a seminar co-organised with Future Earth and the Volvo Environment Prize, Beijer and SRC researchers, together with prize winner Xumei Bai, explored how rapidly growing cities can be made more livable, sustainable and resilient for their own inhabitants, for the surrounding region and globally. To a mixed audience of students, scientists and policy makers, they presented

the biggest challenges and discussed how science can help shape the cities that will be built in this century. The half-day event included performances by street dancer Mario Perez Amigo.

Speakers: Professor Xuemei Bai, Australian National University
 Professor Will Steffen, Australian National University
 Professor Kazuhiko Takeuchi, Tokyo University & United Nations University
 Professor Thomas Elmqvist, Stockholm Resilience Centre
 Dr. Åsa Gren, the Beijer Institute

Moderator Agneta Sundin

Swedish policy week in Almedalen

In the first week in July every year, an event where politicians, NGOs, other organisations and the general public get together to discuss policies and societal issues, is held in Almedalen in Visby, on the Swedish island of Gotland in the Baltic Sea. The Royal Swedish Academy of Sciences organised science and society events during the politicians’ week in 2018. Carl Folke participated in a panel discussion on 3 July 2018 entitled: “Can we trust environmental labelling?” He described industrial actors’ work with transparency, value chains and corporate social responsibility within the SeaBOS project (read more on page 42) and other related research at the Beijer Institute, the Global Economic Dynamics and Biosphere programme (GEDB) and Stockholm Resilience Centre (SRC).

On the same day, Anne-Sophie Crépin took part in a panel discussion on the subject “Our coastal waters are changing – What do we do?”, followed by a round of questions from politicians from all the main political parties in Sweden. She highlighted the socio-economic challenges of assessing and dealing with loss of ecosystem services brought about by alterations in the marine environment. She raised the need for an integrated perspective that fully embraces the uncertainties associated

with this task. She underlined that politicians must have the courage to act despite limited knowledge and that they should seek guidance from the scientific community to help them assess low hanging fruits, win-win situations and other aspects that can simplify these decisions.



Photo: Royal Swedish Academy of Sciences

Science in Society

Breaking barriers for a more sustainable meat consumption

In November 2018, Therese Lindahl and colleagues at the Swedish University of Agricultural Sciences organised a workshop in Stockholm together with the Swedish Consumer Agency (Konsumentverket). The purpose was to identify factors that limit consumers’ ability to make sustainable choices in relation to meat consumption and to identify measures that can be implemented by different actors to overcome these barriers. Among the participants were representatives from retail, consu-

mer associations, civil society organisations, industry organisations, certification bodies, government agencies and environmental experts. The conclusions from the workshop will feed into the report ‘Sustainable Meat Choices: Consumers Possibilities to Act Sustainably on the Swedish Meat Market’, written for the Swedish Consumer Agency, which is due for publication during 2019.

International food hackathon

The Food Hackathon is a yearly 48 hour long innovation competition and food conference for the global food community, initiated by Krinova & the Swedish Research Council for Sustainable Development – Formas. Krinova is a “solution incubator” targeting food, environment and human health, funded by the municipality of Kristianstad and Kristianstad University. Key challenges relate to the UN Sustainable Development Goals. The particular theme for 2019 was “A Healthier Planet”. Max Troell was one of few invited speakers to give inspirational talks aimed at stimulating creative thinking among the 200 participants from 30 different nations. He talked about seafood and in particular the potential contribution from aquaculture to achieving a more sustainable food system and improving human health.



Photos: Krinova



"The ecological footprint" by Ville Högström and an "ongoing natural disaster" as viewed by Adam Siversen Ljung.

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Design students visualise our dependency on nature's services

In the exhibition *In My Backyard*, shown at the design store Svenskt Tenn in Stockholm on 14 March-April 2019, students in Visual Communication at Beckmans School of Design interpreted the research carried out by the Beijer Institute. A common aim for the students was to create a broader understanding of ecosystem services and why they are key for the well-being of humans and that of the planet. The exhibition contained works that are rooted in the Beijer Institute's research on ecosystem services with a focus on ecosystem services in cities. This research shows, among other things, why green areas, trees and wetlands are cost-effective investments in sustainable urban development, but also what happens if these are neglected. Researchers and staff from the Beijer Institute and Stockholm Resilience Centre gave introductory lectures and provided background readings and tuition to the students throughout a five-week course. The result was 16 very diverse artistic interpretations.



Student Anna Knutsson investigated if discarded objects can be used for urban greening in the future.



An audio-visual herbarium by Sara Dunker.

"Meeting and discussing with these young, talented and engaged students was truly inspiring. It provided me with surprisingly novel lenses for viewing my research. The students' ability to grasp complex scientific issues and turn them into engaging, thought provoking and fun art was astonishing."

– Åsa Gren



A cultivation kit to favour pollinators in cities. By Reidar Pritzel and Kourouh Hekmatara.

Among the works was an audiovisual herbarium where rustling and whispers from flowers can create pleasure and calm for stressed city dwellers lacking access to green spaces. Another student explored whether the peace that nature gives can be replaced by a digital park. Design icon Josef Frank's colourful, nature pattern inspired one student to make a pattern that visualises how Swedish nature may look in the wake of increased global warming. The exhibition, was the third joint project by the Beijer Institute, Beckmans College of Design and the Swedish design store Svenskt Tenn in Stockholm. Through the Kjell and Märta Beijer Foundation, Svenskt Tenn's profits support research at the Beijer Institute. During the spring, Beijer researchers took part in another art-science project with Svenskt Tenn. They presented and discussed their research with artists Lars Arrhenius and Eric Ericson who, together with Svenskt Tenn's curator Karin Södergren, are creating an exhibition that will be shown during autumn 2019. The exhibition deals with issues regarding our relationship to the Biosphere and the complex relationship between climate change, norms, ethics and economics.



Julius Tuvén designed meat cutlery with thought-provoking messages engraved.



Unsustainability visualised by Hedda Wallén.

All photos: Svenskt Tenn

Blue Food platform

Beijer Institute researchers are playing a leading role in setting up a new international platform to develop and mobilise broad support for science-based strategies to achieve sustainable blue food transition. This Blue Food platform is part of Friends of Ocean Actions convened by the World Economic Forum, and is a collaboration between EAT/Stockholm Resilience Centre, the FAO, Stanford University and the World Resources Institute. Its first workshop, on structuring a "Blue Food Assessment", was held back-to-back with the Stockholm EAT Forum 2019 and included more than 20 international experts and seafood policy representatives. Specific topics included different aspects of environmental sustainability, health, equity and transformation trajectories.





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Excursion during the Bergen meeting.
Photo: Ola Helge Hjetland/Mowi.

The SeaBOS initiative firmly established

The Seafood Business for Ocean Stewardship, or SeaBOS, is a global initiative created by Stockholm Resilience Centre in collaboration with the Beijer Institute and the GEDB programme of the Royal Swedish Academy of Sciences. The aim of the initiative is to stimulate industry leadership to perform ocean stewardship in accordance with the best available science.

The initiative engages ten of the world's largest commercial seafood companies (including wild catch, aquaculture and aquaculture feed production). SeaBOS members, with companies based in Europe, North America and Asia, are known as "keystone actors" because of their prominence in all levels of the seafood supply chain and strong influence on the resilience of the oceans and marine ecosystems.

SeaBOS is organised into five task forces ranging from reducing illegal, unreported and unregulated fishing and use of antibiotics in aquaculture to creating transparency and traceability in global seafood, to working with governments to improve regulations. In the past year, substantial progress has been made within these task forces.

Two major meetings have taken place during the year. The first, the Karuizawa Dialogue in Japan in September 2018, was the third Keystone Dialogue and was hosted by Maruha Nichiro Corporation, Nippon Suisan Kaisha, Kyokuyo and Mitsubishi Corporation, with support from the Swedish Embassy to Japan. The dialogue included participation of CEOs from the ten member companies of SeaBOS. All CEOs committed to sincere engagement in the SeaBOS initiative and moving the task forces forward. The SeaBOS organisation was established with the appointment of Shigeru Ito, CEO and President of Maruha Nichiro



Some of the participants of the Bergen meeting. From left: Ole-Eirik Lerøy, Karolin A. Johansson, Her Royal Highness Crown Princess Victoria, Knut Nesse, Darian McBain, Carl Folke, Toshiya Yabuki, Yasuhiro Hasegawa.
Photo: Ola Helge Hjetland/Mowi.

Corporation, as the first chairman of SeaBOS.

The second meeting was held in Bergen, Norway, in May 2019. The stewardship challenge was emphasised and a round of reflections illustrated the commitment by all companies. The meeting included updates from science and from individual task forces, discussions and agreement on next steps. The meeting concluded with a number of action items, to be advanced by late August, to support executive decisions at the 4th Keystone Dialogue in Thailand on 1–3 September, 2019. The term "Corporate Biosphere Stewardship" was coined as a positive vision and way forward.

HRH Crown Princess Victoria of Sweden participated throughout both the Karuizawa and Bergen dialogues, in her role as global advocate for the Sustainable Development Goals (SDGs). The contributions of the Crown Princess in the dialogues are of great significance for the success of the SeaBOS initiative.

evolution in its various forms, to offering an assessment of the planet, its inhabitants and its biodiversity. Carl Folke provided examples of the role of science for the planet's future, including examples of how science is already positioned to enhance and help sustain our world. The aim of the Molecular Frontiers symposium was to foster exploration and discovery, connecting scientists from a multitude of disciplines on matters of particular significance, and it received support from the Beijer Foundation.

Planet Earth – A Scientific Journey

The Molecular Frontiers Foundation and the Royal Swedish Academy of Sciences organised a two-day public symposium called *Planet Earth: A Scientific Journey* on 9–10 May, hosted by Stockholm University, with Carl Folke as one of the speakers. The presentations, several by Nobel laureates, ranged from looking at earth from its very beginnings, considering the origin of life and

Science in Society



The research results disseminated were reflected in the lunch buffet.
Photo: Agneta Sundin

Symposium on healthy and sustainable fish consumption

On 7 February 2019, the Beijer-led research programme SeaWin, together with the Swedish Rural Network's thematic group for fisheries and agriculture hosted a symposium at the Royal Swedish Academy of Science on the importance of fish

consumption for health and the environment. The symposium presentations dealt with how a sustainable increase in fish consumption can be achieved, to the benefit of human health and the environment, and how to consider the nutritional value and the climate impact.

The overall message was that fish is nutritious and valuable food and that we should eat more fish. From a nutrition and climate perspective, we should increase the proportions of fish, shellfish and possibly even seaweed in our diet. There are some contaminants present in oily fish, e.g. salmon and herring from the Baltic Sea and other oily freshwater species. However, specific dietary advice on these fish species only applies for women of childbearing age and small children. The positive health effects of fish and other seafood are great.

The overall advice was to increase consumption of fish and to consume a variety of oily and low-fat fish types. The symposium attracted around 60 delegates. A number of the major Swedish food retailers were among the delegates, together with representatives of government agencies, the Ministry of Food, universities and environmental organisations.

Organisers:

Royal Swedish Academy of Sciences, the Beijer Institute, RISE, Stockholm Resilience Centre, Landsbygdsnätverket, SIGHT. Funded by: Swedish Research Council for Sustainable Development – Formas, Landsbygdsnätverket/EU

Seminar on cost-benefit analyses at the Swedish Government Offices

Beijer researchers Anne-Sophie Crépin and Gustav Engström, together with Lars Berg and Johan Rockström from Stockholm Resilience Centre, contributed to a report commissioned by the Swedish Scientific Council for Sustainable Development (Vetenskapsrådet för hållbar utveckling, VRHU) on the possibilities and limitations of different types of socio-economic analyses. The report was presented at the Government Offices on 25 October 2018, where its content was discussed with an audience of invited officials from, among others, the Swedish Environmental

Protection Agency, Energy Agency, Transport Agency and the Ministries of Agriculture, Finance and Environment. Anne-Sophie Crépin presented challenges posed by non-linear interactions and threshold effects, which could generate regime shifts. She made several concrete suggestions on how cost-benefit analyses could be improved to better take these into account. She also discussed the role of the discount rate. The presentation was followed by an animated and constructive discussion that revealed the need for better collaboration and synergies between the different government agencies and departments. The report is in Swedish (Möjligheter och begränsningar med samhällsekonomiska analyser) and available online.

Nobel Prize Summit 2020

In 2020, the National Academies of Sciences, Engineering, and Medicine, in partnership with the Nobel Foundation, the Potsdam Institute for Climate Impact Research and Stockholm Resilience Centre/Beijer Institute, will host the first-ever Nobel Prize Summit: Ensuring Humanity's Future on Earth. The summit will provide a world stage to discuss pathways to help ensure our common future on a stable, resilient planet. It is designed to connect science with societal goals, and focus on how science can support those goals for rapid transformation towards a prosperous world within planetary boundaries. Framed around

the United Nations 2030 Sustainable Development Goals, the summit will gather a powerful network of Nobel laureates, together with world-leading scientists, business leaders, writers, politicians, artists and young people. The aim is to continue building trust in scientific reasoning while exploring transformative models for people and planet on the most pressing existential challenges faced by humanity on Earth: including climate change and biodiversity loss, rising inequality, and rapid societal transformation enabled by emerging and converging technologies. A Nobel Prize Summit Steering Committee is engaged in the preparations for the summit, which will take place on 29 April 29–1 May, 2020, in Washington D.C., USA.

Collaborations

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 the Beijer Institute’s research programmes *Urban Social-ecological Systems*, *Aquaculture and Sustainable Seafood*, *BEN*, and *Governance, Technology and Complexity*, and institute researchers are active in the themes and streams of the SRC and collaborate and participate in seminars, teaching, supervision and more. The communication, outreach and policy engagements of the Beijer Institute are substantially magnified through the interplay with SRC.

Executive programme in resilience thinking

The first executive programme of the SRC was launched in autumn 2018. Carefully selected CEOs and board members of influential companies within various business sectors in Sweden met scientists and leading thinkers to deepen their understanding of the latest research and accelerate the transformation towards sustainability. The course was a great success and the sixteen high-level participants

clearly signified the major ongoing shift in perspective on environmental issues. Conversations unveiled how business can indeed play a pivotal role in sustainability transformations, informed by science and driven by purpose. Beijer Institute researchers and staff played an essential role in the course.

Read more:
executive.stockholmresilience.org

Collaboration with Stanford University

Work with the two significant grants – *Advancing Fundamental Knowledge of Natural Capital, Resilience and Biosphere Stewardship* and *Fundamental Research in Biosphere-based Sustainability Science* – from the Marianne and Marcus Wallenberg Foundation is progressing well and strengthening and extending the collaboration between the Beijer Institute, SRC and Stanford University. The grants provide 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. They draw on the long legacy of the Beijer Institute’s collaborations with Stanford researchers and also on new collaborations within the Beijer Institute/GEDB/SRC cluster. Carl Folke and Gretchen Daily serve as project leaders.

www.stockholmresilience.org



Jacob Wallenberg (chair, Investor) Henrik Henriksson (CEO, Scania) and Lisen Schultz (programme director, SRC) at the SRC Executive programme in resilience thinking.
Photo: M. Sparreus/Azote

Global Economic Dynamics and the Biosphere

The Global Economic Dynamics and the Biosphere (GEDB) programme of the Academy focuses on unexplored interfaces and areas of scientific inquiry with the aim of better understanding global economic dynamics in a biosphere context and uncovering the drivers, mechanisms and effects on social-ecological systems and their resilience at multiple scales.

During its first five years of operation, GEDB has generated over 130 scientific peer-reviewed articles, several published in highly ranked journals like *Nature*, *Science*, *Nature Climate Change*, *Proceedings of the National Academy of Sciences, USA (PNAS)*, *Proceedings of the Royal Society London*, *Philosophical Transactions of the Royal Society London*, *Frontiers in Ecology and the Environment* and *Global Environmental Change*. Some of these research findings have received great attention in the scientific community, among diverse actors in society and in both conventional and social media. A summary of achievements is provided in the GEDB Annual Reports.

The new GEDB – *New Approaches to the Grand Challenge: Global Finance, Global Health and the Biosphere* – started in 2019 and focuses on two broad areas of research. The first, *Biosphere Finance*, studies finance and capital markets linked to the latest research on planet Earth as a system. With this combination, there are new opportunities for progressive social development in conjunction with the dynamics of the biosphere. This is uncharted terrain in research, with enormous development potential, and the escalating interest and engagement by companies and financial actors is remarkable. During the year, GEDB has published highly relevant research on the interplay of financial actors, climate and biosphere dynamics. As a result, there have been over 40 in-

teractions with e.g. banks, pension funds, investors and other financial actors in Sweden and internationally.

Recommended article: Galaz, F., B. Crona, A. Dauriach, B. Scholtens and W. Steffen. 2018. Finance and the Earth system – Exploring the links between financial actors and non-linear changes in the climate system. *Global Environmental Change* 53, 296-302.

The second broad area of research is on *Global Health and Biosphere Stewardship* and there are collaborations with several research groups including medical professionals, psychologists, behavioural economists and food actors, to tackle everything from antibiotic resistance to human health, habitats and food production. This research is linked to the ambition to support innovation and asset management of landscapes, seas and the biosphere as a whole.

Recommended article: Jørgensen, P.S. et al. 2018. Antibiotic and pesticide susceptibility and the Anthropocene operating space. *Nature Sustainability* 1, 632-641.

As we envisioned, GEDB has become a significant channel for research, synthesis and synergies between the Beijer Institute and Stockholm Resilience Centre and our diverse activities. A number of events, workshops and activities have been organised, networks of collaborations have been developed and strengthened and new forms of collaborations between science, practice and business have been initiated.

GEDB is funded by the Erling-Persson Family Foundation.

www.gedb.se



Therese Lindahl (left) and former Beijer Young Scholar Matias Piaggio (right) lectured at a SARAS Master’s course in December 2018. Photo: SARAS

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. Nowadays Juan Carlos Rocha, Henrik Österblom from SRC and Therese Lindahl from the Beijer Institute are engaged in the advisory board, the executive team and exciting workshops.

www.saras-institute.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 editor is Eswaran Somanathan. 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.

RISE – Research Institutes of Sweden

RISE, the Swedish Research Institute, is an innovation partner in international collaboration with industry, academia and the public sector. RISE ensures the competitiveness of the business community and contributes to a 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 long-term FORMAS project, the Beijer Institute has established formal collaboration with the seafood group at RISE, which is an internationally highly recognised research group in the field. Main collaborators involve Max Troell, Therese Lindahl, Patrik Henriksson and Malin Jonell representing the Beijer Institute and SRC. The collective expertise also involves international collaborators adding insights to the role and challenges related to the future of global seafood.

www.ri.se



WorldFish project in India where Patrik Henriksson collected data on farming methods in India for modelling the environmental impacts of aquaculture. **Photo:** Patrik Henriksson.

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 and to build its research and actions in poor and vulnerable communities. During the past 10 years, the mode of cooperation between the Beijer Institute and WorldFish 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 post-doc Patrik Henriksson over several years.

www.worldfishcenter.org

The Resilience Alliance

A central network for collaboration is the Resilience Alliance (RA), an international consortium of leading research groups and their organisations that are collaborating to explore the dynamics of social-ecological systems and seeking novel ways to integrate science and policy in order to discover foundations for sustainability. RA and the focus on social-ecological systems emerged out of research programmes at the Beijer Institute in the 1990s and the Beijer Institute is an active member.

www.resalliance.org

HiG Urban Studio, University of Gävle

The Urban Social-ecological Systems programme collaborates with the HiG Urban Studio at the University of Gävle, a research programme on urban sustainability that is funded from core university funding. Johan Colding is currently employed as a part-time research coordinator at HiG Urban Studio, which conducts research that supports 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 collaboration with other prominent research settings in Sweden that are 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.

Reflections of a Beijer Fellow

THE BEIJER INSTITUTE has transformed research at the interface between economics and environment, and transformed my own approach to my craft. The unique format of the Askö meetings is a model for how to build interdisciplinary collaborations: Bring together a diverse collection of experts, but most importantly folks who know how to listen and want to learn from each other. The late economics laureate Ken Arrow set the norm for us. The less he knew about something, the more eager he was to learn about it, and in so doing he inspired us all. His regular presence at the Askö meetings until the year he died created an atmosphere unmatched in my experience.

I joined the Beijer Board close to its beginnings, when Karl-Göran Maler and Partha Dasgupta were implementing their vision to bring together the best to attack issues at the core of achieving a sustainable future for humanity. The initial meetings were pleasant enough, but were a feeling-out period as we learned respect for one another and each other's languages. However, we quickly discovered that ecology and economics, whose names spring from the same root, share many similarities. In both ecological and economic systems, individuals compete for limited resources, develop exploitative and mutualistic relationships, and solve problems collectively. Societies and ecosystems emerge, their dynamics feeding back to affect individual decisions and behaviours. The processes of evolutionary change on multiple scales, whether genetically based or not, provide a common context for understanding how strategies and stratagems are selected, and how broader scale patterns develop.

The Beijer Institute arose from a desire to work at the interface of multiple disciplines in addressing the world's greatest challenges. Warm exchanges and mutual information converted ecologists into economists, and economists into ecologists, and led to a rich panoply

of collective efforts that contribute to applications in the disciplines and to their theoretical foundations. The Beijer community grew, to involve senior scientists who became regulars at Askö and in Beijer programmes, but also junior fellows and others who flocked to the Beijer activities. New institutes like Stockholm Resilience Centre emerged from the Beijer Institute, and an interactive international network arose and continues to grow. What was novel when the institute was created is now mainstream, and Beijer can take a great deal of credit for that.

Our task is not done. There is now a wonderful diversity of superb younger researchers working at the interface, as evidenced in the recent Special Issue¹ that emerged from a National Academy of Sciences Symposium co-organised by nine Askö alumni. However, mainstream economics has still not satisfactorily adopted the issues pioneered by the Beijer Institute. This must and will change, which is our challenge for the next decade. No set of problems is more important within economics, or for the planet as a whole, than those that drive the Beijer Institute's activities.

Simon Levin
Princeton University

[1] Polasky, S. et al. (2019). Role of economics in analyzing the environment and sustainable development. Proceedings of the National Academy of Sciences. doi: 10.1073/pnas.1901616116.



Photo:
Princeton University

Appendix

Board of Directors

Chair

Neil Adger
Professor, University of Exeter, UK

Ex-Officio members:

Carl Folke*
Director, the Beijer Institute, Sweden

Göran K. Hansson*
Professor, Permanent Secretary of the Royal Swedish Academy of Sciences, Sweden

Anne-Sophie Crépin
Deputy Director, the Beijer Institute, Sweden

Members

J. Marty Anderies
Professor, Arizona State University, USA

Elena Bennett
Associate Professor, McGill University, Canada

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

Juan Camilo Cárdenas
Professor, Los Andes University, Colombia

Joern Fischer
Professor, Leuphana University, Germany

Kathleen Segerson
Professor, University of Connecticut, USA

Jason Shogren*
Professor, University of Wyoming, USA

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

James Wilen
Professor, University of California, Davis, USA

*Member of the Royal Swedish Academy of Sciences



Board meeting 2018:
Back row: Carl Folke, Jason Shogren, Joern Fischer, Neil Adger. Front row: Juan Camilo Cardenas, Jeroen van den Bergh, Kathleen Segerson, Elena Bennett, Oonsie Biggs, Jim Wilen, Anne-Sophie Crépin, Göran K. Hansson, Marty Anderies Photo: Agneta Sundin

Board of Directors

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 first Board

of Directors for the current Beijer Institute was elected on 5 June 1991. The 28th annual board meeting was held at the Royal Swedish Academy of Sciences on 14 September 2018. This meeting was the first for Professor Juan Camilo Cardenas, Los Andes University, Colombia, and Professor Reinette (Oonsie) Biggs, Stellenbosch University, South Africa, who were welcomed as new members of the board.

Beijer Fellow prizes, honours and awards

Terry Chapin
has received the ESA eminent ecologist award 2018, recognising outstanding contributions to ecology in new discoveries, teaching, sustainability, diversity and lifelong commitment to the profession.

Steve Carpenter
was the recipient of the 2018 Ramon Margalef Ecology Prize. The jury stated that his “*creative and original work has transformed our understanding of ecosystems*”.
Steve also received the 2019 Lifetime Achievement Award from the Association for the Sciences of Limnology and Oceanography.

Marten Scheffer
was elected a foreign member of the U.S. National Academy of Sciences 2019.

Jane Lubchenco
was appointed to the Pontifical Academy of Sciences (the Vatican city’s scientific academy) 2019.
Jane also received a Tethys Award from the Ocean Visions Institute for her “*significant achievements as an international leader in science and policy, as well as her untiring efforts to bring a positive outlook on the ocean’s future.*”

Jason Shogren
was appointed honorary doctor at the Faculty of Forest Sciences, Swedish University of Agricultural Sciences (SLU).

Frances Westley
was named honorary doctor at Stockholm University 2019.

Scott Barrett
was named AERE Fellow 2019. The Fellows programme recognises individuals who have made outstanding contributions to the advancement of the profession.

Partha Dasgupta, Aart de Zeeuw, Michael Hoel, Karl-Göran Mäler, Karine Nyborg, Thomas Sterner and Anastasios Xepapadeas
were named EAERE Fellows 2019, recognising their outstanding contributions in the field of environmental and resource economics.



Beijer Fellow Steve Carpenter receiving the 2018 Ramon Margalef Ecology Prize.

Staff members Beijer

Carl Folke
Professor, Director

Anne-Sophie Crépin
Associate professor, Deputy Director

Amar Causevic
Research assistant

Johan Colding
Associate Professor, Researcher, Programme Director

Gustav Engström
PhD, Researcher

Johan Gars
PhD, Researcher

Åsa Gren
PhD, Researcher

Chandra Kiran Krishnamurthy
PhD, Researcher

Sofia-Kristin Kokinelis
MSc, Finance and HR Administrator

Sofia Käll
PhD Candidate

Christina Leijonhufvud
BA, Administrator

Therese Lindahl
PhD, Researcher, Programme Co-ordinator

Daniel Ospina
PhD Candidate

Caroline Schill
PhD, Researcher

Agneta Sundin
Communications Officer

Max Troell
Associate Professor, Researcher, Programme Director

Administration

Office location

The Beijer Institute is located in a wing of the early 20th 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 of the 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.

Affiliated researchers

J. Marty Anderies
Professor, Programme Director (Arizona State University, USA)

Chuan Zhong Li
Professor, researcher (Uppsala University, Sweden)

Victor Galaz
Associate Professor, Researcher, Programme Director

Patrik Henriksson
PhD, Researcher (Stockholm Resilience Centre, Sweden and Wiomsa)

Malin Jonell
PhD, Researcher (Stockholm Resilience Centre, Sweden)

Visiting scientists

Lars Hedin
Princeton University, USA, 14-30 August, 2018

Amare Teklay Hailu
Ethiopian Civil Service University, Ethiopia, 15 September, 2018-15 March, 2019

Brian Arthur
Santa Fe Institute, USA, 18 September-23 October, 2018

J. Marty Anderies
Arizona State University, USA, 9-15 December, 2018 and 21-29 May, 2019

Aart de Zeeuw
Tilburg University, the Netherlands, 5-9 March, 2019

Yana Jin
College of William and Mary in Virginia, USA, 26 March-15 August, 2019

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 performed independently by the Beijer Institute.



Funding

Core funding for the Beijer Institute is provided by the Kjell 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 dairy cattle research at the Swedish University of Agricultural Sciences.
Kjell Beijer was a Swedish businessman who met his wife Märta when she was working in the furniture 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 2018 and 30 June 2019 was also provided by:

- Stockholm County Council (Stockholms läns landsting)
- Swedish Research Council (Vetenskapsrådet)
- The Crafoord Foundation
- The Ragnar Söderbergs Foundation
- The Swedish International Development Cooperation Agency, Sida (Swedbio programme)
- The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, FORMAS
- Western Indian Ocean Marine Science Association, WIOMSA

Teaching and training

In addition to the courses organised by the Beijer Institute listed below, a number of institute researchers give lectures within courses given by other institutions (see under individual researchers) and act as supervisors for graduate and undergraduate students.

Challenges of Environmental Decision-making – Master’s course

Beijer Institute researchers organise and teach the course *Challenges of environmental decision-making* to students taking the Master’s programme *Social-Ecological Resilience for Sustainable Development* at Stockholm Resilience Centre. The objective of the course is to help students understand a broad spectrum of challenges associated with decision making coupled to environmental issues and how these are typically tackled within the field of economics. 2019 was the 7th year in which the course was held. During spring 2019, Gustav Engström, Anne-Sophie Crépin, Therese Lindahl and Johan Gars taught a class of 14 students over a period of 2-3 weeks. The focus was on economic approaches for dealing with regime shifts, behavioural biases, climate change and international trade. Together with the students, alternative approaches for analysing how people make choices individually and collectively when managing social-ecological systems, and the consequences/trade-offs these choices involve, were explored.

Short courses on economics and the environment

Biannually, the Beijer Institute organises a two-day course just before the World Congress of Environmental and Resource Economists (WCERE) or the annual meeting of the European Association of Environmental and Resource Economists (EAERE) intended for researchers from developing countries

Supervisory work

- PhD candidate Daniel Ospina Medina, the Beijer Institute and Stockholm Resilience Centre, Stockholm University, Sweden (Anne-Sophie Crépin, co-supervisor)
- PhD candidate Ami Golland (GEDB and Stockholm Resilience Centre, Stockholm University, Sweden (Victor Galáz)
- PhD candidate Alice Dauriach, GEDB and Stockholm Resilience Centre, Stockholm University, Sweden (Victor Galáz, co-supervisor)
- PhD candidate Oskar Nyberg, Department of Ecology, Environment and Plant Sciences, Stockholm University, Sweden (Patrik Henriksson, co-supervisor).
- PhD candidate Elizabeth (Liz) Drury O'Neill, Stockholm Resilience Centre, Stockholm University, Sweden. Graduated in December 2018. (Therese Lindahl, co-supervisor).
- PhD candidate Noah Linder, Environmental Psychology, Department of Building, Energy, and Environmental Engineering, University



Stockholm Seminar with Juan Rocha, SRC.

of Gävle, Sweden (Therese Lindahl, co-supervisor).

- PhD candidate Lina Isacs, Division of Environmental Strategies Research, Royal Institute of Technology, Sweden (Therese Lindahl, co-supervisor).
- PhD candidate Muhammed A. Oyinlola, University of British Colombia, Canada (Max Troell, co-supervisor)
- Master’s student Charles Horsnell, Gothenburg University (Patrik Henriksson, co-supervisor).
- Master’s student Stefan Fogelqvist, Department of Environmental Science and Analytical Chemistry, ACES, Stockholm University, Sweden (Åsa Gren, co-supervisor)
- Bachelor’s students Julia Mattsson and Petra Jönsson, University of Gävle, Sweden (Johan Colding).

Seminar and workshop series

The Stockholm Seminars: Frontiers in Sustainability Science and Policy

The Stockholm Seminars are arranged by Albaeco, the Beijer Institute, Future Earth and Stockholm Resilience Centre. They cover a broad range of perspectives on sustainability issues and focus on the need for a sound scientific basis for sustainable development policy.

The seminars are given at the Royal Swedish Academy of Sciences (Occasionally at Stockholm Resilience Centre) and are attended by an audience including scientists, students, media and policymakers in the public and private sector. The 200th Stockholm Seminar was celebrated with a half-day seminar on 22 March (read more on page 37).

Between July 2018 and June 2019, the following seminars were held:

2018

14 September: Prof. Juan Camilo Cárdenas
Can competition promote co-operation?
17 September : Prof. Elke U. Weber
Modelling energy and environmental behavior from individual to aggregate levels: Challenges, opportunities, and tools

4 October: Prof. Bill Clark
The state of sustainability science

30 November: Prof. Dirk Roux
Reflections on a transdisciplinary journey in conservation science

2019

6 March: Dr Juan Rocha
Ecological apocalypse can also be a source of hope: Cascading regime shifts within and across scales

22 March: Prof. Malin Falkenmark, Assoc. Prof. Line Gordon, Dr Lan Wang-Erlandsson
Water as the bloodstream of the Biosphere

28 May: Prof. Michèle Lamont
The role of narratives in social resilience

Brown Bag Lunch Seminars

The Brown Bag Lunch Seminars are a joint initiative between the Beijer Institute, Stockholm Resilience Centre and Albaeco, and are held at Stockholm Resilience Centre. The seminars aim to provide a platform for staff, students and visitors at the institutions that together form Stockholm Resilience Centre to share their work in an informal manner with ample time for discussion.



Askö-group 2018:

Back row: Jason Shogren, Carl Folke, Jim Wilen, Peter Sogaard Jorgensen, Steve Polasky. **Middle row:** Marten Scheffer, Brian Walker, Catherine Kling, Laura Walker, Christina Leijonhufvud, Simon Levin, Steve Carpenter, Avinash Dixit, Elena Bennett, Anne-Sophie Crépin, Jeroen van den Bergh, Nils Kautsky, Scott Barrett, Agneta Sundin. **Front row:** Marty Anderies, Paul Ehrlich, Juan Camilo Cardenas, Neil Adger, Karine Nyborg, Lena Kautsky, Sofia Käll, Gretchen Daily, Kathleen Segerson

The Askö Meeting

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 at Askö, a Swedish island in the Baltic Sea. The Askö meetings have generated unique cooperation between these disciplines and each meeting has resulted in a consensus document, often published in a leading scientific journal. The theme of Askö 2018 was The rising trend of extreme events.

Staff Members’ Publications and Activities



Amar Causevic
MA, Research assistant

Research focus

Sustainable finance, human-machine-ecology interactions, climate change and security.

Conferences, workshops and presentations

- » Smart Cities in the Anthropocene. Seminar, University of Gävle, Sweden, 25-26 October 2018. Invited speaker. Presentation: *Precision agriculture in the Anthropocene: Potential usage of emerging technologies in smart cities*.
- » Human-Machine-Ecology: A Workshop on the Emerging Risks, Opportunities, and Governance of Artificial Intelligence. Workshop, PIIRS Global Systemic Risk at Princeton University and Stockholm Resilience Centre,

Princeton, United States of America, 11-12 January 2019. Participant.

- » Interagency Interaction in Crisis Management and Disaster Response 7th Annual Conference. Conference, Crisis Management and Disaster Response Centre of Excellence, Sofia, Bulgaria, 5–6 June 2019. Invited speaker. Presentation: *NATO in the Anthropocene*.

Commissions

- » Journal reviewer for *Journal of Sustainable Finance and Investment*.

Other

- » Online open editorial article:
- » Causevic, A. 2019. Commentary: Five ways the finance community engages with natural capital. *ReThink*.
- » Conference paper: Causevic, A. 2019. NATO in the Anthropocene: Emergence of the tipping points and associated security challenges. *Proceedings Paper for CMDR COE 7th Annual Conference*.



Johan Colding
Associate Professor,
Programme Director

Research focus

Urban social-ecological systems.

Publications during the period

- » Colding, J., and S. Barthel. 2019. Exploring the social-ecological systems discourse 20 years later. *Ecology and Society* 24 (1): 2.

- » Gren, Å., J. Colding, M. Berghauser-Pont, and L. Marcus. 2018. How smart is smart growth? Examining the environmental validation behind city compaction. *Ambio* 48 (6): 580-589.

- » Holmgren, M., A. Kabanshi, L. Langeborg, S. Barthel, J. Colding, O. Eriksson, and P. Sörqvist. 2019. Deceptive sustainability: Cognitive bias in people’s judgment of the benefits of CO2 emission cuts. *Journal of Environmental Psychology* 64: 48-55.

- » Samuelsson, K., J. Colding, and S. Barthel. 2019. Urban resilience at eye level: spatial analysis of empirically defined experiential landscapes. *Landscape and Urban Planning*. In press.

Conferences, workshops and presentations

- » Research in Augmented Urbans. Workshop, University of Gävle, Gävle, Sweden, October 2018. Speaker. Lecture: *Utemiljöers betydelse för ekosystemtjänster i ett urbant landskap (The role of outdoor environments for ecosystem services in an urban landscape)*.
- » Smarta hållbara städer och samhällen (Smart Sustainable Cities and Societies). Workshop, Region Gävleborg and University of Gävle, Gävle, Sweden, October 2018. Participant.
- » Smart Cities in the Anthropocene. Seminar, University of Gävle, Gävle, Sweden, 25-26 October 2018. Organiser.
- » Smarta Städer (Smart Cities). Conference, Easyfairs and Geoforum Sverige, Stockholm, Sweden, November 2018. Speaker. Lecture: *A social-ecological perspective on the smart city. What does research say?*
- » Consortium kick-off meeting URANUS – Urban Rivers Activating Nature in Urban Spa-

ce. Workshop, Amsterdam Institute for Advanced Metropolitan Solutions, Amsterdam, Netherlands, January 2019. Participant.

» Urbanisation in the Anthropocene. Workshop, Royal Swedish Academy of Sciences, Stockholm, Sweden, January 2019. Participant.

» Planners Forum within the Augmented Urban Project. Forum, University of Gävle, Gävle, Sweden, May 2019. Participant.

» The Second Symposium on Social-Ecological Urbanism: Balancing Dense and Green Urban Development. Symposium, Chalmers University of Technology, SMOG, Architecture and Civil Engineering, Gothenburg, Sweden, 18 June 2019. Participant.

Teaching and training

» Supervisor of BSc students Julia Mattsson and Petra Jönsson (University of Gävle), in Miljöteknik/Miljöstrategi (Environmental technology and strategy) and Mobilitet och hållbara transporter (Mobility and sustainable transport), January-June 2019.

Commissions

» Member of the Campus Albano Reference Group.

» Member of the Scandinavian Turfgrass Research Foundation (STERF).

» Member of the Live Baltic Campus Network Group.

» Research coordinator at HiG Urban Studio, University of Gävle (Gävle).

» Co-theme leader of Urban social-ecological systems, Stockholm Resilience Centre.

Other

» Member of the research consortium Social-Ecological Urbanism, Stockholm Resilience Centre, the Beijer Institute, Royal Institute of Technology (Stockholm), Chalmers University of Technology (Gothenburg), Gävle University College (Gävle).

» Member in working group “Smarta hållbara städer och samhällen” (Smart sustainable cities and societies”), Region Gävleborg (Gävle).

» Consultation for University of Gävle on the report “Klimat- och energistrategi för Gävleborgs län 2020-2030” av Länsstyrelsen i Gävleborg (*Climate and energy strategies for the Gävleborg region*), June 16, 2019.

» Consultation for University of Gävle on the Gävle Regional Plan of Green Infrastrucure, “Regional handlingsplan för grön infrastruktur i Gävleborgs län”, Länsstyrelsen Gävleborg, (Regional action plan for green infrastructure in the Gävleborg region), September 2018.



Anne-Sophie Crépin
Associate Professor,
Deputy Director

Research focus

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

Publications during the period

» Crépin, A.-S., and E. Nævdal. 2019. Inertia risk; improving economic models of catastrophes. *Scandinavian Journal of Economics* doi: 10.1111/sjoe.12381.

» Sterner, T., E. B. Barbier, I. Bateman, I. van den Bijgaart, A.-S. Crépin, O. Edenhofer, C. Fischer, C., W. Habla, J. Hassler, O. Johansson-Stenman, A. Lange, S. Polasky, J. Rockström, H.G. Smith, W. Steffen, G. Wagner, J.E. Wilen, F. Alpizar, C. Azar, D. Carless, C. Chávez, J. Coria, G. Engström, S.C. Jagers, G. Köhlin, Å. Löfgren, H. Pleijel, and A. Robinson. 2019. Policy design for the Anthropocene. *Nature Sustainability* 2 (1): 14–21.

» Ospina, D., G. Peterson, and A.-S. Crépin. 2018. Migrant remittances can reduce the potential of local forest transitions-a social-ecological regime shift analysis. *Environmental Research Letters* 14: 024017.

» Jagers, S. C., S. Matti, A.-S. Crépin, D. Langlet, J. Havenhand, M. Troell, H.L. Filipsson, V.R. Galaz, and L. G. Anderson. 2018. Societal causes of, and responses to, ocean acidification - The case of Sweden. *Ambio* 48 (8): 816-830.

» Havenhand, J., H. L. Filipsson, S. Niiranen, M. Troell, A.-S. Crépin, S. Jagers, D. Langlet, S. Matti, D. Turner, M. Winder, P. De Wit, and L. G. Anderson. 2018. Ecological & functional consequences of coastal ocean acidification: Perspectives from the Baltic-Skagerrak system. *Ambio* 48 (8): 831-854.

» Li, C.-Z., A.-S. Crépin, and C. Folke. 2018. The economics of resilience. *International Review of Environmental and Resource Economics* 11 (4): 309–353.

» Ntuli, H., A.-S. Crépin, C. Schill and E. Muchapondwa. 2019. Sanctioned quotas vs. information provisioning for community wildlife conservation in Zimbabwe: A framed field experiment approach. *Environment for the Development Discussion Paper Series* 19–15.

Conferences, workshops and presentations

» The rising trend of extreme events: How to compare the policies for reversing the trend versus building resilience to the trend, comparison of push back versus transform.

Workshop, Askö, Sweden, 15–17 September 2018. Participant.

» Arctic SDG, Planning workshop for EU collaborative grant call. Workshop, Stockholm, Sweden, 9 November 2018. Organiser.

» Beijer Young Scholars. Workshop, Royal Swedish Academy of Sciences Stockholm and Ekskåret, Stockholm, Sweden, 20-24 May 2019. Co-organiser and resource person.

» BENN Modelling Workshop. Workshop, Royal Swedish Academy of Sciences, Stockholm, Sweden, 23–24 May 2019. Participant.

» Social Tipping Elements Relevant to Stay Within Planetary Boundaries. Workshop, GESIS Leibniz Institute for the Social Sciences, Cologne, Germany, 17-19 June 2019. Invited participant.

Teaching and training

» Co-supervisor for PhD student Daniel Ospina Medina (Beijer Institute and Stockholm Resilience Centre, Stockholm University), ongoing.

» Lecturer and examiner of Master’s level course *Governance and Management of Social-Ecological Systems: Challenges of Environmental Decision-Making* (Stockholm Resilience Centre, Stockholm University), spring 2019.

Commissions

» Committee member for the PhD thesis defence of Elisabeth Drury O’Neill with title: *Catching values of small-scale fisheries: A look at markets, trade relations and fisher behaviour*, Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden, 22 November 2018.

» Committee member for the licentiate thesis defence of Jean-Baptiste Jouffray with title: *Biodiversity Feedbacks and the Sustainability of Social-ecological Systems*, Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden, 8 March 2019.

» Committee member for the Licentiate thesis defence of Luigi Piemontese with title: *Biodiversity Feedbacks and the Sustainability of Social-ecological Systems*, Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden, 17 May 2019.

» Member of the Environmental Research Council of the Swedish Environmental Protection Agency (Miljöforskningsrådet för naturvårdsverket), since 2018.

» Member of the advisory board of the Global Challenges Initiative, Stockholm School of Economics, Stockholm, Sweden, since 2016.

» Member of the National Committee for Global Environmental Change, since 2018.

» Co-opted Member of the Environmental Committee of the Royal Swedish Academy of Sciences, since 2016.

» Member of evaluation committee for a funding application to the Östersjöstiftelsen (Baltic Sea Council, 2018) and for a position of University Lecturer in Bioeconomics at the Faculty of Forestry Economics, Umeå University, Sweden, January, 2019.

» Member of scientific committee for the 2019 Conference of the European Association of Environmental and Resource Economists (EAERE2019), Manchester, United Kingdom, June 2019.

» Member of the prize committee for the award for best paper in 2018 in the *Journal Environmental and Resource Economics* with Lucas Bretschger, January-March, 2019.

» Journal reviewer for *Ambio*, *Ecological Economics* and *Nature Sustainability*, July 2018-June 2019.

Other

» Panellist in a panel discussion between scientists and politicians: “Våra kustvatten förändras – vad gör vi?”. (“Our coastal waters are changing – what do we do?”) organised by the Swedish Royal Academy of Sciences within the politicians’ week at Almedalen, Visby, Sweden, 3 July 2018.

» Panellist in a panel discussion with practitioners from government departments and others to discuss the report “Möjligheter och begränsningar med samhällsekonomiska analyser” (“Opportunities and limitations of cost benefit analyses”) from Vetenskapsrådet för hållbar utveckling (Scientific Council for Sustainable Development). Government offices, Stockholm, Sweden, 25 October 2018.



Gustav Engström
PhD, Researcher

Research focus

Various economic aspects of global environmental change, in particular the economics of climate change and issues related to energy supply and tipping points in the climate system. Other research interests include urban economic and environment-related issues.

Publications during the period

» Sterner, T., E.B. Barbier, I. Bateman, I. van den Bijgaart, A.-S. Crépin, O. Edenhofer, C. Fischer, W. Habla, J. Hassler, O. Johansson-Stenman, A. Lange, S. Polasky, J. Rockström, H. G. Smith, W. Steffen, G. Wagner, J. E. Wilen, F. Aplizar, C. Azar, D. Carless, G. Chavez, J. Coria, G. Engström, S. C. Jager, G. Köhlin, Å. Löfgren, H. Pleijel, and Å. Robin-

son. 2019. Policy design for the Anthropocene. *Nature Sustainability* 2 (1): 14–21.

» Czembrowski, P., E. Łaszkiwicz, J.Kronenberg, G. Engström, and E. Andersson. 2019. Valuing individual characteristics and the multifunctionality of urban green spaces: The integration of sociotope mapping and hedonic pricing. *PLoS One* 14 (3): e0212277.

Teaching and training

» Lecturer and organiser, Master’s level course *Governance and Management of Social-Ecological Systems: Challenges of Economic Decision-making*, Stockholm Resilience Centre, Stockholm University, spring 2019.



Carl Folke
Professor, Director

Research focus

Social-ecological systems, resilience thinking, ecological economics, Anthropocene, stewardship and transformation reconnecting development to the biosphere.

Publications during the period

» Carpenter, S.R., C. Folke, M. Scheffer, and F. Westley. 2019. Dancing on the volcano: Social exploration in times of discontent. *Ecology and Society* 24 (1):23.

» Li, C.-Z., A.-S. Crépin, and C. Folke. 2018. The economics of resilience. *International Review of Environmental and Resource Economics* 11 (4): 309–353.

» Elmqvist, T, N. Frantzeskaki, E. Andersson, T. McPhearson, C. Folke, P. Olsson, O. Gaffney, and K. Takeuchi. 2019. Sustainability, resilience and transformation in the urban century. *Nature Sustainability* 2: 267-273.

» Preiser, R., R. Biggs, A. De Vos, and C. Folke. 2018. Social-ecological systems as complex adaptive systems: Organizing principles for advancing research methods and approaches. *Ecology and Society* 23 (4): 46.

» Reyers, B., C. Folke, M.-L. Moore, R. Biggs, and V. Galaz. 2018. Social-ecological systems resilience for navigating the dynamics of the Anthropocene. *Annual Review of Environment and Resources* 43: 267-289.

» Steffen, W., J. Rockström, K. Richardson, T. M. Lenton, C. Folke, D. Liverman, C.P. Summerhayes, A. D. Barnosky, S. E. Cornell, M. Crucifix, J. F. Donges, I. Fetzer, S. J. Lade, M. Scheffer, R. Winkelman, and H. J. Schellnhuber. 2018. Trajectories of the Earth System in the Anthropocene. *Proceedings of the National Academy of Sciences* 115: 8252-8259.

» Westley, F.R., and C. Folke. 2018. Iconic images, symbols, and archetypes: Their function

in art and science. *Ecology and Society* 23 (4): 31.

Conferences, workshops and presentations

» Seminar on Environmental Certification. Seminar, the Royal Swedish Academy of Sciences, Visby, Sweden, July 2018. Invited speaker.

» Collaborative workshop with Princeton University on Food System Transformation to Improve Sustainability and Health. Workshop, Stockholm Resilience Centre, Stockholm, Sweden, August 2018. Invited speaker.

» SRC International Advisory Board meeting. Meeting, Stockholm Resilience Centre, Rosenhöjden, Sweden, August 2018. Invited speaker.

» Workshop on Climate Change Mitigation and Behavioural Change. Copenhagen Business School, August 2018. Participant.

» The Karuizawa Keystone Dialogue and the SeaBOS initiative. Meeting, Tokyo, Japan, September 2018. Participant and speaker.

» The Surprise Group. Workshop, Organizer, Reykjavik, Iceland, September 2018.

» Presentation for the Beijer Foundation. Meeting, Beijer Institute, Stockholm, Sweden, September 2018.

» The Askö meeting 2018. Beijer Institute of Ecological Economics, Askö, Sweden, September 2018. Participant and speaker. Presentation: The Rising Trend of Extreme Events.

» The Blue Planet Prize ceremony and the Board meeting of the United Nations University. Ceremony, United Nations University Institute for the Advanced Study of Sustainability, Tokyo, Japan, October 2018.

» Presentation for staff of the Beijer Foundation. Meeting, Beijer Institute of Ecological Economics, Stockholm, Sweden, October 2018.

» Sustainable Development Solutions Nordic Network (SDSN-Nordic). Meeting, the Royal Academy of Sciences, Stockholm, Sweden, October 2018. Host.

» Temasek visit. Stockholm Resilience Centre, November 2018. Host.

» Resilience Symposium. Symposium, Wageningen University, Veerkracht, Apeldoorn, Netherlands, November 2018. Keynote speaker.

» Advisory board meeting. Helsinki Institute of Sustainability Science/HELSUS, Helsinki University, November 2018.

» Cities - the frontlines for global sustainability. Volvo Environment Prize Seminar, the Royal Academy of Sciences, Stockholm, Sweden, November 2018. Host.

- » Workshop on Sustainable Urbanisation. Workshop, Beijer Institute of Ecological Economics, Stockholm, Sweden, January 2019. Organiser and presenter.
- » SeaBos workshop. Workshop, Seafood Business for Ocean Stewardship, Waxholm, Sweden, 18-19 February 2019. Participant
- » Global Sustainability Strategy Forum. Workshop, Institute for Advanced Sustainability Studies, Potsdam, Germany, March 2019. Participant.
- » Earth Resilience in the Anthropocene. Workshop, Bad Belzig, Potsdam, Germany, March 2019. Participant.
- » International Advisory Board. Individual member meetings, London, United Kingdom, and Stockholm, Sweden, March–April 2019.
- » Water as the Bloodstream of the Biosphere, Celebrating Prof. Malin Falkenmark and the 200th Stockholm. Seminar, Royal Academy of Sciences, Stockholm, Sweden, April 2019.
- » In My Backyard. Exhibition, the Beckman School of Design Beijer Institute of Ecological Economics and Svenskt Tenn, Stockholm, Sweden, March 2019.
- » Ripples of Resilience. Workshop, Stockholm Resilience Centre, Stockholm, Sweden, April 2019.
- » Visit by the 4TU Centre for Resilience Engineering, the Netherlands. Stockholm Resilience Centre, Stockholm, Sweden, April 2019. Host and presenter.
- » Östersjöstiftelsen. Stockholm Resilience Centre, Stockholm, Sweden, April 2019. Presenter.
- » Chairs Circle. Täcka Udden, Stockholm, Sweden, May 2019. Presenter.
- » Molecular Frontiers Foundation symposium and youth forum on “Planet Earth: A Scientific Journey”. Aula Magna, Stockholm University, Stockholm, Sweden, May 2019. Keynote speaker.
- » The Bergen dialogue - SeaBOS Initiative. Workshop, Seafood Business for Ocean Stewardship, Bergen, Norway, 13-15 May 2019. Participant and invited speaker.
- » Beijer Young Scholars annual meeting. Meeting, Beijer Institute of Ecological Economics, Stockholm, Sweden, 6-10 May 2019. Resource person.
- » Resilience thinking - a new mindset for sustainability - from risk to opportunity. Presentation, Swedbank, Stockholm, Sweden, May 2019.
- » Imaginaries and the Biosphere. Workshop, Beijer Institute of Ecological Economics, Stockholm, Sweden, May 2019. Organiser and speaker.
- » Marine Mammal Health Index. Workshop, Beijer Institute of Ecological Economics, Stockholm, Sweden, June 2019. Speaker.

- » Blue Food Assessment. Workshop, Stockholm Resilience Centre, Stockholm, Sweden, June 2019. Opening talk.
- » Meeting with Material Economics. Stockholm Resilience Centre, Stockholm, Sweden, June 2019.
- » Meeting with WWF, IVA, June 2019.
- » Circular Initiative 2019. Eric Ericsonhallen, Stockholm, Sweden, June 2019.

Teaching and training

- » Lecturing executive training course at Stockholm Resilience Centre.
- » Lecturing undergraduate and PhD level courses at Stockholm University.

Commissions

- » Chairman of the Board, Science Director, Founder, Stockholm Resilience Centre.
- » Director of the Erling-Persson Family Academy Programme Global Economic Dynamics and the Biosphere, the Royal Swedish Academy of Sciences.
- » Co-director of the Erling-Persson Family Academy Programme, New Approaches to the Grand Challenge: Global Finance, Global Health and the Biosphere, the Royal Swedish Academy of Sciences.
- » Principal investigator of the research collaboration programme Fundamental Research in Biosphere-based Sustainability Science and for Advancing Fundamental Knowledge of Natural Capital, Resilience and Biosphere Stewardship, Stockholm University, both funded by the Marianne and Marcus Wallenberg Foundation.
- » Member of the Royal Swedish Academy of Sciences.
- » Member (Foreign) of the United States National Academy of Sciences.
- » Member of the Royal Norwegian Society of Sciences and Letters (DKNVS), Trondheim.
- » Member of the Royal Swedish Academy of Agriculture and Forestry (KSLA).
- » Editor-in-chief of *Ecology and Society*.
- » Advisory and editorial board member of *Ambio*, *the Anthropocene Review*, *Ecological Economics*, *Environmental Conservation*, *Environment and Development Economics*, *Environmental Innovation and Societal Transitions*, *Frontiers in Ecology and the Environment*, *Global Sustainability*, *One Earth*, *Proceedings of the National Academy of Sciences of the United States of America*, *Resilience: International Policies, Practices and Discourses*, *Reviews in Ecological Economics*, *Sustainability*, and *Sustainability Science*.
- » Fellow of the Resilience Alliance.
- » Honorary Fellow, South American Institute for Resilience and Sustainability Studies (SARAS), Maldonado, Uruguay.

- » Fellow of the Synergy Programme on Resilience and Critical transitionS (SparcS), Wageningen, Netherlands.
- » Fellow of STIAS - Stellenbosch Institute for Advanced Study.
- » Senior Fellow of IHOPE (Integrated History and future of People on Earth).
- » Member of the Ralph Yorque Society.
- » Academic Advisory Board of STIAS, Stellenbosch Institute for Advanced Study, South Africa.
- » Scientific Advisory Committee of SIGHT (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.
- » Board member of United Nations University Institute for the Advanced Study of Sustainability, Tokyo, Japan.
- » International Scientific Advisory Council, the Waterloo Institute for Complexity and Innovation (WICI), University of Waterloo, Canada.
- » Advisory board, International Network of Research on Coupled Human and Natural Systems (CHANS-Net).
- » Lead faculty of Earth System Governance Project.
- » Advisory board of EAT and EAT Forum.
- » Board member of the SeaBOS Foundation.
- » Senior Advisor of the Ecosperity Advisory Group, Temasek.
- » Chair of the scientific committee of the Volvo Environment Prize.
- » Selection committee of the Kenneth Boulding Award, International Society for Ecological Economics.
- » Lord-in-Waiting (Kabinettskammarherre), Swedish Royal Court.

Other

- » Working with Svenskt Tenn, Eric Ericsson and Lars Arrhenius for the exhibition *Welcome to the Biosphere*.
- » Steering Committee of the Nobel Prize Summit 2020, Ensuring Humanity’s Future on Earth. The United States National Academies of Sciences, Engineering, and Medicine, in partnership with the Nobel Foundation, Potsdam Institute for Climate Impact Research and Stockholm Resilience Centre/ Beijer Institute of Ecological Economics.
- » Recognised as Highly Cited Researcher by Thompson Reuters 2018.



Victor Galaz
Associate professor,
Programme director.
Deputy director,
Stockholm
Resilience Centre

Research focus

Governance challenges created by rapid global change, including novel technologies. Societal challenges created by technological change, including governance dimensions of geo-engineering, early warning systems of epidemic outbreaks, uses of social media to detect ecological change, algorithmic trade in financial markets, and risks embedded in early applications of artificial intelligence.

Publications during the period

- » Burch, S., A. Gupta, C. Inoue, A. Kalfagianni, A. Persson, V. Galaz, et al. 2019. New directions in earth system governance research. *Earth System Governance* 1:200006.
- » Jagers, S. C., S. Matti, A.-S. Crépin, D. Langlet, J. N. Havenhand, M. Troell, V. Galaz, et al. 2019. Societal causes of, and responses to, ocean acidification. *Ambio* 48 (8): 816-830.
- » Keys, P., V. Galaz, M. Dyer, N. Matthews, C. Folke, M. Nyström, and S. Cornell. 2019. Anthropocene Risk. *Nature Sustainability*. In press.
- » Galaz, V. (ed). 2019. *Global Challenges, Governance, and Complexity – Applications and Frontiers*. Edward Elgar, UK/USA. In press.
- » Galaz, V. 2019. Time and politics in the Anthropocene: Too fast, too slow? In Biermann F. and E. Löwbrand (eds.). *Anthropocene Encounters: New Directions in Green Political Thinking*. Cambridge University Press pp. 109-127.

Reports

- » Gaffney, O., A. Dauriach, V. Galaz, and B. Crona. 2018. *Sleeping Financial Giants - Opportunities in Financial Leadership for Climate Stability*. Earth System Finance Project of Stockholm Resilience Centre, Future Earth and the Global Economic Dynamics and the Biosphere project at the Royal Swedish Academy of Sciences.

Conferences, workshops and presentations

- » Finance and Non-linear Climate Change. Seminar, Universidad de Chile (Santiago), Santiago de Chile, Chile, November 2018. Keynote lecture.
- » Sustainable Development Impact Summit. Summit, World Economic Forum, New York, United States of America, September 2018. Participant and speaker.
- » Artificial Intelligence for People and the

- » Planet? Summit, United Nations University (Tokyo), Tokyo, Japan, March 2019. Invited speaker.
- » Sleeping Financial Giants. Tokyo University, Tokyo, Japan, March 2019.
- » Finance and the Earth System. Future Earth Tokyo, Tokyo, Japan, March 2019. Keynote speaker.
- » Sustainable Finance on a Changing Planet. Stockholm Sustainable Finance Centre (SSFC), Stockholm, Sweden, May 2019. Keynote lecture for the 2nd conference of the Northern European Partnership for Sustainable Finance (NEPSF).

Teaching and training

- » Main supervisor for PhD candidate Ami Golland (GEDB and Stockholm Resilience Centre, Stockholm University), ongoing.
- » Co-supervisor for PhD candidate Alice Dauriach (GEDB and Stockholm Resilience Centre, Stockholm University), ongoing.

Commissions

- » PhD Evaluation Committee member for Toler Senbeto Jiren (Leuphana University), 24 April 2019.
- » Licentiate Evaluation Committee member for Luigi Piemontese (Stockholm Resilience Centre, Stockholm University), 17 May 2019.
- » Founding Council Member, Stockholm Climate Security Hub.
- » Subject Editor, *Ecology and Society*.
- » Editorial Board member – *Global Perspectives*.

Other

- » The programme was briefly featured on Swedish media “Veckans Affärer” featuring an interview with W. Brian Arthur and programme director Victor Galaz about how AI will create new social and environmental challenges.
- » Online open editorial article: V. Galaz and D. Malpartida. 2018. Commentary: Machines learning development. ReThink.
- » Conference paper: Brass, I., M. Centeno, V. and Galaz .2019. Governance options for managing risk in dynamic human-machine-ecology systems. Conference paper for *ICPP4 - Montreal*.



Johan Gars
PhD, Researcher

Research focus

Economics of natural resource use and global environmental problems.

Publications during the period

- » Ferguson, S.M. and J. Gars. 2019. Measuring the impact of agricultural production shocks on international trade flows. *European Review of Agricultural Economics*. In press.

Teaching and training

- » Guest lecturer, Master’s level course *Challenges of Environmental Decision-making*, lecture on *Economics of climate change*, Stockholm Resilience Centre, Stockholm University, spring 2019.
- » Guest lecturer, undergraduate course *Ekologisk ekonomi (Ecological Economics)*, lecture on *Economics of climate change*, Stockholm University, spring 2019.
- » Lecturer, undergraduate course *Jordbruks- och miljöekonomi (Agricultural and Environmental Economics, the part Environmental economics)*, the Swedish University of Agricultural Sciences (SLU), Uppsala, autumn 2018.

Commissions

- » Journal Reviewer for *Fish and Fisheries*, *Journal of the European Economic Association* and *Journal of Environmental Economics and Management*.

Other

- » Seminar paper: Gars, J. and C. Olovsson. 2018. International business cycles: Quantifying the effects of a world market for oil. Swedish University of Agricultural Sciences (SLU), Uppsala, December 2018.



Åsa Gren
PhD, Researcher

Research focus

Sustainable and resilient urban development, with particular focus on integrating ecosystem services into urban planning and design.

Publications during the period

- » Gren, Å., J. Colding, M. Berghauser-Pont, and L. Marcus. 2018. How smart is Smart Growth? Examining the environmental validation behind city compaction. *Ambio* 48 (6): 580-589.

Conferences, workshops and presentations

- » Smart Cities in the Anthropocene. Seminar, University of Gävle, Sweden, 25–26 October 2018. Invited speaker. Presentation: How smart is smart growth?
- » Second symposium on Social Ecological Urbanism – Balancing Dense and Green Urban Development. Seminar. Chalmers University

of Technology, SMOG, Architecture and Civil Engineering, Gothenburg, Sweden, 18-19 June 2019. Invited speaker. Presentation: Densification, ecosystem services and environmental gains.

Teaching and training

- » Lecture, Master's level course *Sustainable Development and the Design Professions*, Chalmers Technological University, Gothenburg, 26 February 2018.
- » Lecture, Master's level course *Sustainable Development and the Design Professions*, Chalmers Technological University, Gothenburg, 18 September 2018.
- » Lecture, basic level course *Världens Eko*, Stockholm University, Stockholm, 2 October 2018.
- » Co-supervisor for Master's student Stefan Fogelqvist, Department of Environmental Science and Analytical Chemistry, ACES, Stockholm University, ongoing 2019.
- » Reviewer for Master's student Hanna Bökman, Master's Programme in Sustainable Development at Uppsala University, May 2019.
- » Supervisor of four students at Beckman's Design School within the Visual design-programme, Hannah Green Youngblood, Fredrik Wickberg, Reidar Pritzel and John Bengtsson, spring 2019.

Commissions

- » Journal reviewer for *Planning, Theory and Practice* and *Cities*.

Other

- » One of four Pls in an EU Synergy Grant application, autumn 2018-2019.
- » WP leader in an EU application with Arctic focus, autumn 2018-spring 2019.
- » PI of two applications for funding from FOR-MAS, spring 2019.



Patrik Henriksson
PhD, Researcher

Research focus

Aquaculture, LCA, food, sustainability.

Publications during the period

- » Hamann, M., K. Berry, T. Chaigneau, T. Curry, R. Heilmayr, P. J. G. Henriksson, J. Hentati-Sundberg, A. Jina, E. Lindkvist, Y. Lopez-Maldonado, E. Nieminen, M. Piaggio, J. Qiu, J. C. Rocha, C. Schill, A. Shepon, A. R. Tilman, I. Van Den Bijgaart, and T. Wu. 2018. Inequality and the Biosphere. *Annual Review of Environment and Resources* 43:61-83.

- » Shepon, A., P. J. G. Henriksson, and T. Wu. 2018. Conceptualizing a sustainable food system in an automated world: towards a "Eudaimonian" future. *Frontiers in Nutrition*.
- » Tlusty, M., P. Tyedmers, F. Ziegler, M. Jonell, P. J. Henriksson, R. Newton, D. Little, J. Fry, D. Love, and L. Cao. 2018. Commentary: comparing efficiency in aquatic and terrestrial animal production systems. *Environmental Research Letters* 13 (12): 128001.

Reports

- » Hornborg, S., E. Hallström, F. Ziegler, K. Bergman, M. Troell, M. Jonell, P. Rönnbäck, and P. J. G. Henriksson. 2019. *Frisk med fisk utan risk?: Betydelsen av svensk konsumtion av sjömat för hälsa och miljö*. RISE Report.

Conferences, workshops and presentations

- » The Bergen Dialogue - SeaBOS Initiative. Workshop, Seafood Business for Ocean Stewardship, Bergen, Norway, 13-15 May 2019. Participant.
- » Beijer Young Scholars 2016-2018 workshop. Beijer Institute of Ecological Economics, Stockholm, Sweden, 6-10 May 2019. Organizer.
- » SeaBos workshop. Workshop, Seafood Business for Ocean Stewardship, Waxholm, Sweden, 18-19 February 2019. Participant.
- » SeaWin workshop. Workshop, Gothenburg, Sweden, 12-13 November 2018. Participant.
- » World Aquaculture Society Aquaculture conference. Conference, World Aquaculture Society, Montpellier, France, 27-29 August 2018. Speaker. Presentation: Aquaculture's potential role as a sustainable protein source.

Teaching and training

- » Co-supervisor for PhD student Oskar Nyberg (Department of Ecology, Environment and Plant Sciences, Stockholm University), 2018-2021.
- » Co-supervisor for MSc student Charles Horsnell (Gothenburg University), 2018-2019.
- » Aquaculture LCA data training, Central Institute Of Freshwater Aquaculture, Bhubaneswar, India, 20-22 January 2019.

Commissions

- » Reviewer for *Plos one*, *International Journal of LCA*, *Journal of Cleaner Production*, *Sustainability*, *Ambio*, *Environmental Science and Technology*.

- » Opponent in PhD defence for Sen Sorphea (Swedish University of Agricultural Sciences), 13 June 2019.

Other

- » Participation in pilot internet-TV show. Parental leave June-September 2018



Malin Jonell
PhD, Researcher

Research focus

Seafood in global food systems and the role of markets, trade and the private sector in driving positive change in the food sector.

Publications during the period

- » Tlusty, M., P. Tyedmers, F. Ziegler, M. Jonell, P. J. Henriksson, R. Newton, D. Little, J. Fry, D. Love, and L. Cao. 2018. Commentary: Comparing efficiency in aquatic and terrestrial animal production systems. *Environmental Research Letters* 13 (12): 128001.
- » Springmann, M., M. Clark, D. Mason-D'Croz, K. Wiebe, B. L. Bodirsky, L. Lassalle, W. de Vries, S. J. Vermeulen, M. Herrero, K.M. Carlson, and M. Jonell. 2018. Options for keeping the food system within environmental limits. *Nature* 562 (7728): 519-525.
- » Willett, W., J. Rockström, B. Loken, M. Springmann, T. Lang, S. Vermeulen, T. Garnett, D. Tilman, F. DeClerck, A. Wood, M. Jonell, M. Clark, L. Gordon, J. Fanzo, C. Hawkes, R. Zurayk, J.A. Rivera, W. De Vries, L. Majele Sibanda, A. Afshin, A. Chaudhary, M. Herrero, R. Agustina, F. Branca, A. Lartey, S. Fan, B. Crona, E. Fox, V. Bignet, M. Troell, T. Lindahl, S. Singh, S.E. Cornell, K. S. Reddy, S. Narain, S. Nishtar, and C. J. L. Murray. 2019. Food in the Anthropocene: The EAT-Lancet Commission on healthy diets from sustainable food systems. *The Lancet* 393: 447-492.
- » Luthman, O., M. Jonell, and M. Troell. Governing the salmon farming industry: comparison between national regulations and the ASC salmon standard. 2019. *Marine Policy* 106: 103534.
- » Jonell, M., M. Tlusty, M. Troell, and P. Rönnbäck. 2019. Certifying farmed seafood – a drop in the ocean or a 'stepping-stone' towards increased sustainability? In Vogt, M. (ed.). *Sustainability Certification Schemes in the Agricultural and Natural Resources Sectors: Outcomes for Society and the Environment*, Oxon, Routledge, UK. pp 157-178.
- » Troell, M., M. Jonell, and B. Crona. 2019. The role of seafood for sustainable and healthy diets - The EAT-Lancet commission report through a blue lens. *Beijer Discussion Paper Series* No. 266.

Reports

- » Hornborg, S. E. Hallström, F. Ziegler, K. Bergman, M. Troell, M. Jonell, P. Rönnbäck, and P. Henriksson. 2019. *Frisk med fisk utan risk? Betydelsen av svensk konsumtion av sjömat för hälsa och miljö. (Improved human health*

from seafood consumption without risks – a Swedish perspective). RISE report.

Conferences, workshops and presentations

- » Electrolux Taste Target. Meeting, Electrolux, March 2019. Invited speaker. Presentation: The EAT-Lancet Commission on Healthy Diets from Sustainable Food Systems.
- » Blue Food Assessment (BFA) – Putting Aquatic Production at the Heart of Global Food Systems. Workshop, Stockholm Resilience Centre, Stockholm, Sweden, 11 June 2019. Co-organiser and speaker. Presentation: The EAT-Lancet Commission on Healthy Diets from Sustainable Food Systems.

Commissions

- » Internal committee member for licentiate examination seminar of PhD student Matilda Petersson (Stockholm Resilience Centre, Stockholm University), February 2019.

Other

- » Parental leave, March 2018-December 2018.



Sofia Kristin Kokinelis
MSc, Finance and HR administrator

Sofia is Finance & HR administrator 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. More specifically, she works with accounting, financial reporting and budgeting. She also provides support and financial information to researchers about their projects, assisting them with budgeting and financial reporting. In her role as HR administrator she also prepares staff contracts, assisting staff member with different issues. Owing to the research collaboration between the Beijer Institute and the Stockholm Resilience Centre (SRC), her work tasks also require close cooperation with the administration team at SRC.



Chandra Kiran Krishnamurthy
Assistant Professor, researcher

Research focus

Economics of coupled human-natural systems, economics of electricity markets, urban transportation and pollution.

Publications

- » Krishnamurthy, C.K., M. Vesterberg, R. Sven-to, H. Böök, and A. Lindfors. 2018. Real-time pricing revisited: Demand flexibility in the presence of micro-generation. *Energy Policy* (123) 642-658.
- » Krishnamurthy, C.K., M. Vesterberg, and A. Karimu. 2019. CERE Working Paper 2019-04:Dynamic pricing of electricity: Some implications for Swedish households. *CERE Working Paper Series*.

Conferences, workshops and presentations

- » Seminar: the Department of Economics, SLU, Uppsala, Sweden, June, 2019. Presentation: *Parking, transit, and welfare: Evidence from SFPark*
- » Seminar: The Chair of Resource Economics, ETH, Zurich, Switzerland, April, 2019. Presentation: *The economics of Planetary Boundaries*
- » Conference: 26th Ulvön Conference on Environmental Economics, Ulvön, Sweden, June, 2019. Presentation: *Electricity market dynamics with intermittent supply and storage*.

Teaching and training

- » Lecturer, PhD level course and workshop, *Behavioural Environmental Economics*. Department of Forest Economics, Swedish University of Agricultural Sciences, Uppsala, 33-6 June, 2019.
- » Lecturer, Master's level course *Skogsindustriell försörjningsstrategi (Forest Industry Supply Strategy)*, Module on *Strategic decision making*, Swedish University of Agricultural Sciences, Umeå, December 2018.
- » Lecturer, Master's level course on Forest Economics, Swedish University of Agricultural Sciences, Umeå, December 2018.

Commissions

- » Reviewer for PLOS ONE, *The Energy Journal*, *Journal of Forest Economics*, and *Energy Economics*.



Sofia Käll
PhD candidate

Sofia is a PhD candidate with the Global Economic Dynamics and the Biosphere (GEDB) Academy programme. She has been employed part time with the Beijer Institute, mainly to help developing the institute's new web page, due for launch in the autumn 2019. Among other things, she also assisted in organizing workshops, including the yearly Askö meeting.



Christina Leijonhufvud
BA, Chief administrator

Christina was responsible for the administration of the Board and Askö meetings in September 2018. In January 2019, she organized the *Urbanization in the Anthropocene – In Support of a Liveable Planet* workshop at the Royal Swedish Academy of Sciences and in May the *Beijer Young Scholars Workshop* at the Academy and on the island of Ekskäret. Furthermore the workshop on *Imaginaries and the Biosphere* in May and the *Marine Mammal Health Index* workshop in June, both at the Academy. She is responsible for the administration of guest research posts and deals with various office tasks.



Chuan-Zhong Li
PhD, Research Professor

Research focus

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

Publications during the period

- » Li, C.Z., A.-S. Crépin, and C. Folke. 2018. The economics of resilience. *International Review of Environmental and Resource Economics* 11: 309-353.
- » Shen, M., D. Mao, H. Xie, and C. Z. Li. 2019. The social costs of marine litter along the East China Sea: Evidence from ten coastal scenic spots of Zhejiang Province, China. *Sustainability* 11 (6): 1-15.
- » Wu, S., X. Zheng, J. Guo, C. Z. Li, and C. Wei. 2019. Quantifying energy consumption in household surveys: An alternative device-based accounting approach. *Field Methods*. In press.
- » Yu, Y., and C. Z. Li. 2019. Green certificate trading, renewable portfolio standard and tax burden reductions. *Chinese Journal of Population, Resources and Environment*. In press.



Therese Lindahl
PhD, Programme Director

Research focus

Human behaviour in social-ecological systems, in

particular how ecosystem dynamics (e.g. threshold effects, uncertainty, variability, spatial dynamics) influence resource users' exploitation and cooperation behaviour and implications for natural resource management. Alternative approaches to environmental policies based on psychological insights.

Publications during the period

- » Willett, W., J. Rockström, B. Loken, M. Springmann, T. Lang, S. Vermeulen, T. Garnett, D. Tilman, F. DeClerck, A. Wood, M. Jonell, M. Clark, L. Gordon, J. Fanzo, C. Hawkes, R. Zurayk, J.A. Rivera, W. De Vries, L. Majele Sibanda, A. Afshin, A. Chaudhary, M. Herrero, R. Agustina, F. Branca, A. Lartey, S. Fan, B. Crona, E. Fox, V. Bignet, M. Troell, T. Lindahl, S. Singh, S.E. Cornell, K. S. Reddy, S. Narain, S. Nishtar, and C. J. L. Murray. 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet* 393: 447-492.

Reports

- » Sahlin K., E. Röö, and T. Lindahl. 2019. *Hållbara val av kött: Konsumenters möjligheter att agera hållbart på den svenska köttmarknaden (Sustainable meat choices: Consumers possibilities to act sustainably on the Swedish meat market)*, report for Konsumentverket (The Swedish Consumer Agency). In press.

Conferences, workshops and presentations

- » Smart Cities in the Anthropocene. Seminar, University of Gävle, Gävle, Sweden, 25-26 October 2018. Invited speaker. Presentation: *Social norms and behavioural change of urban dwellers - the role of social media*.
- » Workshop on Consumer Potential to Act Sustainably on the Swedish Meat Market. Workshop, The Swedish Consumer Agency, Stockholm, Sweden, November 2018. Organizer.
- » The EAT-Lancet Stockholm launch. Meeting, the Royal Swedish Academy of Sciences and Stockholm Resilience Centre, Stockholm, Sweden, 18 January 2019. Participant.
- » Methods for Studying Social-Ecological Systems. Workshop, Leuphana University, Luneburg, Germany, 4-5 February 2019. Participant.
- » Frisk med Fisk utan Risk? – Sjömatens betydelse för hälsa och miljö (Healthy with Fish without Risk? - The importance of seafood for health and the environment). Symposium, the Royal Swedish Academy of Sciences, Stockholm, Sweden, 7 February 2019. Participant.
- » Economic Research Seminar. Seminar, Osnabrück University, Osnabrück, Germany, 30 April 2019. Invited speaker. Presentation:

Collective action for avoiding ecological regime shifts: Insights from behavioural experiments.

- » Imaginaries and the Biosphere. Workshop, the Beijer Institute, The Royal Swedish Academy of Sciences, Stockholm, Sweden, 27-28 May 2019. Participant.

Teaching and training

- » Co-supervisor for PhD candidate Elizabeth (Liz) Drury O'Neill (Stockholm Resilience Centre, Stockholm University).
- » Co-supervisor for PhD candidate Noah Linder (Environmental Psychology, Department of Building, Energy, and Environmental Engineering, University of Gävle).
- » Co-supervisor for PhD candidate Lina Isacs, Division (Environmental Strategies Research, Royal Institute of Technology).
- » Member of Assessment committee for PhD candidate Simon Elsborg Nygaard (Department of Psychology, Aarhus University).
- » Lecturer, PhD level course *How 2B a scientist?* Causality and correlation, Stockholm Resilience Centre, Stockholm University, autumn 2018.
- » Lecturer, Bachelor's level course *Global Challenges: Water – A common and scarce resource*, Stockholm School of Economics, autumn 2018.
- » Lecturer on Master's level course *Introduction to Social-Ecological Systems Research in Latin America: Behavioural biases in decision making*, SARAS, Maldonado, Uruguay, autumn 2018.
- » Lecturer, Master's level course *Governance and Management of Social-Ecological Systems: Challenges of Environmental Decision-making*, Stockholm Resilience Centre, Stockholm University, spring 2019.
- » Lecturer, Master's level course *Governance and Management of Social-ecological Systems: Drama of the Commons*, Stockholm Resilience Centre, Stockholm University, spring 2019.
- » Lecturer, undergraduate level course *Ekologisk ekonomi (Ecological Economics)*, Department of Physical Geography and Stockholm Resilience Centre, Stockholm University, spring 2019.
- » Lecturer, PhD level course *Behavioural Environmental Economics: Experiments and Social-ecological Systems*, Department of Economics, Swedish Agricultural University, Ultuna campus, spring 2019.

Commissions

- » Scientific council member, Fores, Stockholm, since 2010.
- » Co-stream leader of Biosphere Stewardship Stream, Stockholm Resilience Centre, Stockholm Sweden, since 2016.

- » SARAS Associate, South American Institute for Resilience and Sustainability Studies (SARAS), since 2018.

- » Journal reviewer for *Environmental and Resource Economics*, *Journal of Environmental Economics and Management*, *Ecological Economics*.

Other

- » Interviewed by Dagens Industri TV, Därför ses ekonomipristagarna som kontroversiella, available online, 8 October, 2019. <https://www.di.se/ditv/ekonomistudion/darfor-ses-ekonomipristagarna-som-kontroversiella/>
- » Interviewed by the Local, Sweden announces winners of 2018 Nobel Prize in Economics, available online, 8 October, 2019.
- » Interviewed by Lunchekot, Sveriges radio, Årets Nobelpristagare, 8 October 2019.
- » Op-ed Gordon, L., Bignet, V., Cornell, S., Crona, B., Jonell, M., Lindahl, T., Loken, B., Rockström, J., Stordalen, G., Troell, M., and A. Wood 2019. Ställ om snabbt till nyttigare och mer klimatsmart mat (Change quickly towards healthier and more climate-smart food), Dagens Nyheter, 17 January 2019.
- » Op-ed Gordon, L., Bignet, V., Cornell, S., Crona, B., Jonell, M., Lindahl, T., Loken, B., Rockström, J., Stordalen, G., Troell, M., and A. Wood 2019. Kostomställning behövs för gastronomisk och biologisk mångfald, (A dietary change is needed for gastronomic diversity and biodiversity), Dagens Nyheter, 28 January 2019,



Daniel Ospina
PhD student,
Junior Researcher

Research focus

Coupled dynamics of rural livelihoods and landscapes in developing regions, amidst increasing global connectivity and urbanisation. Understanding how rural out-migration and remittances shape land use/management decisions, particularly the conditions under which these rural-urban teleconnections may contribute to forest regrowth in migrant-origin areas.

Publications during the period

- » Ospina, D., G. Peterson, and A.-S. Crépin. 2019. Migrant remittances can reduce the potential of local forest transitions - a social-ecological regime shift analysis. *Environmental Research Letters* 14: 1-15.

Conferences, workshops and presentations

- » Urbanisation in the Anthropocene. The Royal Swedish Academy of Sciences, Stockholm, Sweden, 27-30 January 2019. Participant.
- » Fourth Open Science Meeting of the Global Land Programme, Transforming Land Systems for People and Nature. Centre for Development and Environment, University of Bern, Bern, Switzerland, 24-26 April 2019. Participant.
- » Beijer Young Scholars III. Meeting, Beijer Institute of Ecological Economics, Stockholm and Ekskäret, Sweden, 20-24 May 2019. Participant.

Teaching and training

- » Lecturer, Master's level course *Resilience Reflections and Applications*, Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden, spring 2019.

Commissions

- » Journal reviewer for *Environmental Research Letters*.

Other

- » “Outstanding article award” for paper by Haider et al. (2018. The undisciplinary journey: early-career perspectives in sustainability science. *Sustainability Science* 13 (1): 191–204.



Caroline Schill
PhD, Postdoctoral
Researcher

Research focus

Human behaviour in social-ecological systems. How human behaviour shapes, and is shaped by, different social-ecological contexts. Particular interest in collective action and sustainability in contexts of environmental change and uncertainty.

Publications during the period

- » Hamann, M., K. Berry, T. Chaigneau, T. Curry, R. Heilmayr, P. J. G. Henriksson, J. Hentati-Sundberg, A. Jina, E. Lindkvist, Y. Lopez-Maldonado, E. Nieminen, M. Piaggio, J. Qiu, J. C. Rocha, C. Schill, A. Shepon, A. R. Tilman, I. van den Bijgaart, and T. Wu. 2018. Inequality and the Biosphere. *Annual Review of Environment and Resources* 43 (1): 61-83.

Discussion paper:

- » Ntuli, H., A.-S. Crépin, C. Schill and E. Muchapondwa. 2019. Sanctioned quotas vs. information provisioning for community wildlife conservation in Zimbabwe: A framed field experiment approach. *Environment for*

the Development Discussion Paper Series 19-15.

Conferences, workshops and presentations

- » Postdoc Academy for Transformational Leadership Seminar I. Seminar, Bosch Foundation, Fundamentals of Inter- and Transdisciplinarity in Human-Environment Research, IRI THESys, Humboldt University of Berlin, Germany, October 2018. Participant.
- » Beijer Young Scholars Workshop on Inequality and the Biosphere. Workshop, Beijer Institute of Ecological Economics, Ekskäret, Stockholm, Sweden, May 2018. Participant.
- » Imaginaries and the Biosphere. Workshop, Royal Swedish Academy of Sciences, Stockholm, Sweden, May 2018. Participant.

Teaching and training

- » Guest lecturer, Master's level course *The Global Economy – Environment, Development and Globalisation, Tragedy of the Commons*, Centre for Environment and Development Studies (CEMUS), Uppsala University, fall 2018.
- » Module leader and lecturer, Master's level course *Governance and Management of Social-ecological Systems: Drama of the Commons*, Stockholm Resilience Centre, Stockholm University, spring 2019.

Other

- » Parental leave: January–May 2018.
- » “Outstanding article award” for paper by Haider et al. 2018. The undisciplinary journey: early-career perspectives in sustainability science. *Sustainability Science* 13 (1): 191–204.
- » Three grants awarded in competition: “Living with the 'new normal': exploring human responses to abrupt environmental change in the Arctic using behavioural and interpretive social science” (Formas project grant, Principal investigator); “Climate change - from the small-scale fisher's point of view. Identifying critical multi-level processes for sustainable small-scale fisheries.” (Formas future research leaders grant, co-applicant); “Inequality and the sustainable development goals: A multi-scale analysis of tradeoffs, synergies, and interactions” (Formas planning grant, co-applicant).
- » Popular science article: Livet i det nya normala (Life in the new normal), Extrakt, 26 January 2019.



Agneta Sundin
Communications Officer

Agneta's responsibilities include developing and editing the website and the annual report and administering the Beijer publication series, as well as taking part in organising workshops and other events. A member of Stockholm Resilience Centre's communications team, Agneta is involved in activities arranged jointly by SRC, Beijer and Albaeco, for example the Stockholm Seminars series. In addition, she was amongst other things co-organiser and moderator of the seminar *Cities – Frontlines for Sustainability* in November; co-organiser and facilitator of the Beijer Young Scholars workshop in May at the Academy and on the island of Ekskäret; and, on behalf of the Beijer Institute, project leader for the course for students at the Beckman School of Design in February-March and the subsequent exhibition *In my backyard* at Svenskt Tenn in March 2019 (Described on page 40-41). In spring 2019, she has been leading the project to develop a new website for the institute, due for launch in the autumn 2019.



Max Troell
Associate Professor,
Senior Researcher

Research focus

Sustainability of seafood, aquaculture, capture fisheries, governance of coastal and marine ecosystems, mangrove ecosystems, ecosystem services, ecosystem functions, biodiversity, resilience, regime shifts, food systems, nutrition and food security, integrated aquaculture, sustainability metrics, life-cycle analysis, seafood certification standards.

Publications during the year

- » Springmann, M., M. Clark, D. Mason-D'Croz, K. Wiebe, B. Leon Bodirsky, L. Lassaletta, W. de Vries, S. J. Vermeulen, M. Herrero, K. M. Carlson, M. Jonell, M. Troell, F. DeClerck, L. Gordon, R. Zurayk, P. Scarborough, M. Rayner, B. Loken, J. Fanzo, H.C.J. Godfray, D. Tilman, J. Rockstrom, and W. Willett. 2018. Options for keeping the food system within environmental limits. *Nature* 562: 519-525.
- » Tallis, H.M., P.L. Hawthorne, S. Polasky, J. Reid, M.W. Beck, K. Brauman, J.M. Bielicki, S. Binder, M.G. Burgess, E. Cassidy, A. Clark, J. Fargione, E.T. Game, J. Gerber, F. Isbell, J. Kiesecker, R. McDonald, M. Metian, J. L. Molnar, N. D. Mueller, C. O'Connell, D. Ovando, M. Troell, T.M. Boucher, and B. McPeck. 2018. An attainable global vision for conservation and human well-being. *Frontiers in Ecology and the Environment* 16 (10): 563-570.

» Jagers, S. S. Matti, A.-S. Crépin, D. Langlet, J. N. Havenhand, M. Troell, H. L. Filipsson, V. Galaz, and L. G. Anderson. 2019. Societal causes of, and responses to, ocean acidification. *Ambio* 48 (8): 816-830.

» Willett, W., J. Rockström, B. Loken, M. Springmann, T. Lang, S. Vermeulen, T. Garnett, D. Tilman, F. DeClerck, A. Wood, M. Jonell, M. Clark, L. Gordon, J. Fanzo, C. Hawkes, R. Zurayk, J.A. Rivera, W. De Vries, L. Majele Sibanda, A. Afshin, A. Chaudhary, M. Herrero, R. Agustina, F. Branca, A. Lartey, S. Fan, B. Crona, E. Fox, V. Bignet, M. Troell, T. Lindahl, S. Singh, S.E. Cornell, K. S. Reddy, S. Narain, S. Nishtar, and C. J. L. Murray. 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet* 393: 447-492.

» Luthman, O., M. Jonell, and M. Troell. Governing the salmon farming industry: Comparison between national regulations and the ASC salmon standard. 2019. *Marine Policy* 106: 103534.

» Troell, M., M. Jonell, and B. Crona. 2019. The role of seafood for sustainable and healthy diets - The EAT-Lancet commission report through a blue lens. *Beijer Discussion Paper Series* No. 266.

» Jonell, M., M. Tlusty, M. Troell, and P. Rönnbäck. 2019. Certifying farmed seafood – a drop in the ocean or a ‘stepping-stone’ towards increased sustainability? In Vogt, M. (ed.). *Sustainability Certification Schemes in the Agricultural and Natural Resources Sectors: Outcomes for Society and the Environment*, Oxon, Routledge, UK. Pp. 157-178.

Reports

» Hornborg, S. E. Hallström, F. Ziegler, K. Bergman, M. Troell, M. Jonell, P. Rönnbäck, and P. Henriksson. 2019. Frisk med fisk utan risk? *Betydelsen av svensk konsumtion av sjömat för hälsa och miljö. (Improved human health from seafood consumption without risks – a Swedish perspective)*. RISE report.

» Eriksson H., M. Troell, C. Brugere, M. Chadag, M. Phillips, and N. Andrew. 2018. *A Diagnostic Framework for Equitable Mariculture Development in the Western Indian Ocean*. Australian Centre for International Agricultural Research: Canberra, ACT. ACIAR Monograph No. 204.

» Troell, M., F. Ziegler, M. Jonell, K. Bergman, and P. Henriksson. 2018. *Seafood for Sustainability*. Seawin Project Report.

» WAS 2018. *Compilation of Session Summaries. Expanding Aquaculture within the Planetary Boundaries*. EAS Secretariat.

Conferences, workshops and presentations

» EAT Competence Forum 2019. Symposium, EAT, Stockholm, Sweden, 12 June 2019. Participant

» Blue Food Assessment (BFA) – Putting Aquatic Production at the Heart of Global Food Systems. Workshop, Stockholm Resilience Centre, Stockholm, Sweden, 11 June 2019. Organiser and speaker. Presentation: *EAT Blue scoping report*.

» The Bergen Dialogue - SeaBOS Initiative. Workshop, Seafood Business for Ocean Stewardship, Bergen, Norway, 13-15 May 2019. Invited speaker. Presentation: *Antibiotics in aquaculture – Task Force III*.

» Future Industry Forum, What Will it Take to Create a New, Profitable and Sustainable Industry? Forum, Karlstad, Sweden, 14-15 March 2019. Presenter. Presentation: *Global perspective on foods and the role of aquaculture for sustainable growth*.

» Network for Food and Environment. Seminar, RISE, Gothenburg, Sweden, 5 December 2018. Presenter. Presentation: *Framtidens hållbara och hälsosamma tallriksmodell (Future sustainable and healthy plate model)*.

» The Sixteenth Meeting of the Marine Science for Management (MASMA) Grantees. Meeting, Nairobi, Kenya, 12-13 November 2018. Chair and evaluator.

» Nya foderråvaror till fisk och kräftdjur för utveckling av hållbart vattenbruk (New Feed Resources for Fish and Shellfish for Sustainable Aquaculture). Workshop, SWEMARC, Gothenburg University, Nomaculture and Maritima klustret i Västsverige (Nomaculture and Maritime clusters of Western Sweden), Gothenburg, Sweden, 18 September 2018. Participant.

» MASMA grantee research evaluation meeting. Workshop, Nairobi, Kenya, 6-7 September 2018. Evaluator.

» World Aquaculture Society Annual Meeting. Symposium, World Aquaculture Society, Montpellier, France, 27-30 August 2018. Organizer, session chair and speaker. Presentation: *Expanding aquaculture within the Planetary Boundaries*.

» Krinova Food Hackaton. Krinova Incubator & Science Park, Kristianstad, Sweden, 15 March, 2019. Invited speaker. Presentation: *Can farmed seafood contribute to healthy people and a healthy planet?*

» Sustainable Aquaculture at Local and Global Scales. Symposium, the Royal Swedish Academy of Agriculture and Forestry, Stockholm, Sweden, 21 March 2019. Presenter. Presentation: *Perspectives on sustainable aquaculture*.

» MASMA grantee research evaluation meeting. Workshop, Nairobi, Kenya, 25-26 April, 2019. Evaluator.

Teaching and training

» Co-supervisor for PhD candidate M. Oyinlo-Ila, Nereus (University of British Colombia), 2015–ongoing.

Commissions

» Evaluation committee member at PhD defence for Innocent Wanyonyis (Linnaeus University), 22 November 2019.

» Evaluation committee member at PhD defence for Nguyen Huu Yen Nhi (Swedish University of Agricultural Sciences), 2 April 2019.

» ISP review for Victoria Bignet (Stockholm Resilience Centre, Stockholm University), 31 January 2019.

» Expert reviewer for FAIRR Initiative, Shallow returns? ESG risks and opportunities in aquaculture, FAIRR, London, 2019.

» Contributing author in nature sub-chapter on Aquaculture, IPBES Global Assessment, 2018.

» Reviewer for ACIAR project Fisheries project FIS/2018/155 Agriculture for improved nutrition: integrated agri-food systems in the Pacific region, March 2019.

» Senior adviser for SWEDBIO´s marine portfolio and strategy. 2017–ongoing.

» Member of ICES Working Group on Social and Economic Dimensions of Aquaculture (WGSEDA), since 2011.

» Member of the MASMA Programme Committee, Western Indian Ocean Marine Science Association, since 2007.

» Review editor for *Journal of Aquaculture Environment Interactions (AEI)*, *Frontiers in Marine Science*, *Western Indian Ocean Journal of Marine Science*.

» Journal reviewer for *Nature*, *Science*, *Proceedings of the National Academy of Sciences*, *Aquaculture Research*, *Aquaculture*, *WIOJMS* and *Journal of Fisheries and Aquaculture*.

The Beijer publication Series

Scientific papers by Beijer staff or Beijer fellows, published in refereed journals or in books that have undergone review, are reproduced in the BEIJER E-PRINT SERIES, in order to facilitate dissemination of research results. Some of the E-prints may have appeared earlier as discussion papers. The total number of E-prints since 1991 is at present 557, of which 29 were published on our website between July 2018 and June 2019. The BEIJER DISCUSSION PAPER SERIES constitutes a forum for unpublished scientific papers with content that should be subject to discussion and comments. The discussion papers can be downloaded from the Beijer website. A total of 267 discussion papers have been produced since 1991.

E-Print Series

» **557.** Valuing individual characteristics and the multifunctionality of urban green spaces: The integration of sociotope mapping and hedonic pricing. Czembrowski, P., E. Łasz-

kiewicz, J. Kronenberg, G. Engström, and E. Andersson. 2019. *PLoS One* 14 (3): e0212277.

» **556.** Time and politics in the Anthropocene: Too fast, too slow? Galaz, V. 2019. in Biermann F. and E. Löwbrand (eds.). *Anthropocene Encounters: New Directions in Green Political Thinking*, Cambridge University Press, pp. 109-127.

» **555.** Certifying farmed seafood – a drop in the ocean or a ‘stepping-stone’ towards increased sustainability? Jonell, M., M. Tlusty, M. Troell, and P. Rönnbäck. 2019. In Vogt, M. (ed.). *Sustainability Certification Schemes in the Agricultural and Natural Resources Sectors: Outcomes for Society and the Environment*, Oxon, Routledge, UK., pp 157-178.

» **554.** The social costs of marine litter along the East China Sea: Evidence from ten coastal scenic spots of Zhejiang Province, China Shen, M., D. Mao, H. Xie, and C. Z. Li. 2019. *Sustainability* 11 (6):1-15.

» **553.** Food in the Anthropocene: The EAT–Lancet Commission on Healthy Diets from Sustainable Food Systems Willett, W., J. Rockström, B. Loken, M. Springmann, et al. 2019. EAT-Lancet EAT–Lancet Commission on healthy diets from sustainable food systems DOI: 10.1016/S0140-6736(18)31788-4.

» **552.** Commentary: Comparing efficiency in aquatic and terrestrial animal production systems. Tlusty, M., P. Tyedmers, F. Ziegler, M. Jonell, P. J. Henriksson, R. Newton, D. Little, J. Fry, D. Love, and L. Cao. 2018. *Environmental Research Letters* 13 (12): 128001.

» **551.** Inequality and the biosphere. Hamann, M., K. Berry, T. Chaigneau, T. Curry, R. Heilmayr, P. J. G. Henriksson, J. Hentati-Sundberg, A. Jina, E. Lindkvist, Y. Lopez-Maldonado, E. Nieminen, M. Piaggio, J. Qiu, J. C. Rocha, C. Schill, A. Shepon, A. R. Tilman, I. Van Den Bijgaart, and T. Wu. 2018. *Annual Review of Environment and Resources* 43 (1): 61-83.

» **550.** Inertia risk: Improving economic models of catastrophes. Crépin, A.-S., and E. Nævdal. 2019. *Scandinavian Journal of Economics* doi: 10.1111/sjoe.12381

» **549.** Governing the salmon farming industry: Comparison between national regulations and the ASC salmon standard. Luthman, O., M. Jonell, and M. Troell. 2019. *Marine Policy* 106: 103534.

» **548.** Combined climate and nutritional performance of seafoods. Hallström, E., K. Bergman, K. Mifflin, R. Parker, P. Tyedmers, M. Troell, and F. Ziegler. 2019. *Journal of Cleaner Production* 230: 402-411.

» **547.** Sustainability and resilience for transformation in the urban century. Elmqvist, T., E. Andersson, N. Frantzeskaki, T. McPhearson, P. Olsson, O.Gaffney, K. Takeuchi, and C. Folke. 2019. *Nature Sustainability* 2: 267-273.

» **546.** Policy design for the Anthropocene. Sterner, T., E. B. Barbier, I. Bateman, I. van den Bijgaart, A-S. Crépin, O. Edenhofer, C. Fischer, W. Habla, J. Hassler, O. Johansson-Stenman, A. Lange, S. Polasky, J. Rockström, H. G. Smith, W. Steffen, G. Wagner, J. E. Wilen, F. Alpizar, C. Azar, D. Carless, C. Chávez, J. Coria, G. Engström, S. C. Jagers, G. Köhlin, Å. Löfgren, H. Pleijel, and A. Robinson. 2019. *Nature Sustainability* 2: 14–21.

» **545.** Deceptive sustainability: Cognitive bias in people’s judgment of the benefits of CO2 emission cuts. Holmgren, M., A. Kabanshia, L. Langeborg, S. Barthel, J. Colding, O. Eriksson, and P. Sörqvist. 2019. *Journal of Environmental Psychology* 64: 48-55.

» **544.** Exploring the social-ecological systems discourse 20 years later. Colding, J., and S. Barthel. 2019. *Ecology and Society* 24 (1): 2.

2018

» **543.** Trajectories of the Earth System in the Anthropocene. Steffen, W., J. Rockström, K. Richardson, T. M. Lenton, C. Folke, D. Liverman, C.P. Summerhayes, A.D. Barnosky, S.E. Cornell, M. Crucifix, J.F. Donges, I. Fetzer, S.J. Lade, M. Scheffer, R. Winkelmann, and H. J.Schellnhuber. 2018. *PNAS* 115 (33): 8252-8259

» **542.** Social-ecological systems insights for navigating the dynamics of the Anthropocene. Reyers, B., C. Folke, M-L. Moore, R. Biggs, and V. Galaz. 2018. *Annual Review of Environment and Resources* 43: 267-289.

» **541.** Iconic images, symbols, and archetypes: Their function in art and science. Westley, F. R., and C. Folke. 2018. *Ecology and Society* 23(4): 31.

» **540.** Social-ecological systems as complex adaptive systems: Organizing principles for advancing research methods and approaches. Preiser, R., R. Biggs, A. De Vos, and C. Folke. 2018. *Ecology and Society* 23 (4): 46.

» **539.** Societal causes of, and responses to, ocean acidification. Jagers, S.C., S. Matti, A-S. Crépin, D. Langlet, J.N. Havenhand, M. Troell, H.L. Filipsson, V.R. Galaz, and L.G. Anderson. 2019. *Ambio* 48 (8): 816-830.

» **538.** Ecological and functional consequences of coastal ocean acidification: Perspectives from the Baltic-Skagerrak System. Havenhand, J.N., H.L. Filipsson, S. Niiranen, M. Troell, A-C. Crépin, S. Jagers, D. Langlet, S. Matti, D. Turner, M. Winder, P. de Wit, and L.G. Anderson. 2019. *Ambio* 48 (8): 831-854.

» **537.** An attainable global vision for conservation and human well-being. Tallis, H., P. Hawthorne, S. Polasky, J. Reid, M. Beck, K. Brauman, J. Bielicki, S. Binder, M. Burgess, E. Cassidy, A. Clark, J. Fargione, E. Game, J. Gerber, F. Isbell, J. Kiesecker, R. McDonald,

M. Metian, J. Molnar, N. Mueller, C. O’Connell, D. Ovando, M. Troell, T. Boucher, and B. McPeck. 2018. *Frontiers in Ecology and the Environment* 16 (10): 563-570.

» **536.** Cascading regime shifts within and across scales. Rocha, J.C, G. Peterson, Ö. Bodin, and S. Levin. 2018. *Science* 362 (6421), 1379-1383.

» **535.** Migrant remittances can reduce the potential of local forest transitions - a social-ecological regime shift analysis. Ospina, D., G. Peterson, and A-S. Crépin. 2019. *Environmental Research Letters* 14 (2): 1-15.

» **534.** Conceptualizing a sustainable food system in an automated world: Toward a “Eudaimonian” future. Shepon, S., P.J.G. Henriksson, and T. Wu. 2018. *Frontiers in Nutrition* 5: 104.

» **533.** Dynamic games of international pollution control: A selective review. de Zeuw A. 2018. In: Başar T. and G. Zaccour (eds.) *Handbook of Dynamic Game Theory*. Springer, pp. 703-728.

» **532.** Options for keeping the food system within environmental limits. Springmann, M., M. Clark, D. Mason-D’Croz, K. Wiebe, B. L. Bodirsky, L. Lassalle, W. de Vries, S. J. Vermeulen, M. Herrero, K.M. Carlson, M. Jonell, M. Troell, F. DeClerck, L. J. Gordon, R. Zurayk, P. Scarborough, M. Rayner, B. Loken, J. Fanzo, H. C. J. Godfray, D. Tilman, J. Rockström, and W. Willett. 2018. *Nature* 562: 519-525.

» **531.** Climate tipping and economic growth: Precautionary capital and the price of carbon. van der Ploeg, F., and A. de Zeeuw. 2018. *Journal of the European Economic Association* 16 (5): 1577–1617.

» **530.** How smart is smart growth? Examining the environmental validation behind city compaction. Gren, Å., J. Colding, M. Bergthauer-Pont, and L. Marcus. 2019. *Ambio* 48 (6): 580-589.

» **529.** The economics of resilience. Li, C-Z, A-S. Crépin, and C. Folke. 2018. *International Review of Environmental and Resource Economics* 11: 309-353.

Discussion papers

» **267.** Discounting in the presence of scarce ecosystem services. Xueqin Zhu, Sjak Smulders, and Aart de Zeeuw. 2019.

» **266.** The role of seafood for sustainable and healthy diets - The EAT-Lancet commission report through a blue lens. Max Troell, Malin Jonell, and Beatrice Crona. 2019.

» **265.** The tipping game. Florian Wagener and Aart de Zeeuw. 2018.

» **264.** Jan Tinbergen, from mathematics to poverty and environment, Aart de Zeeuw. 2018.



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.

Humanity is embedded in the Biosphere and shape it from local to global scales, from the past to the future. At the same time humanity is fundamentally dependent on the capacity of the Biosphere to sustain development.

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. Cooperation efforts include collaborative research between economists and ecologists and related disciplines on fundamental and applied problems in relation to sustainability, as well as teaching and training on those issues nationally and internationally.

The Beijer Institute's major activities are international research programmes, synthesis workshops, a broad set of research projects, teaching and training programmes, dissemination of results, the science-policy interface and collaborative communication.

Core funding is provided by Kjell och Märta Beijer Foundation. Funding is also provided by Swedish and international research councils, foundations and other organisations.

This annual report covers the period
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