

THE BEIJER INSTITUTE OF
ECOLOGICAL ECONOMICS
ANNUAL REPORT
2015/2016



The Beijer Institute of Ecological Economics

Annual Report

1 july 2015 – 30 june 2016

Cover photos: Sergio Guarín Torres, Lars Hall, Nils Ryrholm/Azote,
Juan-Carlos Rocha, Ása Gallegos Torell/Azote, Helsinki Metropolia
UAS / Juan Covarrubias, Jerker Lokrantz/Azote

© The Beijer Institute of Ecological Economics 2016

Editor

Agneta Sundin

Design, illustration and production

Bror Rudi Creative

Proof reading

Mary McAfee

Paper

Munken Polar

P.O. Box 50005, SE-104 05 Stockholm, Sweden

Phone: +46 8 673 95 00 | **Fax:** +46 8 15 24 64

beijer@beijer.kva.se | www.beijer.kva.se

Contents

Director's column	4
Research programmes	
Aquaculture and Sustainable Seafood Production	6
Urban Social-Ecological Systems	8
Behaviour, Economics and Nature Network - BENN	10
Global Dynamics and Resilience	12
Complex Systems	14
Selected publications	
Making ecosystems predictable may backfire	16
A new landscape of global crises	17
Marine resource exploitation can be contagious	18
How to set taxes to save the climate	19
The Beijer Young Scholars	20
Science in society	22
Education	26
Collaborations	28
Supporting environmental economics networks	32
Appendix	
Board of directors	34
Staff news	34
Staff members	35
Visiting scientists	35
Administration	36
Funding	36
Teaching and training	36
Staff members' publications and activities	37
The Beijer Publication Series	47

Director's column

THE BEIJER INSTITUTE of Ecological Economics celebrates 25 years in 2016. What an exciting journey to be part of! I dare to say that we have had an influence.

The 'new' direction of the Institute at the interface of ecology and economics was decided by the Royal Swedish Academy of Sciences and supported by the Beijer Foundation. The Director, Karl-Göran Mäler, asked me to become his deputy. A set of meetings with leading scholars took place in early 1991 to outline a few research pathways on the research front. The Beijer Institute of Ecological Economics was inaugurated in that same year.

We had a kick-start with our first programme on the ecology and economics of biodiversity loss and ecosystem services. It was novel, shifting the mindset from conserving species to their role in sustaining life support systems and natural capital for human wellbeing. It also showed that people are part of the planet and dependent on the biosphere.

The work of the programme immediately inspired policy and practice and the approach spread into science and society across the world. Now, work on biodiversity, natural capital and ecosystem services for human wellbeing is almost mainstream.

I am happy to observe that this pattern of contributing to science and society seems to have repeated itself many times during the 25 years of the Beijer Institute. I find it most exciting and rewarding that our basic, curiosity-driven and interdisciplinary research collaborations for a deeper understanding of the interplay between ecological systems and social and economic development have become highly relevant in knowledge generation and applied in decision-making. The examples are numerous, from work on oceans to urban development, from influence on international conventions to policy and practice, from development agencies and poverty alleviation to the business

world and multinational corporations.

By asking new questions across disciplines, we have contributed to forming new research fronts and research areas and have demonstrated that interdisciplinary collaboration is indeed worthwhile and of great significance for confronting the sustainability challenges of the 21st century.

The never-ending engagement, flexibility and professional support of the Academy is deeply appreciated. The Beijer Foundation's long-term core funding to the Institute is unique, not for quick solutions to specific problems, but as solid support for new ways of thinking and understanding to prepare for the challenges of the future. The continuous support of Anders Wall and the members of the Beijer Foundation and their trust in our work and activities are invaluable and, as always, gratefully acknowledged.

Leading scholars from economics and ecology and related disciplines are engaged in the activities of the Beijer Institute. The Beijer Board members, the Beijer Fellows, researchers and staff, the close collaboration between the Beijer, Stockholm Resilience Centre and the Global Economic Dynamics and the Biosphere Programme (GEDB) – each and every one involved plays a key role and deserves more than heartfelt thanks for all their very inspiring and rewarding work!

The work of the Beijer Institute is now more relevant than ever. Humanity has become a significant force in shaping the dynamics of planet Earth at a scale and pace never witnessed before. At the same time, humanity is fundamentally dependent on the resilience of the biosphere to sustain development. We seem to be in the midst of a new renaissance of reconnecting development to the biosphere as the way forward towards prosperity. The Beijer Institute is ready to take on the challenges and contribute to the solutions.



Photo: Cecilia Nordstrand

Carl Folke, Director
Stockholm, 16 August, 2016

Research

The Beijer Institute of Ecological Economics provides a forum for researchers in economics and ecology and related disciplines to interact and develop joint research, seeking a deeper understanding of social-ecological systems. Research at the Beijer Institute is organised into five international programmes that comprise a diverse set of projects.





Aquaculture and Sustainable Seafood Production

Programme director:
Max Troell

THE ROLE OF AQUACULTURE in poverty alleviation is receiving increasing attention within the Beijer Aquaculture programme. A study on the contribution of fisheries and aquaculture to food security and poverty reduction has been published in *World Development*. Funding was recently obtained from the Australian Centre for International Agricultural Research (ACIAR) for work in the project *Fish in national development: Contrasting case studies in the Indo-Pacific (2015-2017)*, in collaboration with WorldFish and former FAO-affiliated researcher Cecile Brugere.

Food security and policy

The emergence and recognition of the 'Blue Economy' concept (alternative economic models for sustainable development that acknowledge human dependency on oceans) has highlighted the role of marine and brackish water aquaculture (mariculture) for

sustainable expansion of seafood production, and also for meeting food security and income generation. This is true for many countries, including coastal and island states within the Western Indian Ocean. However, mariculture expansion cannot be pursued in isolation, as many of these countries share common coastal resources that are variously interconnected to, and influenced by, mariculture expansion. Thus, the future development trajectory of mariculture in the region requires a shared understanding and perspective across boundaries and stakeholders. In order to improve decision-making on mariculture policy and planning in the Western Indian Ocean, a five-day workshop entitled *Sustainable and equitable mariculture development in the Western Indian Ocean - Development of a policy framework* was held in May 2016. The workshop was organised by the Beijer Institute, Wiomsa, WorldFish and IORA and brought together key stakeholders

influencing the development pathway of mariculture in the region, or representing sectors with interests in mariculture. The output was a tentative policy framework aimed at guiding sustainable and equitable development of mariculture in the Western Indian Ocean. The workshop also provided an opportunity to enhance regional co-operation on mariculture development at policy level.

References:

Béné, C., R. Arthur, H. Norbury, E. H. Allison, M.C.M Beveridge, S. Bush, L. Campling, W. Leschen, D. Little, D. Squires, S. Thilsted, M. Troell and M. William. 2016. Contribution of fisheries and aquaculture to food security and poverty reduction: Assessing the current evidence. *World Development* 79: 177.

RESEARCH PROGRAMMES



Fishers in Myanmar, where the Beijer Institute is engaged in assisting the government to achieve sustainable development of its fisheries and aquaculture sector. Photo: Ben Belton

Aquaculture part of transformation

Through the Myanmar Fishery Partnership (MFP), the Beijer Institute is actively involved in assisting the Myanmar government to achieve sustainable development of its fisheries and aquaculture sector. A policy meeting in the capital, Naypyidaw, resulted in a series of fisheries and aquaculture policy briefs (see more under 'Science in Society').

With the aim of transforming the aquaculture sector, the Beijer Aquaculture programme, together with Stockholm Resilience Centre, in collaboration with Forum for the Future and the Soneva Foundation, is engaging the leaders of global seafood corporations (identified as keystone actors in an article in *PLOS One*) in strategic informal dialogue about seafood production and sustainability. The next step in this initiative will be an event in Norway in November.

References:

Österblom, H., J-B. Jouffray, C. Folke, B. Crona, M. Troell, A. Merrie, and J. Rockström. 2015. Transnational corporations as 'keystone actors' in marine ecosystems. *PLOS One* 10(5): e0127533.

Small-scale farmers in a global economy

The Beijer Aquaculture programme is also involved in collaborative work examining how global seafood trade drives and shapes social-ecological systems. A typology of interactions between small-scale fishers and farmers was identified in an article in *Marine Policy* and a forthcoming article illustrates, with real practical examples, how global trade can drive small-scale crab farming in East Africa and its environmental and economic consequences.

References:

Crona, B., X. Basurto, D. Squires, S. Gelcich, T.M. Daw, A. Khan, E. Havice, V. Chomo, M. Troell and E. Buchary. 2016. Towards a typology of interactions between small-scale fisheries and the global seafood trade. *Marine Policy* 65:1-10.

Aquaculture, environment and consumers

A paper in *PNAS* on the use of antibiotics in aquaculture has prompted collaboration with Princeton University, USA, Leiden University, the Netherlands, and University of Los Lagos, Chile, in two

studies: 1) Global estimates of total antibiotic consumption in aquaculture and livestock and 2) identification of factors influencing antimicrobials in aquaculture. Other ongoing studies are examining benchmarking of environmental performance of aquaculture using Life Cycle Assessment, with case studies from Egyptian, Indonesian and Vietnamese aquaculture.

The programme continues to focus on consumers and is seeking to increase understanding about factors determining seafood choices. Two studies have investigated the role of eco-labelling in consumer preferences for seafood and, more broadly, on consumer purchasing of sustainable seafood in Sweden.

References:

Phillips, M.J., P.J.G. Henriksson, N. Van Tran, C.Y. Chan, C.V. Mohan, U. Rodriguez, S. Suri, S. Hall and S. Koeshendrajana. 2015. Exploring Indonesian Aquaculture Futures. Program Report: 2015-39. WorldFish, Penang, Malaysia.

Henriksson, P. Troell, M. and Rico, A. 2015. Antimicrobial use in aquaculture: Some complementing facts. Letter, *PNAS*. 112(26): e0127533



Workshop May 2016: Sustainable and equitable mariculture development in the Western Indian Ocean - Development of a policy framework
Photo: Max Troell

Urban Social-Ecological Systems

A CLEAR PATTERN in the era of the Anthropocene is that the world is urbanising at an unprecedented rate, placing ever-increasing demands on resources and living ecosystems. By the year 2030, an additional 60% of the land area on the planet is expected to be urban, posing a major challenge that needs wise navigation and governance, in particular considering that we are experiencing an uncertain future due to climate change.

As part of biosphere stewardship, cities need to provide better stewardship of ecosystems, both inside and outside their borders, that paves the way for new and faster ways to reconnect humans to the biosphere. Such reconnection is enabled by institutional designs and urban processes that involve learning, self-organisation and fostering wiser management of diversity. For example, cities need to be better prepared to meet the new challenges of the Anthropocene, including those threats and opportunities posed by climate change and new global migration patterns of humans.

Cities as complex adaptive systems

At a theoretical level, urban systems can be approached as complex adaptive systems (CAS), since they exhibit many of the common properties of CAS, such as interconnectedness, unpredictability, modularity, redundancy and resiliency. As part of advancing knowledge of cities as complex adaptive systems, the theoretical premises behind our research in the *Urban social-ecological systems* programme derive from studies on how to build resilience in linked social-ecological systems. This is an integral part of the Beijer Institute's and Stockholm Resilience Centre's (SRC) past and ongoing research activities.

Urban resilience

The *Urban social-ecological systems* programme also aims to advance urban resilience science. To achieve this, it is essential to improve understanding on designing urban systems that can deal more proactively with both known and

uncertain future scenarios. Urban resilience building could be viewed as the outcome of a recurrent process that entails proactive anticipation, learning and adaptation to changing circumstances, including climate change and biodiversity loss.

A primary requirement is research centred on improving understanding of the relationships between urban form, ecosystem services, institutions and resilience. This entails comparing, merging and developing methods and tools originating from different relevant scientific disciplines, such as economics and urban ecology. Another important mission is to translate research insights into meaningful urban planning policies, including the development of novel urban design principles and tools.

“As part of biosphere stewardship, cities need to provide better stewardship of ecosystems, both inside and outside their borders.”

Strengthening collaboration between academia and practitioners

The research unit formerly known as ‘the Urban Lab’ of the Beijer Institute and SRC urban research platform has recently been reformed and is now an academic research collaboration network. After careful consideration and long-term negotiations with the Gothenburg research centre Mistra Urban Futures (MURF), as described in the previous annual report, a decision was

Programme director:
Johan Colding

made to transform the Urban Lab into an academic research hub that will focus on improving current knowledge of social-ecological urban systems. This research network is currently referred to as “*Hej Tätort!*” (Hello Urbanity!), and is intended to act as an arena for closer research collaboration between architects and urban system ecologists with the focus on building more resilient and sustainable cities.

A result of this long-term partnership is the development of a new research field known as social-ecological urbanism, where interlinking of urban services and ecosystem services is a key mission. Another feature of social-ecological urbanism is that institutions (norms and rules) and the city's built form are regarded as key tools to build resilience.

In previous years the collaboration has received several major research grants and conducted a series of development projects with public actors in society, resulting in both scientific and more policy-orientated publications. The intention now is to deepen and consolidate this collaboration within an academically stronger network that will cooperate in research and teaching, aiming also at developing closer links with the Future Earth research initiative on global environmental change and sustainability.

Project members:

Johan Colding, Beijer Institute and SRC, Åsa Gren, Beijer Institute, Stephan Barthel, University of Gävle and SRC, Lars Marcus and Meta Berghauser Pont, Chalmers University of Technology, Ann Legeby, KTH Royal Institute of Technology, Erik Andersson and Sara Borgström, SRC.

Partners:

SRC; Chalmers University of Technology, Sweden; KTH Royal Institute of Technology, Sweden; University of Gävle, Sweden.

The Live Baltic Campus Project

Live Baltic Campus (LBC) is a new and exciting research project aimed at developing campuses as innovation hubs by creating better urban environment for businesses and residents. It brings together city planners, government representatives, campus developers and stakeholders to utilise university campuses as laboratories for developing plans for better integrated urban management of the Central Baltic region. The project aims to create a network of practitioners that will enhance knowledge transfer in the region. The idea is to create a working method for participative urban planning which is then adopted by the cities involved, as part of their normal work.

LBC involves researchers from both the Beijer Institute and SRC that are actively involved in the development of Campus Albano, which is the newest addition to the Stockholm University campus. Construction of Campus Albano commenced on 30 November 2015, after a five-year planning and design process. The process was characterised by its participatory planning approach and its strong focus on supporting ecosystem services, for example wetlands and allotment gardens, which is evident in the final campus design.

The participatory design process for Campus Albano is being studied within the LBC project. By sharing and comparing the experiences from regional pilot projects, LBC is striving for better urban planning in which different stakeholders – residents and businesses – are taken into account.

Project members:

Johan Colding, Beijer Institute and SRC, Stephan Barthel, University of Gävle and SRC, Erik Andersson and Maria Schewenius, SRC.

Project partners:

Helsinki Metropolia UAS and Turku University, Finland; University of Latvia, Stockholm University and Uppsala University, Sweden; Tartu University, Estonia; Turku; the City of Helsinki; Riga Planning Region.

Funding:

Central Baltic Programme
Read more at: <http://livebalticcampus.eu>



Workshop within the Live Baltic Campus project in Helsinki in June.

Above: Johan Colding.

Below: Planning exercise.

Photo: Helsinki Metropolia UAS / Juan Covarrubias



Behaviour, Economics and Nature Network - BENN

Programme Director: Marty J. Anderies
Programme Manager: Therese Lindahl

AS ECONOMIC GLOBALISATION continues and the scale of human societies increases, human activities are affecting the biosphere and its ecosystems more rapidly and intensely, giving rise to complex social-ecological interactions. These interactions in turn limit the effectiveness of institutions and policies seeking to simplify assumptions about ecological dynamics and human behaviour. An important task is thus to shed light on these interactions and generate less naïve models of human behaviour.

The mission of BENN is to contribute to this task by exploring alternative approaches to living within planetary boundaries that emphasise achieving a good ‘fit’ between human behaviour, the biosphere and governance. Two relevant BENN activities are summarised here.

Social-ecological dynamics in common-pool resource systems

Experimental research has made important contributions to our understanding of human behaviour. For example, experimental studies on resource dilemmas have identified a range of motivations that go beyond mere profit maximisation that affect user interactions and resource management decisions. However, because of inadequate design, many experiments fail to capture how the biophysical context affects the natural resource. In recent years, there have been increasing efforts to incorporate ecological characteristics into experimental designs. A special feature published in the journal *Ecology and Society*, co-edited by Therese Lindahl, brought together a set of research papers that provide an overview of this emerging research field.

One of the experimental designs described in that special feature incorporates a potential regime shift in ecosystem dynamics in a commons dilemma and has been implemented in various laboratory settings with students as participants. The extent to which the experimental results can be generalised beyond the laboratory is of



Fishers helping each other pulling up the boats in Tasajera, Colombia.
Photo: Juan-Carlos Rocha

course an important question. One way to address this question is to run experiments in the field with resource users as participants, which is the aim of a BENN project launched in 2014. In December 2014, the first set of field experiments in the project, involving artisanal fishers, was conducted in southern Thailand (featured in last year’s Annual Report). The results indicate more cautious exploitation, both collective and individual, when facing a potential regime shift, but show that successful cooperative management also depends on contextual conditions, such as resource dependency.

The second set of field experiments within this project was conducted in

January 2016 in four fishing communities along the Caribbean coast of Colombia. Preliminary results indicate that fishers facing a potential regime shift fish more cautiously. The results also show that with increasing uncertainty around the regime shift, groups manage the resource more successfully. Furthermore, complementary survey data indicate that the social-ecological context may play a crucial role. For example, groups that depleted the fish stock in the experiments often came from communities with higher livelihood diversification, lower resource dependence and a strong influence of infrastructure development.

Project members:

Field work in Thailand: Therese Lindahl (Beijer Institute), and Rawadee Jarunggrattanapong (Sukhothai Thammathirat Open University, Thailand); Field work in Colombia: Juan-Carlos Rocha and Caroline Schill (Beijer Institute) with the help of a local research team: Lina María Saavedra Díaz (University of Magdalena, Santa Marta, Colombia), Alisson Soche Forero and Nidia Andrea Vanegas Pérez.

Funding:

The Swedish research council Formas.

References:

Janssen, M., T. Lindahl and J. Murphy. 2015. Advancing the understanding of behavior in social-ecological systems: results from lab and field experiments. *Ecology and Society* 20(4):34.
Schill, C., T. Lindahl, and A.-S. Crépin. 2015. Collective action and the risk of ecosystem regime shifts: insights from a laboratory experiment. *Ecology and Society* 20(1):48.
Lindahl, T., A.-S. Crépin and C. Schill. 2016. Potential disasters can turn the tragedy into success. *Environmental and Resource Economics*. First online. doi: 10.1007/s10640-016-0043-1.
Lindahl, T., N. Oreskovic and A.-S. Crépin. Playing Safe: The Role of Quotas to Avoid Ecosystem Regime Shifts. In: Dinar, A. (ed.). *The WSPC Reference of Natural Resources and Environmental Policy in the Era of Global Change. Volume 4: Experimental Economics*. World Scientific Publishing Co. Pte. Ltd., Singapore. In press.

RESEARCH PROGRAMMES

Neuroscience meets social-ecological system research

Effective environmental governance in the Anthropocene will require a much more robust understanding of human decision-making behaviour than exists today. One way to improve understanding is to utilise cutting-edge techniques developed by neuroscientists and combine these with experimental designs developed by common-pool resource (CPR) researchers.

There are several different techniques that can be used to understand the biological basis of behaviour and decision making. One of the most popular techniques is neural imaging (fMRI), which is used to determine the areas

of the brain that are most active during particular decision tasks. With neural imaging, it is possible to disentangle the role of positive and negative emotional states for decision making and explore the role of trial and error learning in different decision-making environments.

In a unique project collaboration led by Marty Anderies and Therese Lindahl, CPR researchers from the Beijer Institute, Arizona State University, USA, and Los Andes University, Colombia, are working with neuroscientists from the medical university Karolinska Institute in Stockholm in an effort to develop a better understanding of how humans, individually and in groups, respond to various types of natural resource

dynamics and to social interactions. This project is based on two workshops within BENN 2014 and 2015 described in earlier Annual Reports.

In the first stage of the project, the team developed an experimental treatment and software consistent with practices in neuroscience research. The software has since been tested in Stockholm and Bogotá, Colombia. Before running the experiments with the fMRI camera, trials are being run using simpler measurements such as heart rate and skin conductance to fine-tune the experimental design. The team is aiming to conduct experiments in fMRI machines in autumn 2016.

Fishing village, Buenavista, Colombia.
Photo: Sergio Guarín Torres

“Preliminary results indicate that fishers facing a potential regime shift fish more cautiously.”



Global Dynamics and Resilience

THE Global Dynamics and Resilience programme is part of Changing Planet (www.changingplanet.se), a joint initiative with Stockholm Resilience Centre (SRC) and the research programme Global Economics Dynamics and the Biosphere (GEDB) of the Royal Swedish Academy of Sciences. The Global Dynamics and Resilience programme focuses specifically on the following research questions: What are the social-ecological interactions that may trigger regime shifts at the planetary scale and what kinds of governance structures can create long term conditions for human development?

Including critical Earth system processes in economic policies

The aim of a research project that started in January 2016 is to develop and apply economic theoretical insights related to the problem of climate-change and study critical Earth system processes in a unified framework. The focus is on the trade-offs and interlinkages of policies for addressing global environmental problems.

One of the most important questions, which has been receiving an increasing amount of attention in the scientific community, is how human development and betterment can be managed without adverse effects on critical Earth system processes, which we humans depend upon. Key processes, critical for the functioning of the planet, have been

identified within the Planetary Boundaries framework, together with threshold levels that should not be transgressed in order to avoid unacceptable environmental consequences. To complement these scientific advances, this project will attempt to thoroughly analyse, using empirical data as well as theoretical modelling, economic aspects of these challenges in a unified framework.

Key research questions include:

- For what processes, apart from climate change, is there good data on, and how can the processes identified be introduced into existing frameworks of coupled dynamic climate-economy models?
- Does the inclusion of additional processes necessitate the use of additional policy instruments (i.e. taxes and subsidies in addition to the carbon tax)?
- How do interactions between the Earth system processes affect the design of policies commonly considered for combating climate change? There can be direct interactions between the Earth system processes, but also interactions going through the economic system that affect the Earth system processes.

A workshop will be hosted in Stockholm in September 2016 with an invited group of international scholars to map out the main issues involved when considering economic policies for addressing these interacting global environmental problems.

Programme director:
Anne-Sophie Crépin

Project members:

Gustav Engström and Chandra Kiran Krishnamurthy, the Beijer Institute, Johan Gars, GEDB. Funding: The Ragnar Söderberg Foundation.

Consequences of rural-to-urban migration for forest cover

The Planetary Boundaries framework aims at defining a 'safe operating space' along nine geo/biophysical dimensions, in which societies should remain to pursue sustainable development pathways. One of these dimensions is 'land system change', measured by the amount of remaining forests, which is crucially linked to the two so-called core planetary boundaries, namely climate change and biosphere integrity.

The consequences of rural-to-urban migration on forest cover, has been studied from different disciplinary perspectives and at different scales, but the results remain inconclusive. While there is some empirical and theoretical support for the argument that the rural labour scarcity drives forest regrowth on abandoned marginal farmlands, some authors have identified an increase in deforestation as a result of urbanization via increases in affluence and consumption.

Under the supervision of Anne-Sophie Crépin and Garry Peterson, SRC, Daniel Ospina-Medina has started a PhD research project aimed at

identifying the conditions under which rural out-migration, and associated factors such as remittances, can lead to forest resurgence. Internal migration and remittances are estimated to be much larger than international migration, affecting the environment more directly.

So far the work has been focused on extending an existing mathematical model linking rural out-migration and forest cover. This theoretical exercise is aimed at analysing different mechanisms that have been proposed to explain this relationship. In a future stage, case study work in the Colombian Andes is planned, to explore the occurrence of specific mechanisms empirically.

Although this issue is of great relevance for any developing country, this project will focus on Latin America, given the high levels of urbanization this region reached already decades ago, compared to much lower levels in most Asian and African countries. In line with this, Daniel Ospina-Medina, together with other Beijer Institute researchers participated in a workshop organized by the South American Institute for Resilience and Sustainability Studies, SARAS, in Uruguay, March 2016, entitled *Seeking sustainable pathways for land use in Latin America*. Senior and junior researchers from economics, ecology, geography, and agronomy attended to discuss this subject.

A manuscript idea and outline was prepared, intended to be developed into a framework to assess sustainable land change trajectories, based on the identification of a set of 'archetypes of land systems change' in the face of current global pressures in the region.

The role of transnational corporations for biospheric change

Across diverse sectors, transnational corporations are consolidating power and influence in an increasingly globally connected world, both over societies and the ecosystems on which these depend. The ambition of the 23rd annual Askö meeting, which took place on 12-14 September 2015, was to investigate what the implications of this might be when it comes to the chances for humanity to maintain the planet in a safe operating space allowing future generations to prosper. Since the meeting, a core writing team has collected data and initiated a scientific paper in which one aim is to quantify the imprint of these corporations on the biosphere.

The Askö meetings gather internationally renowned researchers, predominantly ecologists and economists and has since the start generated unique cooperation between these disciplines.

Other activities

Further work has been done on projects

initiated during the series of workshops held within the programme previous years, focusing in particular on developing a general framework to diagnose the underlying causes of and propose solutions to global environmental problems. In connection to this a small workshop was held in Stockholm September 2015 on the topic "Global Dynamics, Feedbacks and 'Telecouplings' - Taking Stock and Moving Forward"

Following up on the 7th framework project Arctic Climate Change, Economy and Society, ACCESS, described in last year's Annual Report, several Beijer Institute researchers have contributed manuscripts to a special issue in *AMBIO* on topics related to the implications of climate change on economics and society in the Arctic. Beijer contributions focus on Arctic sea food production as well as design of tools to support integrated management in the Arctic. The special issue is edited jointly by Anne-Sophie Crépin, Oran Young, University of California, Santa Barbara; Jean-Claude Gascard, CNRS, France and Michael Karcher, University of Texas.

Askö meeting 2015. Back row: Nils Kautsky, Astrid Dannenberg, Scott Barrett, James Watson, Marty Anderies, Henrik Österblom, James Wilen, Neil Adger, Line Gordon, Aart de Zeeuw. Front row: Terry Chapin, Beatrice Crona, Eric Lambin, Jean-Baptiste Jouffray, Christina Leijonhufvud, Paul Ehrlich, Agneta Sundin, Brian Walker. Sitting down: Karine Nyborg, Anne-Sophie Crépin, Carl Folke, Marten Scheffer.



Complex Systems

THE AIM OF THIS research programme is to develop economic theory and policy instruments for improving the management of social-ecological systems. By employing small-scale integrated models, we explore the essential links, feedbacks and thresholds in complex systems, as well as their implications for resource management strategies. Where empirical data are available, we also conduct econometric analysis in order to arrive at quantitative conclusions.



Photo: Åsa Gallegos Torell/Azote

Renewable resource management

How to manage renewable resources in the presence of a risk of regime shifts is a challenging task. Regime shifts are uncertain and may lead to structural changes in system dynamics, such as lowering the carrying capacity of the resource. Based on previous research, Aart de Zeeuw and Xiaoli He have conducted a new study on the issue and among other things, they found that optimal harvesting may become either precautionary or more aggressive depending on the adjustments that are needed after the regime shift. With sufficiently high marginal hazard rate of the regime shift, however, resource management

becomes precautionary.

For the case of fisheries management, Chuan-Zhong Li, Sebastian Villasante and Xueqin Zhu have investigated the role of tipping points and the inter-linkages between ecological and economic resilience. Using empirical data, they estimated the stock dynamics of the Argentine hake and the demand and harvest functions, and then studied the optimal resource management by taking into account the hazard rate of fisheries collapse. Among other things, they showed how much the optimal harvesting programme outperforms the naïve one, which ignores the risk of fisheries collapse, as well as how the value of resilience may depend on the fish stock level.

References:

de Zeeuw, A. and He, X. 2015. Beijer Discussion paper, 254: Managing a renewable resource facing the risk of a regime shift in the ecological system. *Beijer Discussion Paper Series*.

Li, C.Z., S. Villasante and X. Zhu. 2016. Regime Shifts and Resilience in Fisheries Management: A Case Study of the Argentinean Hake fishery. *Environmental and Resource Economics*. First online. doi: 10.1007/s10640-016-0038-y.

Climate change economics

When threatened with a catastrophic shock to productivity, which becomes more imminent with global warming, the global response is to have carbon taxes to curb the risk of a calamity and to accumulate precautionary capital to facilitate smoothing of consumption. Fredrick van der Ploeg and Aart de Zeeuw have developed a multi-region model of growth and climate change and have found that without international lump sum transfers, the cooperative global response to such stochastic tipping points requires converging carbon taxes for developing and developed regions. Non-cooperative responses lead to lower diverging carbon taxes. Precautionary capital suffers less from international free-rider problems than carbon taxes. Ploeg and de Zeeuw

Programme directors:
Chuan-Zhong Li and Aart de Zeeuw

illustrate the various outcomes with a calibrated North-South model of the global economy.

The science of climate changes involves many uncertainties regarding climate dynamics, economic damage and potentially irreversible catastrophes. Based on an augmented optimal growth model, Gustav Engström and Johan Gars have analysed how the risk of such events may affect optimal fossil fuel use, carbon taxes and fossil fuel prices over time. They relate their findings to the theory of green paradox with numerical illustrations, and highlight the importance of considering the supply-side impacts on climate policy in response to catastrophic climate events.

References:

van der Ploeg, F. and A. de Zeeuw. Non-cooperative and cooperative responses to climate catastrophes in the global economy: a North-South perspective. *Environmental and Resource Economics*. In press.

Engström, G. and J. Gars. 2016. Climatic tipping points and optimal fossil fuel use. *Environmental and Resource Economics*. First online. doi: 10.1007/s10640-016-0042-2.

Water and pollution

In the simple lake model with common-property outcomes, the amount of phosphorus sedimentation and recycling is treated as fixed. In a new paper, Dieter Grass, Anastasios Xepapadeas and Aart de Zeeuw extend the model by treating the amount as a slowly changing variable. By doing so, they show that two Nash equilibria with different levels of ecological services exist. While the equilibrium with a higher level of ecological services is more desirable, they demonstrate a trap within which all initial conditions lead to the undesirable equilibrium with a lower level of ecological services. The analytical tool they use in their paper is an advanced extension of a Matlab solver for boundary value problems.

As reported in more detail in the

previous Annual Report, Chuan-Zhong Li and Ranjula Bali Swain have developed a dynamic stochastic general equilibrium model to analyse how water resilience affects economic growth and dynamic welfare. This study is now in press in the journal *Water Economics and Policy*.

References:

Grass, D., Xepapadeas, A. and de Zeeuw, A. 2015. Beijer Discussion Paper 255: Optimal management of ecosystem services with pollution traps: The lake model revisited. *Beijer Discussion Paper Series*.

Li, C.Z. and R. Bali Swain. 2016. Growth, water resilience, and sustainability: A DSGE model applied to South Africa. *Water Economics and Policy*. First online. doi: 10.1142/S2382624X16500223.

Applied econometrics

For dynamic welfare measurements, Chuan-Zhong Li and Karl-Gustav Löfgren have applied the theory of dynamic price index to the data from US covering the period 1959-2008. Among other things, their econometric analysis illustrates that when deflated with the proper dynamic price index, the real green NNP becomes an ideal measure for welfare comparisons over time.

In another empirical study, Chu Wei and Chuan-Zhong Li analyse resource misallocations in China, with special reference to energy and labour inputs in manufacturing enterprises. They examine a simultaneous system of equations for (gross) industrial output value, wage bill, energy expenditure and

carbon emissions. Their main findings are that there is substantial resource misallocation in the enterprises, with labour being underpaid and energy overpaid, on average, in comparison with the marginal productivity of each.

References:

Li, C.Z. and K.G. Löfgren. 2015. A dynamic price index theory for deflating green net national product: an illustrative application using data from the United States. *Environmental Economics* 6(2):21-29.

Wei, C. and C.Z. Li. Resource misallocation in Chinese manufacturing enterprises: Evidence from firm-level data. *Journal of Cleaner Production*. doi:10.1016/j.jclepro.2016.04.083. In press.

Photo: Nils Ryrholm/Azote

Making ecosystems predictable may backfire

by Sturle Hauge Simonsen, SRC

When it comes to ecosystem goods and services, we humans tend to want to know what we are going to get. Therefore, we try to manage the use of our ecosystems in ways that minimise their variability. However, a study published in the *Proceedings of the National Academy of Sciences* concludes that managing ecosystems for predictable outcomes is risky. In fact, more often than not, it backfires. Co-author Carl Folke explains: "Command-and-control management of ecosystems might make flows of ecosystem services predictable in the short term, but unpredictable and less resilient in the long term."

The risk with short-term thinking

At the heart of the problem is the fact that while we can reduce variability in the short-term frame, variability does not go away, but just goes somewhere else. Take for example the attempts at flood control on rivers.

By installing levees, engineers are able to constrain flow and curb the fluctuations in water levels that once led to routine flooding of low-lying areas. These levees work so well that whole communities now live in what were once floodplains. However, the levees cannot remove all variability from the system. Sometimes a levee breaks or a river reaches levels higher than the levee was built to withstand. The end result is a flood that is much more destructive than before.

According to lead author Steve Carpenter, Beijer Fellow and director of the Center for Limnology at the University of Wisconsin-Madison: "For many years the river stays in the levee and everything is fine. However, every once in a while, it goes out and everything is worse."

Living systems need a certain amount of stress

Folke, Carpenter and colleagues ran a series of computer models looking at three human endeavours – controlling nutrient pollution in lakes, maintaining cattle production on rangeland invaded by shrubs and sustaining harvest in a

fishery. In all cases, when they tried to control variation, for instance by tightly controlling fish harvest or shrubs on rangeland, unexpected outcomes occurred – the fish stocks collapsed at lower harvesting levels and rangeland grass was replaced by shrubs with even light pressure from cattle grazing.

Steve Carpenter believes that living systems "need a certain amount of stress", noting that "as they evolved they were continually calibrated against variability."

"Just as our immune system relies on exposure to bacteria and viruses to sharpen its skills at responding to

disease, natural systems also need that kind of stimulation."

This does not mean we should not try to manage our ecosystems responsibly and sustainably. Rather, it means that we may need to redefine acceptable levels of change and variability.

Carl Folke concludes that we need more adaptive approaches that allow for greater natural variability in social-ecological systems and encourage a diverse set of management approaches: "By exploring what does and does not work, resource managers can better learn how to sustain ecosystems as they change over time".

"Just as our immune system relies on exposure to bacteria and viruses to sharpen its skills at responding to disease, natural systems also need that kind of stimulation."



A levee broken by hurricane Katrina, on the day after the hurricane hit New Orleans (29 August 2005). Photo: Federal Emergency Management Agency, USA

Reference:

Carpenter, S.R., W. Brocks, C. Folke, E. van der Nees and M. Scheffer. 2015. Allowing variance may enlarge the safe operating space for exploited ecosystems. *Proceedings of the National Academy of Sciences* 112:14384-14389.

A new landscape of global crises

by Marika Haeggman, SRC

In the past, crises were often local and isolated and therefore left surrounding ecosystems and societies largely unaffected. This made aid and governance work easier. Today, crises are becoming more global in reach, affecting more people and systems at the same time.

A study in *Ecology and Society* proposes a framework to identify the causes, processes and outcomes of multiple interconnected crises, which the authors term "synchronous failure". This study, which emerged from a series of workshops within the Global Dynamics and Resilience programme, was led by Thomas Homer-Dixon and Brian Walker and the team of authors include Beijer researchers Anne-Sophie Crépin, Carl Folke and Max Troll, as well as colleagues from Stockholm Resilience Centre.

The framework shows how several stressors together can cause a crisis which can rapidly spread to become global in reach. It can be used as an initial guide for systematic analyses and for identifying early-warning signals and measures for building social-ecological resilience. It can also support establishment of appropriate governance structures that can navigate the danger of synchronous failure.

Causes of crises

The authors argue that future crises will increasingly result from three long-term global trends: the dramatic increase in human economic activity in relation to Earth's environment, the rapidly increasing connections across the globe and the decreasing diversity of human cultures, institutions, practices and technologies. These three trends create a number of stresses and reduce the capacity of systems to deal with disturbances. Case studies from the 2008 financial-energy and food-energy crises illustrate this. In the food-energy crisis, four stresses seem to have affected systems simultaneously, sometimes enhancing the impacts on one another. These were: Diminishing supply of new agricultural land of good quality, declining returns on intensifying agriculture

through more extensive inputs, climate change-related extreme weather such as droughts and increasing demand for food in a world with a growing population.

Three processes at play

The authors identify three processes that occur in such a crisis, often simultaneously and reinforcing each other. The first is the "long fuse big bang", where slow-burning stresses suddenly reach a tipping point. The straw that breaks the camel's back is not a steadily increased pressure with proportional response throughout, but rather a sudden shift. In the second process, "simultaneous stresses", many stresses can act on a system simultaneously, for example drought, poverty and social conflict. Understanding the relationships and the combined effect of these is important in order to predict their effect and outcome. The third type, called "ramifying cascade", occurs when sudden and severe disturbances spread through tightly connected networks.

Outcomes

The synchronous failures that the authors outline stem from shifts in social-ecological systems that may be

unexpected and irreversible. They can occur in several systems at once, developing quickly to reach global scale. Taken together, future risks may lead to shifts in social-ecological systems that will be difficult to reverse. This could have catastrophic consequences on development as vital ecosystems and ecosystem services are affected. According to Carl Folke, "The future wellbeing of humankind depends on functioning energy, food, water, climate and financial systems. It is increasingly clear how tightly these systems are connected. We encourage further research on how energy, food, water, climate and financial systems are connected. This type of knowledge is important in order to understand our capacity to sustain these systems and learn how to deal with crises in the future."

Reference:

Homer-Dixon, T., B. Walker, R. Biggs, A.-S. Crépin, C. Folke, E. F. Lambin, G. Peterson, J. Rockström, M. Scheffer, W. Steffen and M. Troell. 2015. Synchronous failure: the emerging causal architecture of global crisis. *Ecology and Society* 20(3): 6.



Marine resource exploitation can be contagious

By Sturle Hauge Simonsen, SRC

The current high-speed seafood trade leaves consumers blissfully ignorant of the strains it imposes on marine ecosystems and fish species. This is because global trade guarantees consistent availability of fish at affordable prices by sourcing from suppliers around the world, despite fish species being on the brink of extinction.

In a study published in *Frontiers in Ecology and the Environment*, Beijer researchers, together with colleagues at SRC, GEDB and WorldFish, argue that global marine resource exploitation can spread in similar patterns to disease epidemics.

Learn from WHO

The study highlights how the speed and connectivity of seafood commerce is severely challenging the capacity of existing regulatory institutions, with the potential to decimate fisheries and the livelihoods of those that rely on them.

"Globalised markets connect distant sources of supply with metropolitan areas of demand. Exploitation expands so fast across the world in these modern sourcing networks that overfishing can occur before the resource is even perceived as threatened by management agencies," says lead author Hampus Eriksson.

The authors propose that international cooperative initiatives, modelled on experiences in managing contagious diseases, could help to ensure the future sustainability of fisheries. One example of a model that could be used to control contagious resource exploitation is the World Health Organisation's (WHO) global coordination system for mitigating and controlling the spread of disease.

Existing international initiatives aimed at policing global seafood trade and global fishery operations are limited, but include the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and Parties to the Naruru Agreement (PNA). However, the

authors note that these organisations have varying levels of authority in terms of implementing coordinated actions.

The example of sea cucumbers

The analysis is based on the sea cucumber trade. In just 15 years (1996-2011), the sea cucumber sourcing network has expanded from 35 to 83 countries and sea cucumber fisheries serving the Chinese market now operate within countries cumulatively spanning over 90% of the world's tropical coastlines. Traditionally sourced from the Indian and Pacific Oceans, sea cucumber exploitation is now burgeoning in Europe. Sea cucumbers were chosen as a study example given their wide geographical distribution but specific market for consumption in China. They are an important source of livelihood for many in impoverished communities, with over

three million people worldwide engaged in their harvesting. Overfishing is common, with 16 species considered to be vulnerable or endangered.

Time for action

The authors argue that it is time for more extensive measures to curb large-scale marine exploitation and call on the international community to consider global governance measures to control and mitigate negative effects of rapid large-scale exploitation for ecosystems and people.

Reference:

Eriksson, H., H. Österblom, B. Crona, M. Troell, N. Andrew, J. Wilen and C. Folke. 2015. Contagious exploitation of marine resources. *Frontiers in Ecology and the Environment* 13(8):435-440.

"Exploitation expands so fast across the world [...] that overfishing can occur before the resource is even perceived as threatened."



Sea cucumbers for sale in Singapore's Chinatown. Using sea cucumber trade as an example, this study shows how the speed and connectivity of seafood commerce outpace current governance measures and that the exploitation can spread in similar patterns to disease epidemics. Photo: Marina Hedin

How to set taxes to save the climate

In the work of addressing human-induced climate change due to CO2 emissions, economists have long been advocating a tax on fossil-fuel energy sources as an effective way of reducing emissions. Designing an appropriate tax is not a trivial task, however. An efficient system of carbon taxation must consider not only how the taxes impact on current and future energy use, but also how the level of the tax should be adjusted across time and space to account for other aspects of this changing world, such as other policy measures, technological developments and environmental uncertainties.

Moving the debate forward

In a major synthesis of the literature on optimal taxes in relation to climate change published in the *Annual Review of Resource Economics*, Gustav Engström, Beijer Institute, and Johan Gars, GEDB, take stock of the current debate and move it forward. In particular, they convincingly demonstrate that conclusive answers are still lacking about the underlying assumptions and mechanisms that shape optimal carbon taxes in work with macroeconomic models of climate change. This has major implications for policy. They also emphasise the need to include spatial dynamics and adaptation with regard to climate change, as well as trade and patterns of migration.

Many questions remain

In their article, Engström and Gars provide a review and discussion of some of the most recent developments and some well-established results with respect to optimal taxation in macroeconomic models of climate change. The issue of climate change is broad and affects a large part of the economy both through its causes, and consequently in climate change mitigation, and through its effects. Determining the optimal policy in terms of a tax on carbon emissions therefore involves careful consideration of a wide variety of aspects, including: If countries are different, does that mean that the carbon tax should differ



Photo: Jerker Lokrantz/Azote

between countries? How is the optimal level of the carbon tax affected when it is considered as part of a tax system including a number of different types of taxes? How can the many sources of uncertainty that are important when considering climate change be accounted for in determination of an optimal tax? How does consideration of the effects of the tax on technological progress affect the optimal tax?

Despite an impressive body of research, the authors point out that we

are still far from reaching conclusive answers concerning the underlying assumptions and mechanisms that shape optimal carbon taxes in macroeconomic models of climate change. There is still much research to be done, with important questions that need to be addressed. Their hope is that their article can help bring together many of the aspects that need to be included in determination of an optimal tax to mitigate human-induced climate change.

The Beijer Young Scholars

By Agneta Sundin and Patrik Henriksson

A NEW BEIJER Young Scholars (BYS) network was formed in the past year, with a workshop on 30 May-3 June 2016. The Beijer Young Scholars Programme was initially founded in 2012 with the aim of creating an international network of young researchers and stimulating the emergence of new research pathways and new ways of co-operating across disciplines on issues concerning the global challenges facing humanity. Three workshops have been held with the first generation of young scholars (2012-2015), as described in earlier Annual Reports.

The new BYS group consists of 18 post-docs, young faculty members (within five years of completing their PhD) and advanced PhD students, all nominated by Beijer Board members, Beijer Fellows or earlier Beijer Young Scholars. They come from Europe, North and South America and Asia, and have a background in economics, ecology, political science or related disciplines. These young scholars were supported at this year's workshop by a group of senior scientists, who were available throughout to provide advice on processes and methods.

The theme for the meeting was Inequality and the Biosphere, a broad topic that posed many challenges which were enthusiastically tackled by the participants during the week-long workshop at the Royal Swedish Academy of Sciences and the island of Ekskäret in the Stockholm Archipelago. The Ekskäret foundation seeks to create initiatives and arenas to stimulate sustainable development at both individual and societal

level. The site on the island was established to encourage and enhance meetings and discussions, as well as personal reflection. Several meeting spaces, all designed in harmony with the landscape, scattered across the island.

The initial sessions were intended to provide participants with an understanding of each other's research, interspersed with input by the senior scientists on how to conduct interdisciplinary research, including examples from different fields and their own research.

The discussions during the workshop then went through many phases, with much time spent in smaller



Photo: Andrew Tilman



Photo: Christina Leijonhufvud

Beijer Young Scholars:

Kevin Berry, Yale University; Tom Chaigneau, University of Exeter; Tracie Curry, University of Alaska Fairbanks; Maike Hamann, Stellenbosch University; Robert Heilmayer, Stanford University; Patrik Henriksson, SRC and Beijer Institute; Jonas Hentati Sundberg, Swedish University of Agricultural Sciences; Amir Jina, University of Chicago; Emelie Lindqvist, SRC; Yolanda Lopez, University of Munich; Emmi Nieminen, University of Helsinki; Matias Piaggio, Environment and Development Center for Central America, and University of the Republic, Uruguay; Jiangxiao Qiu, University of Wisconsin; Juan-Carlos Rocha, the Beijer Institute; Caroline Schill, the Beijer Institute; Alon Shepon, Weizmann Institute of Science; Andrew Tilman, Princeton University; Tong Wu, Arizona State University

Organisers:

Christina Leijonhufvud, Agneta Sundin, Anne-Sophie Crépin, Carl Folke and Anna Emmelin, SRC.

Resource persons:

Anne-Sophie Crépin; Steve Polasky, University of Minnesota; Jim Wilen, University of California, Davis; Frances Westley, University of Waterloo

“Instead of hitting walls we found pathways forward, which was insightful and heartening.”

groups, in order to share perspectives and methods in more depth. At the end of the workshop, the group agreed upon a general outline for a paper, working groups and a time schedule. The working groups have since concentrated on building a database of case studies, a literature review, key figures and general text for a scientific paper. Smaller sub-groups of Beijer Young Scholars aim to meet up over the coming year, using other events as opportunities to extend their collaboration.

In parallel with the scientific task, much emphasis during the week was on the process of interdisciplinary learning and group collaboration. This extraordinary group of young scholars excelled in all areas and exceeded the expectations, showing respect for each other's views and ideas and yet managing to move the scientific process forward.

In a closing session, the Beijer Young Scholars reflected on the learning process. Some comments were: “It was a very democratic process, no leader

dominated”, “The social interactions and the setting were important for creating trust” and “Instead of hitting walls we found pathways forward, which was insightful and heartening”.

The Beijer Institute will support this generation of Beijer Young Scholars for a total of three years and two more workshops will be held in Stockholm. Financial support for this year's workshop from the Anna-Greta and Holger Craford foundation is gratefully acknowledged.

Sunset at the island of Ekskäret
Photo: Andrew Tilman

Photo exhibition on the road

The photo exhibition *Reflections - on People and the Biosphere* with pictures by Lars Hall and text by Carl Folke, which was first shown in central Stockholm in spring 2015 (described in the previous annual report), lives on and has since been shown on three different occasions.

- » On 5-7 October 2015, it was shown to researchers from around the world who had gathered for the Transformations 2015 conference in Stockholm. The conference focused on transformations towards sustainability: the challenge of solving problems in the Anthropocene and creating conditions for good lives for people, today and in the future, while strengthening Earth's life support system.

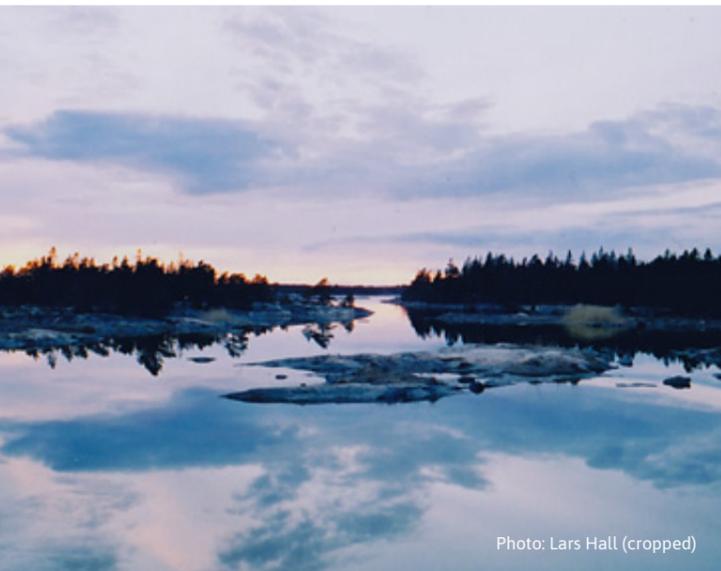


Photo: Lars Hall (cropped)



The photo exhibition *Reflections - on People and the Biosphere*, shown at SAMAK annual meeting 14-15 January 2016. Photo: Agneta Sundin

- » On 4-23 November 2015, it was exhibited during the event Science, Sustainability and Art - Exploring tools for transformation at Freiburg University, Germany. This series of events, organised by Freiburg Scientific Theatre, sought to explore the use of art as a tool for transformation in the field of sustainability science.
- » On 14-15 January 2016, it was shown for the leaders of the Social Democratic parties and trade unions in the Nordic countries, including the Swedish prime minister Stefan Löfven. The occasion was the annual meeting of SAMAK, the Co-operation Committee of the Nordic Social Democratic parties and trade unions, at a conference centre outside Stockholm.

NorMER and GreenMar science policy seminar at the Academy

A high-level seminar was organised on 28 September 2015 with the two top-level Nordic research initiatives NorMER (Nordic Centre for Research on Marine Ecosystems and Resources under Climate Change) and GreenMAR (Green Growth Based on Marine Resources: Ecological and Socio-economic Constraints). The seminar had speakers and panel participants from policy and practice in the Nordic countries. Professors Nils Christian Stenseth and Carl Folke, chair and co-chair of NorMER, opened and led the seminar.

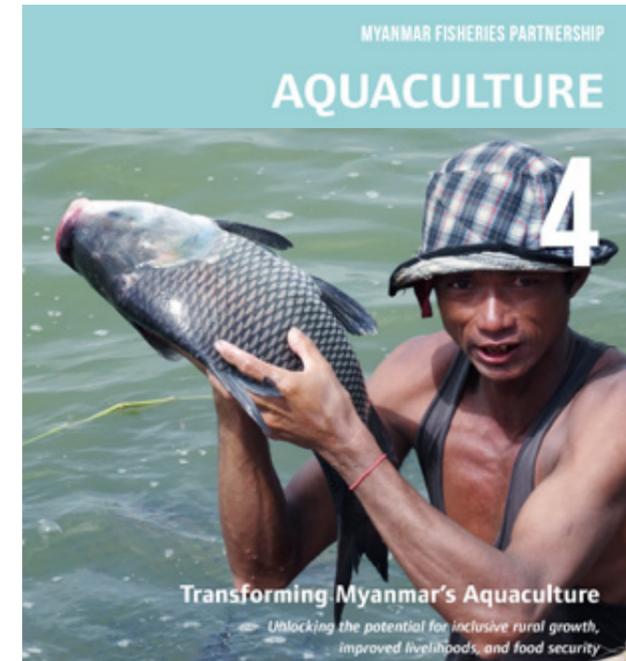
Collaboration for sustainable fisheries in Myanmar

Through the Myanmar Fishery Partnership (MFP), the Beijer Institute's Max Troell is actively involved in assisting the Myanmar government in achieving sustainable development of its fisheries and aquaculture sector.

Myanmar's fishery sector, comprising marine fisheries, inland fisheries and aquaculture, is experiencing increasing demand to supply food and income for the growing domestic population of 53 million and to increase foreign exchange earnings through export. However, the development trajectory for fisheries remains uncertain, with increases in export earnings and production coupled with rapid declines in the offshore fishery, aquatic habitats under risk and evidence that increasing fishing pressure in inland fisheries is associated with falling yield. As Myanmar opens up and attracts more domestic and foreign investment, it will need to make informed choices about how the fishery sector is managed and developed in order to meet growing future demand.

The MFP involves representatives from the Department of Fisheries, members of parliament, the private sector, NGOs, universities and fishers, who are working together to improve state and regional fisheries legislation. A number of science policy workshops have been held, the most recent in the capital, Naypyidaw, in April 2016. This aimed at producing a framework for the development of a national strategic plan

for fisheries and integrated resource governance. One outcome was a series of fisheries and aquaculture policy briefs.



Social-Ecological Urbanism for creating a more resilient Stockholm region

As a step in the cooperation between urban researchers at the Beijer Institute and at Stockholm Resilience Centre (SRC) and Stockholm county authority on strengthening social-ecological resilience in the region, a meeting with representatives for the Stockholm County Administration Board, Stockholm County Council and the City of Stockholm was held on 29 April at SRC. Johan Colding and Åsa Gren were co-organisers and participants, together with other researchers and architects.

Right now, a series of parallel tasks of great importance for the future development of Stockholm are being carried out. The County Administration Board is working on the government directive on green infrastructure to be completed in 2017, Stockholm County Council is formulating a new development plan for the region to be completed in 2018, and the City of Stockholm is engaged in a revision of its master plan with completion date in 2018. Many of these endeavours have a rather similar overall goal, which primarily concerns creating greater social and ecological sustainability. Taken together, this creates a window of opportunity for cross-border cooperation between the administrations and a need for more scientific in-depth knowledge of the city as a social-ecological system.

Consensus has been reached on the need to build a long-term working relationship and further discussions will take place during autumn 2016 to devise a more concrete work plan.

“Many of these endeavours have a rather similar overall goal, which primarily concerns creating greater social and ecological sustainability.”



Photo: Steven Zeff/Azote

Sustainable and equitable mariculture development in the Western Indian Ocean

In order to improve decision making on mariculture policy and planning in the Western Indian Ocean, a five-day workshop entitled *Sustainable and equitable mariculture development in the Western Indian Ocean - Development of a policy framework* was held in May 2016 in Zanzibar. The workshop was organised by the Beijer Institute, Wiomsa, WorldFish and IORA and brought together key stakeholders influencing the development pathway of mariculture in the region, or representing sectors with interests in mariculture. The output was a tentative policy framework aimed at guiding sustainable and equitable development of mariculture in the Western Indian Ocean. The workshop also provided an opportunity to enhance regional cooperation on mariculture development at policy level.

The 12th Royal Colloquium - Environmental Reality: Rethinking the Options

His Majesty King Carl XVI Gustaf of Sweden has a special interest in the environment and future development and in 1992 he initiated, as host, a series of Royal Colloquia engaging internationally leading scientists, decision makers and cultural representatives. Environmental reality has become a core

challenge of development, wellbeing and even survival. The round table Royal Colloquium at the royal castle Rosersberg outside Stockholm on 23-25 May 2016, provided dynamic and engaging interactions linking issues such as demography, urbanisation, globalisation and technological development to today's environmental challenges. Unexpected and extreme events such as disasters, financial crises and epidemics, as well as complexity, resilience and vulnerability, were on the agenda, as was the central role of institutions, values and trust in relation to action and implementation. Chaired by His Majesty King Carl XVI Gustaf of Sweden, the 2016 Royal Colloquium gathered 25 specially invited experts on the environmental realities facing humanity, including Beijer Institute Director Carl Folke. Chaired by His Majesty King Carl XVI

EAT - knowledge and action for food, health and sustainability

Gustaf of Sweden, the o

The third annual EAT Stockholm Food Forum took place on 13-14 June 2016. Bringing together science, policy and business, this high-level event uses food as a starting point to tackle the many health and sustainability challenges that humanity faces. The global food system is at the centre of these challenges and a possible source of solutions. This year, the forum covered consumption and production patterns, cities, accountability, technology and innovation across the food industry. Over two days, the delegates explored key solutions to the food system challenge, focusing on opportunities for action and possible commitments.



Participants of the Royal Colloquium 2016, initiated by King Carl XVI Gustaf (in the middle). Photo: kungahuset.se



Chef and food activist Jamie Oliver in talk with moderator Femi Oke at the Stockholm Food Forum. Photo: EAT 2016 Johan Lygrell

EAT-Lancet commission - new solutions for our global food system

Obesity rates are rising in nearly every country in the world and one in three people on Earth suffers from some form of malnutrition. Overconsumption of unhealthy food is increasing, at the expense of human health and the resilience of ecosystems.

To address this, a new EAT-Lancet commission has been launched to tackle the global food system's role in malnutrition and global change. The commission will investigate the connections between diet, human health and the state of the planet to provide a basis for new evidence-based policies. This global assessment, due for completion in 2017, will be the first systematic analysis of the global food system and will help policy makers by providing a roadmap for how transformation of the food system can help in attaining the UN Sustainable Development Goals (SDGs) and meeting the terms of the Paris Climate Agreement.

The EAT-Lancet Commission, which consists of 20 world-renowned scientists, was launched in Stockholm on 11-12 June prior to the 2016 EAT Stockholm Food Forum. It is co-chaired by Professor Johan Rockström, SRC and Professor Walter Willet, Harvard School of Public Health. Beijer researchers Therese Lindahl and Max Troell belong to the team of supporting co-authors.

EAT and multifunctional landscapes

As part of EAT, there is collaboration on multifunctional landscapes, food production and sustainability. In the globalised world, the drivers of current food production and consumption and how these relate to people's health and the sustainability of landscapes and seascapes are very complex. Within EAT, the focus is on food production practices and social-ecological systems that enhance the multifunctionality and resilience of landscapes and seascapes in relation to human health

and beyond solely maximising food production. Two workshops have been run during the period, one organised by Biodiversity International (CGIAR) in Rome on 12-13 October 2015 and one in Stockholm at SRC on 2-3 May 2016. Line Gordon, SRC, is central to the activity, with the Beijer Institute's Carl Folke and Max Troell deeply involved.

Read more and see presentations at: <http://eatforum.org/>

Sustainable golf course management

Over several years, Johan Colding has taken an active part in sustainable golf course management. Together with colleagues his empirical research has demonstrated what great potential this form of land use has for supporting eco-

system services. In the Stockholm region, for example, golf courses provide about a quarter of all available freshwater ponds, providing support to endangered amphibian populations, and other declining wetland-dependent species. For many years, Johan has been working closely with the Swedish Golf Federation and The Scandinavian Turfgrass Research Foundation for sustainable development of golf courses, both nationally and internationally.

Global Resilience Partnership

The Global Resilience Partnership (GRP) is convened by The Rockefeller Foundation, USAID and Sida. It is now recognised that poverty and development in the globalised world of the Anthropocene operate in a new context that requires new solutions for new realities. In 2014, the three organisations joined forces and created the GRP, which aims to identify and scale locally driven, high-impact, innovative solutions that will build the resilience of hundreds of millions of people in Africa and across Asia. By better aligning humanitarian and development planning, the GRP intends to institute a new model for solving the complex and interrelated challenges of the 21st century, such as persistent and often extreme poverty, food insecurity and climate shocks.

Stockholm Resilience Centre, through its Sida-funded GRAID programme, functions as a strategic knowledge partner to GRP and experts from the Beijer Institute are involved, with the Director serving as advisor on resilience thinking and development. Partners in the GRP include the World Bank, United Nations Development Program (UNDP), Department of International Development (DfID), UK, and the Zurich Insurance Group, among others.

Challenges of environmental decision making

DURING SPRING 2016, Beijer Institute and GEDB researchers organised and taught, for the fourth year in a row, a specially designed course in environmental and resource economics for students taking the Master's programme in Social-Ecological Resilience for Sustainable Development at Stockholm Resilience Centre. The title of the course is *Challenges of Environmental Decision Making*.

The objective of this course is to help the students understand the whole range of challenges associated with decision making coupled to environmental issues. It explores alternative approaches for analysing how people make choices individually and collectively to manage social-ecological systems and what consequences these choices have. The aim is to give the students insights into economic approaches to decision making. In particular, the course focuses on economic approaches for dealing with regime shifts, behavioural biases, climate change and international trade.

The course was delivered over a period of three weeks to a class of 16 students. At the end of the period, an exam was given which all students passed. The perception was that, after having completed the course, the course participants had acquired considerable knowledge about the many challenges involved in economic and environmental decision-making. The evaluation also indicated that the participants much appreciated the course content and structure.

Course leader:

Gustav Engström, the Beijer Institute

Lecturers:

Anne-Sophie Crépin, Therese Lindahl, the Beijer Institute, Johan Gars, GEDB and Mark Sanctuary, Stockholm School of Economics

The course was attended by 11 students from countries including Zimbabwe, Ethiopia, Vietnam, Tanzania, Ghana, Kenya, Thailand and South Africa. The two weeks were dominated by lectures, but the small group size enabled the students to interact with the teachers. From their comments, it was clear the participants were happy with the course:

“It was a great learning experience. It was interesting to look into the diverse impacts of climate change and the diversity in the working areas of the Beijer Institute”



Students of the course *Ecosystems, ecosystem services and economics*. From left: Sarun Kamolthip, Marshal Negussie, Rebecca Klege, Zachary Gitonga, Eyoual Demeke, Samson Mukanjari, Tewodros Tesemma, Victoria Said Ayubu, Max Troell, Ngo Thi Thanh Truc and Kevin Rugaimukamu (missing: Chalmers Mulwa)

“Lectures about ‘Regime shift and economics,’ ‘Introduction to ecosystem structure,’ ‘Estimating climate damage’ and ‘Using experiments to explore socio-ecological dynamics’ were very interesting for me. They introduced me to complex but fascinating concepts regarding ecosystems and also opened my methodological understanding”

“Because of the course I come across new research methodologies/approaches, am able to identify research gaps and generally it helps me to grasp new ideas about climate-related problems from different perspectives.”

Ecosystems, ecosystem services and economics

Since 2003, the Beijer Institute has been involved in the Environmental Economics PhD programme at Gothenburg University, a long-term initiative funded by the Swedish International Development Agency providing scholarships for applicants from developing countries.

Within this programme, the Beijer Institute runs 2 to 5-week courses every second year. This year's course, *Ecosystems, ecosystem services and economics*, followed the general trend in recent years of stronger integration with Stockholm Resilience Centre themes. Its core aim was to increase understanding of the complexity and functions of interlinked social-ecological systems and the implications of this for management and governance. Some key concepts covered were: the Anthropocene, resilience, ecosystem services, regime shifts, climate change, food sustainability and global trade, integrated assessment models and global actors and transnational corporations.

The course gave students important understanding and insights that can be useful for their ongoing PhD work but, since they were at different stages of their PhD work, they benefited from the content of the course in different ways.

“Since my thesis is almost completed, the contribution is less great. However, some topics in this course strongly attracted my attention and I want to work further on these topics in my future research.”

As always it is a privilege to have students spending time with us at the Beijer Institute and we welcome them back in future.

Course leader:

Max Troell, the Beijer Institute

Lecturers:

Anne-Sophie Crépin, Åsa Gren, Chandra Kiran, Therese Lindahl, Caroline Schill and Max Troell, the Beijer Institute, Johan Gars, GEDB, Lisa Deutsch, Liz Drury O'Neil, Garry Peterson, Björn Schulte-Herbrüggen and Henrik Österblom, SRC, Malin Jonell, Uppsala University and Kyle Meng University of California, Santa Barbara

Valuing and designing payment systems for ecosystem services

For the fourth time, the Beijer Institute organised a two-day course just before the World Congress of Environmental and Resource Economists or the annual meeting of the European Association of Environmental and Resource Economists. The course is intended for a selected group of researchers from developing countries and thus contributes to the long legacy of capacity building by the Beijer Institute. Organising it back-to-back with the major conference in the field means that at little extra cost, these researchers can participate in the conference and present a paper or a poster, if accepted.



Attentive students at the course *Valuing and designing payment systems for ecosystem services*. Photo: Christina Leijonhufvud

This is a good way to connect these researchers from developing countries to networks of researchers in Europe and North America.

Anne-Sophie Crépin, Christina Leijonhufvud, Jeff Vincent and Aart de Zeeuw were in charge of this event, with excellent support from the local organisers of the Annual Conference of the European Association of Environmental and Resource Economists in Zürich, where the course was held on 21-22 June 2016. This time there were 20 participants, who originated from Brazil, Costa Rica, Chile, China, India, Indonesia, Kenya, Madagascar, Malawi, Nepal, Sri Lanka, Thailand, Uganda, Venezuela, Vietnam and Zimbabwe.

Evaluations of previous courses had shown that the participants prefer an empirical orientation, rooted in solid theory, with some hands-on activities in the course. This fits nicely with the current development in economics. The topic was the valuation of ecosystem services and the design of payments for ecosystem services. Jeff Vincent (Duke University, USA) lectured on valuation of ecosystem services on Day 1 and Nick Hanley (University of St Andrews, Scotland) on payments for ecosystem services on Day 2.

Jeff Vincent showed in a clear way how the theory leads to correct specification in an econometric valuation study. In his first application, he derived the willingness-to-pay in terms of incremental agricultural profits for drought mitigation by protecting a watershed in Indonesia. In his second application, he focused on the value of water purification by protecting a forest in Malaysia. He provided datasets and instructions on how to use the econometric software, so that the participants could perform some of the steps in the analysis themselves.

Nick Hanley explained that payments for ecosystem services mean that a market or an auction is created between a buyer (usually the government or some NGO) and sellers (usually farmers). The buyer offers to the sellers a contract containing a willingness-to-pay for a change in behaviour so that part of nature is conserved. Nick Hanley provided some examples from the UK and challenged the participants to design a project along these lines and discuss it in the group and they were not short of topics. This confirms an old saying by Partha Dasgupta: “Environmental economics is important for developing countries, because they still have something to conserve!”

Last but not least, new friendships were made and old friendships were strengthened. The Beijer Institute is grateful for the financial support from UNEP, SIDA and EAERE.

Course organisers:

Anne-Sophie Crépin, Christina Leijonhufvud, Jeff Vincent and Aart de Zeeuw

Lecturers:

Jeff Vincent, Duke University, USA and Nick Hanley, University of St Andrews, Scotland

Global Economic Dynamics and the Biosphere (GEDB)

THE ERLING-PERSSON Family Academy Programme on Global Economic Dynamics and the Biosphere (GEDB) focuses on unexplored interfaces and areas of scientific inquiry, with the aim of gaining a better understanding of global economic dynamics in a biosphere context. It seeks to uncover drivers and mechanisms that affect social-ecological systems and their resilience at multiple scales. The Beijer Institute, GEDB and SRC collaborate closely. Beatrice Crona, executive director of the programme, has performed excellent work in developing and operating this programme. During its two and a half years of operation, GEDB has generated around 60 scientific peer-reviewed articles, several published in highly ranked journals such as *Nature*, *Science*, *Nature Climate Change*, *Proceedings of the National Academy of Sciences (PNAS)*, *USA*, *Proceedings of the Royal Society London*, *Philosophical Transactions of the Royal Society London*, *Frontiers in Ecology and the Environment* and *Global Environmental Change*. A number of the research findings have received attention from different actors in society and in both conventional and social media.

The programme is structured around three themes: *(Macro)economy and the biosphere*; *Marine resource trade and its effects on social-ecological systems*; and *Interactions between financial markets and the biosphere*. New ground has been broken in expanding macroeconomic models to account for biosphere and earth system processes.

Furthermore, new interactions and feedbacks between marine ecosystems and globalisation from local to global markets have been clarified, for instance how the connectivity, speed, spread and scale of global economic dynamics shape marine and coastal social-ecological systems worldwide and, in particular, the important role of trade dynamics and transnational companies in this context.

Links between financial markets and biosphere dynamics are also explored, such as how commodity markets and new trading technologies create new global connections through which financial markets can influence global ecosystem changes, but also invest in and finance solutions for ecosystem

stewardship. The research on financial markets is conducted in collaboration with Stockholm School of Economics.

Several events, workshops and activities have been organised, with collaborations predominantly between economists and sustainability science scholars. Scientific networks have been developed and strengthened and new forms of collaborations between science, practice, and business have been initiated. GEDB has become a significant channel for research, synthesis and synergies between the Beijer Institute and SRC, with strong ties especially with the Beijer programmes *Global Dynamics and Resilience* and *Aquaculture and Sustainable Seafood*.

GEDB was evaluated during autumn 2015 and received a very positive rating. According to one reviewer: "In summary, I believe the programme has been very successful in carrying out cutting-edge scientific research guided by the articulated vision, adding value through innovative interdisciplinary framework and approaches, developing new methodologies, and creating new network and partnerships within and outside the academic communities."

Read more in the GEDB annual reports and the GEDB Progress Report available at www.gedb.se



Beijer and GEDB staff at a joint staff day in April 2016. First row: Patrik Henriksson, Agneta Sundin, Alice Dauriach, Christina Leijonhufvud, Sofia Käll, Caroline Schill. Second row: Carl Folke, Anne-Sophie Crépin, Johan Colding, Daniel Ospina Medina, Juan-Carlos Rocha, Therese Lindahl, Eny Buchary. Third row: Sofia-Kristin Kokinelis, Tracy Van Holt, Beatrice Crona, Åsa Gren, Chuan-Zhong Li, Jean-Baptiste Jouffray. Back row: Gustav Engström, Peter Søgaard Jørgensen, Chandra Kiran Krishnamurthy, James Watson, James Wilen, Johan Gars.

Stockholm Resilience Centre

The close collaboration with Stockholm Resilience Centre (SRC) continues successfully, with many joint projects, grants, workshops and publications. SRC was established in 2007 with core funds from Mistra through 2018. The communication, outreach and policy engagements of the Beijer Institute are substantially magnified through collaboration with SRC and its communication team, as well as with communication strategists at our partner Albaeco. Beijer researchers are engaged with the themes of SRC and collaborate and participate in seminars, teaching, supervision etc. The work with two significant grants is now underway and is strengthening and extending the collaboration between the Beijer Institute, SRC and Stanford University.

Advancing Fundamental Knowledge of Natural Capital, Resilience and Biosphere Stewardship

This five-year programme comprises a research exchange between Stanford University and SRC, with the Marianne and Marcus Wallenberg Foundation providing 9.5 million SEK in funding. It provides a research platform for the development of new theory, analysis and synthesis on stewardship of natural capital and the biosphere, for social-ecological resilience, human wellbeing and sustainability. Carl Folke and Gretchen Daily serve as project leaders. The exchange programme will engage top young scientists, who will gain experience in problem-orientated, interdisciplinary collaboration in sustainability science. The programme draws on the legacy of science developed jointly by Stanford and the Beijer Institute, and more recently, SRC. It will focus on the following research frontiers:

- » Characterising, managing and governing natural capital and ecosystem services
- » Linking social and economic development to biosphere stewardship at local to global level
- » Sustainable and healthy food and water for a rapidly urbanising world
- » Human behaviour, cognition and mental wellbeing in an urbanised, highly dynamic world.

GRAID - Guidance for Resilience in the Anthropocene: Investments for Development

GRAID is funded by the Swedish International Development Agency (Sida), with a start-up grant of 107 million SEK over four years. Professor Belinda Reyers serves as the director of GRAID at SRC. Prof. Reyers is also deeply engaged in the Programme on Ecosystem Change and Society (PECS) and Future Earth and serves as vice-chair of its scientific committee.

GRAID aims to contribute to a world where resilience forms an integral part of sustainable development for poverty alleviation and human wellbeing. Resilience thinking grew out of the Beijer Institute's research programmes leading to the formation of the Resilience Alliance and later to the founding of SRC. Beijer Institute researchers play an active

role as theme leaders and contribute to the scientific content and research direction of SRC, and are engaged within GRAID. The collaboration takes an integrated view of people and nature, aiming at a deeper understanding of human-environment interactions, wellbeing, resilience and stewardship of social-ecological systems as part of the biosphere from local to global levels. GRAID has three strategic goals:

- » To provide strategic support and capacity building and operate as a knowledge contributor to the Global Resilience Partnership (GRP) of the Rockefeller Foundation, USAID and Sida (see Science in Society).
- » To further develop methods, practices and actionable tools for integrating resilience into development planning at local to global scale.
- » To further develop the resilience framework, including its underlying principles, theories, practices and empirical evidence, based on, e.g., on-the-ground experiences and insights from GRP and its implementing partners.

www.stockholmresilience.su.se

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 seek 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. The Beijer Institute works with RA on central issues such as the Arctic Resilience Assessment and other relevant resilience assessments. The journal *Ecology and Society* is owned by the Resilience Alliance, with Beijer Director Carl Folke as editor-in-chief together with Lance Gunderson.

www.resalliance.org

Nereus – Predicting the Future Ocean

Over-exploitation of the world's fish resources has caused serious declines in fish populations and there is widespread concern that the world's oceans will be unable to supply fish products for future generations. Given the importance of marine fisheries for food security throughout the world, this poses a serious threat for coming generations. The Nereus programme was launched to provide scientific advice on these issues. It is an international research and outreach network with five leading academic institutions as partners. The focus is on understanding the status of the global ocean and how we can ensure that there will continue to be fish products and a healthy ocean for future generations to enjoy. The researchers in the programme are based at the University of British

Columbia, Princeton University, Duke University, WCMC/ Cambridge University and Stockholm Resilience Centre/ the Beijer Institute. Henrik Österblom, SRC, coordinates the Swedish efforts and he and Carl Folke serve as principal investigators in the programme. The Nippon Foundation is providing financial support.

www.nereusprogram.org

Future Earth and PECS – Research on global sustainability

Future Earth is an international research initiative aimed at developing knowledge for responding effectively to the risks and opportunities presented by global environmental change. The Royal Swedish Academy of Sciences has played a central role in the development of a decentralised Future Earth Secretariat with a strong Swedish presence. The Beijer Institute is especially active in the Future Earth core project Program for Ecosystem Change and Society (PECS), chaired by Beijer fellow Steve Carpenter, with the International Programme Office hosted by the SRC. PECS aims to integrate research on the stewardship of social-ecological systems, the services they generate and the relationships between natural capital, human wellbeing, livelihoods, inequality and poverty in the new global context. Albert Norström, SRC, is executive director and Carl Folke is programme director of PECS. The first major PECS conference was held in November 2015 in Stellenbosch, South Africa. PECS and the Southern African PECS (SAPECS) serve as central links between the GRAID-Sida grant and the Wallenberg grant with Stanford University, SRC, the Beijer Institute and GEDB.

www.futureearth.org
www.pecs-science.org



SARAS - The South American Institute for Resilience and Sustainability Studies

The Beijer Institute is engaged in the South American Institute for Resilience and Sustainability Studies (SARAS). SARAS is an interdisciplinary research institute based in Maldonado, Uruguay, that is designed 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. A special issue of the SARAS collaboration *Reconciling Art and Science for Sustainability* is in progress in *Ecology and Society*. The Science Board includes Beijer fellows Marten Scheffer and Steve Carpenter, as well as Carl Folke.



Part of the group at the SARAS workshop during an excursion to a nearby nature reserve.
Photo: Daniel Ospina-Medina

Sustainable pathways for land use

The Beijer Institute helped organise and participated in the SARAS workshop *Seeking sustainable pathways for land use in Latin America*, in Bella Vista, Uruguay, 2-4 March, 2016. The purpose of this workshop was to initiate a transdisciplinary exploration of the linkages between land use change, its global drivers, decision making and ecosystem services in the Latin American context, and jointly create an outline and action plan for a SARAS positional paper on this topic. It brought together participants with expertise in topics such as economics and ecology from six Latin American countries, Sweden, the Netherlands and the United States. Participants' institutional affiliations included both academia and government institutions. These three intense days of workshops at the newly inaugurated SARAS building in Bella Vista offered a fantastic opportunity for networking and establishing collaborations across regions and disciplines, but they also yielded tangible outcomes. First, the foundations for a positional paper about the research and policy agenda for achieving sustainable pathways of land use in Latin America were laid and a group of lead authors has been working since March to develop this

paper. Second, subgroups were formed around five key research ideas that emerged from the workshop. These groups are currently working on stand-alone papers that will collectively form the core of a special issue, on the same topic as the positional paper.

www.saras-institute.org

NorMER – Nordic Centre of Excellence and the new GreenMAR programme

Through collaboration with SRC, Beijer Institute researchers contribute to a Nordic Centre of Excellence on Climate Change Effects on Marine Ecosystems and Resource Economics (NorMER). Carl Folke serves as co-chair of the programme, with Professor Nils Christian Stenseth from the Centre for Ecological and Evolutionary Synthesis at the University of Oslo as the other co-chair. The five-year programme, which has now come to an end, explored the biological, economic and societal risks and opportunities of global climate change related to fisheries resources across the Nordic region. Through post-doc posts and PhD projects, there are ongoing international collaborations between the participating partners in the Nordic countries. The top-level research initiative Nordforsk funded the programme. NorMER has generated a spin-off project, GreenMAR, also funded by Nordforsk. The GreenMAR network aims at understanding to what extent the ecological and social components of complex marine systems are capable of adapting to growing stress factors, such as fishing or climate change, and to provide corresponding management recommendations that can ensure green growth. Beijer Fellow Simon Levin serves on the Advisory Panel for

NorMER and is participating in GreenMAR, representing the Princeton node. Beijer Fellows Jim Wilen and Partha Dasgupta are members of the advisory board of GreenMAR and, together with Thorsten Blenckner, SRC, Carl Folke leads the Stockholm node.

www.normer.uio.no
www.greenmar.uio.no

Ebba and Sven Schwartz Foundation

The Swedish Foundation Ebba and Sven Schwartz Stiftelse has provided unique support to the Beijer Institute and Stockholm Resilience Centre through a career grant to three skilled researchers during 2011-2015 and the support continues into 2016. The overall focus of the grant is to find ways to allow people to take account of ecosystem support and ecosystem services in decision making. The projects concern economic theory, regime shifts and wellbeing; freshwater, agriculture and ecosystem services; and adaptive governance of social-ecological systems in dynamic landscapes and seascapes. A summary pamphlet of the objectives of the long-term support and of the achievements under the grant is available. The achievements of the unique Schwartz Foundation collaboration were presented in a seminar at Stockholm Resilience Centre on 22 February 2016 and Carl Folke received the Ebba and Sven Schwartz Scientific Award “for pioneering work in ecological economics and social-ecological resilience”.

www.schwartzstiftelse.com
www.stockholmresilience.org/research/research-news/2016-03-24-thanks-for-your-support.html



Claes Felländer, Chairman of the Schwartz Foundation board, and Carl Folke at a summarising seminar at SRC in February 2016. Lisen Schultz one of the Schwartz Foundation Fellows, played the cello with her sister Irma Schultz on guitar and vocals.
Photo: Marika Haegmann

Supporting Environmental Economics networks

By Agneta Sundin, Eswaran Somanathan, Jeffrey Vincent and Aart de Zeeuw

THE BEIJER INSTITUTE cooperates with four regional networks on environmental economics in Africa (CEEPA/RANESA), Asia (EPEEA and SANDEE) and Latin America (LACEEP). These networks are striving to strengthen the local capacity for economic analysis of environmental problems and to conduct research on the interlinkages between economic development, poverty and environmental change, with the aim of providing sound advice to policy makers. Researchers connected to the Beijer Institute support the networks with various activities, including participating in workshops organised in the network regions, evaluating research proposals, tutoring in research and teaching short courses. In addition, the Beijer Institute provides support to the *Environmental and Development Economics* (EDE) journal and offers mobility grants in the form of Mäler scholarships.

Activities

Jeffrey Vincent participated in SANDEE's biannual research and training workshops in Kathmandu, Nepal, in December 2015 and in Colombo, Sri Lanka, in June 2016, as lead discussant on multiple proposals, progress reports and final reports. He also served as an advisor on SANDEE research projects in four countries (India, Nepal, Pakistan and Sri Lanka), delivered a plenary lecture on impact evaluation of forest conservation programmes at the Colombo workshop and facilitated a pair of plenary lectures at the Kathmandu workshop by Prof. David Zilberman (University of California, Berkeley). Vincent, Beijer Fellow Partha Dasgupta, and EDE editor E. Somanathan all lectured in SANDEE's annual summer course in environmental economics, held in Bangkok, Thailand, in May 2016. For EPEEA, Vincent supervised research projects on storm protection services of mangroves in the Philippines and water purification services of forests in Thailand.

For the fourth time, the Beijer Institute organised a two-day course just before the World Congress of Environmental and Resource Economists or the annual meeting of the European Association of Environmental and Resource Economists. This year's course *Valuing and designing payment systems for ecosystem services*, was organised by Anne-Sophie Crépin, Christina Leijonhufvud, Jeff Vincent and Aart de Zeeuw, with support from the local conference organisers. Nick Hanley, University of St Andrews, Scotland, and Jeff Vincent lectured. These courses are intended for a selected



Students of the course *Valuing and designing payment systems for ecosystem services*, in Zürich June 2016. Back row: Pushpam Kumar, Aart de Zeeuw, Robertson Khataza, Andrés Riquelme, Herbert Ntuli, Wasantha Rathnayake, Thiago Morello, Rajesh Rai, Eric Mungatana, Zhi Li, Sarun Kamolthip, Irene Alvarado-Quesada, Jeff Vincent, Anne-Sophie Crépin, Nick Hanley. Front row: Nguyen Tuan Kiet, Chandan Singha, Claudia Aravena, Prajna Mishra, Rawadee Jarungrattanapong, Saudamini Das, Suzy Anna, Anchal Arora, Sarobidy Rakotonarivo, Faisal Buyinza.



Jeffrey Vincent at the Zürich course dinner.



Mäler Scholar 2016 Claudia Aravena Novielli (to the right) with Zürich course participant Irene Alvarado-Quesada. Photos: Christina Leijonhufvud.

group of researchers from developing countries and in Zürich 20 persons participated from 16 countries in Africa, Asia and Latin America. The Beijer Institute is grateful for the financial support from UNEP, SIDA and EAERE for this course. The Zürich course is described in more detail in the Education section of this report.

Mäler scholars

The Mäler Scholarship is intended for researchers from the Regional Networks in Environmental Economics. With this scholarship, the Beijer Institute wishes to support the networks in creating increased capacity in their respective regions in using ecological economics for analysing environment and development issues. It 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.

Mäler Scholar 2016 is Dr. Claudia Aravena Novielli (LACEEP). Dr. Aravena Novielli is a research fellow and adjunct lecturer in Applied Microeconomics at the Department of Economics, Trinity College Dublin. She completed her PhD at Queen's University, Belfast (UK), and a certificate in Sustainable Development at University College Dublin. Her research interests are in the areas of energy efficiency, smart grids,

renewable energy sources, electric vehicles, energy policy, environmental valuation, conservation, ecosystem services, sustainable development and behavioural and experimental economics. Dr. Aravena Novielli visited the Beijer Institute in June 2016 and will return to stay during autumn 2016.

In light of the time- and resource-consuming selection process, the Beijer Institute selected the 2016 and the 2017 Mäler Scholar at the same time. Thus, Dr. Herbert Ntuli will be Mäler Scholar 2017. Dr. Ntuli holds a PhD in Economics from the University of Cape Town. His research interests include community-based natural resource management, valuation of non-market environmental goods, wildlife and biodiversity conservation, behavioural and experimental economics, energy and climate change, agriculture and rural development, land tenure and land use economics. He will visit the Beijer Institute in spring 2017.

In addition, collaboration with former Mäler scholars continues. Rawadee Jarungrattanapong is involved in the BENN programme, Matias Piaggio, now a researcher with the Tropical Agricultural Research and Higher Education Center (CATIE) in Costa Rica is a member of the new Beijer Young Scholars group. He co-arranged the workshop *Seeking sustainable pathways for land use in Latin America* in Uruguay in March (read more in the Collaborations section of this report), where Beijer researchers participated and were part of the organising team. Sebastian Villasante has co-operated with Chuan-Zhong Li on studies within the Complex Systems programme.

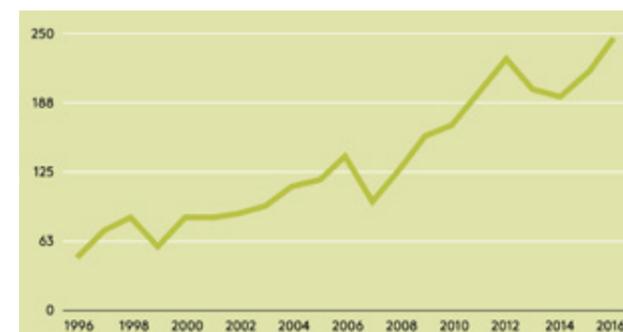
Environment and Development Economics

The *Environment and Development Economics* (EDE) journal 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 the field in both developed and developing countries. The editor is Eswaran Somanathan, Professor at the Indian Statistical Institute and Director of SANDEE, while Dimi Xepapadeas is new assistant editor as of December 2015.

Submissions

The number of submissions in 2015 (218) was higher than in 2014, while in 2016 the number of submissions is projected to significantly surpass that. In June 2016, the journal received a record number of 32 submissions in just one month. The number of papers submitted each year from 1995 to 2016 is shown in Figure 1.

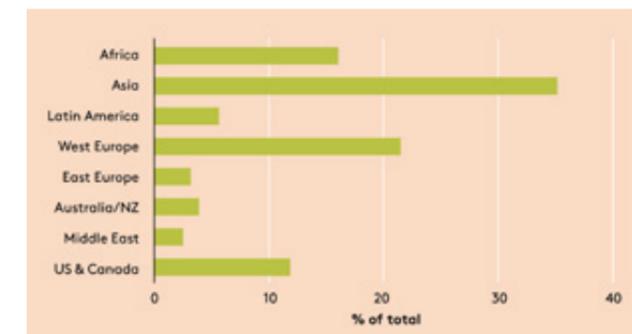
Figure 1. Annual submissions, 1995-2016 (*projected).



Geographical distribution

Figure 2 shows the geographical distribution of papers submitted in 2015 and the first six months of 2016. The geographical location of a paper is usually the location of the submitting author, but if there is more than one author the geographical area that best reflects the authors' geographical area is used. The submissions from developing areas represent about 60% of the total and the proportion is continuing to increase.

Figure 2. Geographical breakdown of paper submissions from January 2015 to June 2016 (% of the total).



These figures indicate the effectiveness of the journal in addressing one of its primary objectives, which is capacity building in developing areas of the world. In 2015, the numbers of submissions from Africa and Asia increased significantly, while those from Latin America were about the same as in the previous three years. The acceptance rate is now 18%. This is down from earlier years, since the number of submissions has increased while the number of papers published has remained stable. For the first time, the numbers of published papers from the developing and the developed world are equal.

University libraries are the principal customers for the journal; the general reach of the journal is increasing and EDE is likely to have more subscriptions in 2016 than in 2015.

Future Targets

A special issue on *Recent Advances in Empirical Research on Growth and Environment* (guest editors George Halkos and Shunshuke Managi) is currently accepting submissions and is planned for publication in 2017.

The journal will continue to focus on: encouraging and giving maximum support to authors of high-quality theoretical and empirical research papers in environment 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.

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 new Institute was elected on 5 June 1991. The 25th annual board meeting was held at the Royal Swedish Academy of Sciences on 11 September 2015.

At this meeting, Professor Aart de Zeeuw reached the end of his term. The Beijer Institute wishes to express its warmest gratitude for his great efforts for the Institute over the years.

This meeting was the first for Professor James Wilen, University of California, Davis, USA, who was welcomed as a new member of the board.



Board meeting 11 September 2015.
J. Marty Anderies, Eric Lambin, Stuart "Terry" Chapin, Anne-Sophie Crépin, James Wilen, Carl Folke, Aart de Zeeuw, Neil Adger, Karine Nyborg
Photo: Agneta Sundin

Staff news

Patrik Henriksson

Patrik is a postdoctoral researcher based at the Beijer Institute of Ecological Economics but co-affiliated to, and funded by, Stockholm Resilience Centre.

His PhD was on Asian aquaculture, using Life Cycle Assessment (LCA) to evaluate the environmental consequences of European seafood imports from Asia. His main research interests are related to identifying and promoting more sustainable aquaculture practices. As part of his post-doc, Patrik aims to incorporate social and economic aspects in the Life Cycle Sustainability Assessment (LCSA) framework. This will be done using aquaculture in Bangladesh and the sardine fishery in the Strait of Bali as case studies.

Juan-Carlos Rocha

Juan-Carlos Rocha joined the Beijer Institute in August 2015 as a post doctoral researcher. His research seeks to understand emergent patterns, from regime shifts in ecological systems to collective action in society. At the Beijer Institute, Juan-Carlos has been working on behavioural economics in social-ecological systems with thresholds within BENN. He is also interested in methods development for resilience assessments. Juan-Carlos earned his PhD in Sustainability Science at the Stockholm Resilience Centre, where he wrote a thesis assessing global patterns of regime shifts. He was also one of the main developers of the Regime Shifts Database. Juan-Carlos will spend the academic year 2016-17 as visiting researcher at Princeton University (working with Beijer Fellow Simon Levin) and at MIT (working with Professor Cesar Hidalgo). He will be developing theoretical models of cascading effects of regime shifts with Beijer Fellow Simon Levin at Princeton University. At MIT he will work

BOARD OF DIRECTORS

Chair

Karine Nyborg

Professor, University of Oslo, Norway

Ex-officio members

Carl Folke*

Professor, Director, the Beijer Institute, Sweden

Göran K. Hansson*

Professor, Permanent Secretary of the Royal Swedish Academy of Sciences, Sweden

Anne-Sophie Crépin

PhD, Deputy Director, the Beijer Institute, Sweden

Members

Neil Adger

Professor, University of Exeter, UK

J. Marty Anderies

Professor, Arizona State University, USA

Stuart "Terry" Chapin

Professor, University of Alaska, USA

Eric Lambin

Professor, University of Louvain, Belgium, and Stanford University, USA

Rosamond Naylor

Professor, Stanford University, USA

Jason Shogren

Professor, UNiversity of Wyoming, USA

M. Scott Taylor

Professor, University of Calgary, Canada

James Wilen

Professor, University of California, Davis, USA

Aart de Zeeuw

Professor, Tilburg University, the Netherlands

*Member of the Royal Swedish Academy of Sciences

with Professor Cesar Hidalgo, looking for empirical evidence of cascading effects of regime shifts in trade data, and developing online visualisation tools.

Nikolina Oreskovic and Britt Stikvoort

Nikolina and Britt joined as research assistants in 2013 within BENN. Both left the Beijer Institute during the first half of 2016 for other assignments, Nikolina to SRC and Britt to take up a PhD position at the Department of Psychology, Uppsala University. We thank Nikolina and Britt for their contributions to both the output and the atmosphere of the Beijer Institute.



On 19 May, 2016, Beijer Fellow Professor Simon Levin, Princeton University, received the National Medal of Science from the hands of President Barack Obama. He was granted this award "For international leadership in environmental science, straddling ecology and applied mathematics, to promote conservation; for his impact on a generation of environmental scientists; and for his critical contributions to ecology, environmental economics, epidemiology, applied mathematics, and evolution."
Photo: epa european pressphoto agency b.v. / Alamy

BEIJER FELLOW PRIZES, HONOURS & AWARDS

Fikret Berkes

The 2015 Elinor Ostrom award

Simon Levin

National Medal of Science 2015

Stuart "Terry" Chapin

2016 honorary degree of Swarthmore College

Partha Dasgupta

2016 Tyler Prize for Environmental Achievement

Kanchan Chopra

2016 Kenneth Boulding award

Staff members

Carl Folke

Professor, Director

Anne-Sophie Crépin

PhD, Deputy Director

Marty Anderies

Professor, Programme Director

Johan Colding

Associate Professor, Researcher, Programme Director

Gustav Engström

PhD, Researcher

Åsa Gren

PhD, Researcher

Patrik Henriksson

PhD, Affiliated Researcher

Jean-Baptiste Jouffray

PhD candidate

Chandra Kiran Krishnamurthy

PhD, Researcher

Sofia-Kristin Kokinelis

MSc, Finance and HR Administrator

Christina Leijonhufvud

BA, Chief administrator

Linda Lindström

Research Assistant

Chuan-Zhong Li

Professor, Programme Director

Therese Lindahl

PhD, Researcher, Programme Manager

Nikolina Oreskovic

MSc, Research Assistant

Daniel Ospina-Medina

PhD candidate

Juan-Carlos Rocha

Phd, Researcher

Caroline Schill

PhD candidate

Britt Stikvoort

MSc, Research Assistant

Agneta Sundin

Communications Officer

Max Troell

Associate Professor, Researcher, Programme Director

Jeffrey Vincent

Professor, Senior Advisor

Aart de Zeeuw

Professor, Programme Director

Visiting scientists

Jim Wilen

Professor, University of California, Davis, 2-18 September, 2015

Aart de Zeeuw

Tilburg University, 7-14 September, 2015

Karine Nyborg

University of Oslo, 21 September-3 October, 2015

Kyle Meng

University of California, Santa Barbara, 21-23 September, 2015

Jim Wilen

Professor, University of California, Davis, 8-26 January, 2016; 21 March-16 April 2016; 28 May-9 June 2016.

Claudia Aravena Novielli

University of Dublin, Trinity College, 2-16 June, 2016

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 'national city park' by the Swedish parliament. The Institute's visiting address is Lilla Frescativägen 4, Stockholm.

Organisation

The Institute's administration is partly carried out by, or coordinated with, the Royal Swedish Academy of Sciences, for example accounting and maintenance of premises and computers. Other administrative procedures are 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, but 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 2015 and 30 June 2016 was also provided by:

- » International Center for Living Aquatic Resources Management (ICLARM), also known as WorldFish
- » Ragnar Söderbergs stiftelse
- » The Crafoord Foundation
- » The European Association of Environmental and Resource Economics, EAERE
- » The European Commission
- » The Ebba and Sven Schwartz Foundation
- » The Foundation for Strategic Environmental Research, MISTRA
- » The Riksbankens Jubileumsfond, The Swedish Foundation for Humanities and Social Sciences
- » The Swedish International Development Cooperation Agency, Sida
- » The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, FORMAS
- » Western Indian Ocean Marine Science Association, WIOMSA

Teaching and training

The Beijer Institute serves as a link between university departments and institutions working with ecological economics issues, and PhD students are involved in its research programmes and projects. The Institute organises training workshops and international research seminars on the environment and development and international training programmes.

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 and how these are typically tackled within the field of economics. Read more under the Education section of this report.

Ecosystems, ecosystem services & economics - PhD Course

This course aims to provide students in Environmental economics with an understanding of the complexity and functions of interlinked social-ecological systems, and the implications this has for governance. It is aimed at PhD students participating in the SIDA-funded PhD programme in Environmental Economics at Gothenburg University and it is held at the Beijer Institute every second year. Read more under the Education section of this report. The PhD programme was established by the Beijer Institute and the Environmental Economics unit at Gothenburg University in 1997. The purpose of the programme is to strengthen the capacity in developing countries to teach environmental economics at university level, and to establish a firm basis for research that can be used for policy advice pertaining to environmental economics and sustainable development.

The Stockholm Seminars: Frontiers in Sustainability Science and Policy

The Stockholm Seminars are arranged by the Beijer Institute, Stockholm Environment Institute and Stockholm Resilience Centre, along with Albaeco. 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 and attended by a large audience, including scientists, students, media and policy-makers in the public and private sector.

Between July 2015 and June 2016, the following seminars were held:

2015

- » **15 September:** Prof. Stephen R. Carpenter *Regional scenarios: Emergence of fragility in safe operating spaces*
- » **5 October:** Prof. David Christian *Big history: An Origin story for the Anthropocene*
- » **17 December:** Assoc. Prof. Trevor A. Branch *Fishing impacts on food webs: Multiple working hypotheses*

2016

- » **12 February:** Prof. Eduardo Viola *Is Latin America contributing to the de-carbonization of the global economy?*
- » **13 May:** Prof. Nancy B. Grimm *Extreme events call for a resilient urban SETS infrastructure*
- » **25 May:** Prof. Hans Joachim Schellnhuber *The nonlinearity of the climate challenge*
- » **2 June:** Assoc. Prof. Daniel Souffer *The complexity and simplicity of ecological communities*
- » **17 June:** Prof. Katherine Richardson and Jorgen Randers *Are we likely to hit planetary boundaries before 2050?*

The Stockholm Environmental and Resource Economics (SERE) Seminars

The Stockholm Environmental and Resource Economics (SERE) Seminars is a seminar series initiated 2016 and arranged by the Beijer Institute, the Global Economic Dynamics and the Biosphere programme and the Stockholm School of Economics. It provides a forum for leading early career economists from the world over to present exciting new research.

This monthly series, covering a broad range of topics touching upon the environment and natural resources, targets economists and other scientists interested in public policy aspects. It is also intended to serve as a forum to bring together and to spark interesting discussions among economists interested in these issues from a broad range of institutions, including academia, research centres, government, the private sector and NGOs.

Between January and June 2016 the following seminars were arranged:

- » **28 January:** Dr. Sturla Kvamsdal *Up the ante on bioeconomic sub-models of marine foodwebs: A data assimilation-based approach*
- » **23 February:** Dr. Thomas Lontzek *The social cost of carbon with economic and climate risks*
- » **22 March:** Dr. Nicole Ngo *The environmental and health impacts of transboundary pollution from China to the US*
- » **20 April:** Dr. Xiaojia Bao *Temperature and human performance: Evidence from online game*

behavior in China

- » **12 May:** Dr. Antony Millner *Heterogeneous altruism and long-run discounting*

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. The Brown Bag Seminars have proven to be a success and often attract a large audience.

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 2015 was *Keystone actors in the Anthropocene*. This meeting is described under the *Global dynamics and resilience* section of this report.

Staff members' publications and activities

All portraits by Cecilia Nordstrand, except Chandra Kiran Krishnamurthy, Nikolina Oreskovic and Britt Stikvoort (by Agneta Sundin).



Johan Colding
Associate Professor,
Researcher

Research focus

Urban social-ecological systems.

Reports

- » Colding, J., S. Barthel, L. Marcus, Å. Gren, A. Legeby and M. Berghausen-Pont. 2016. *Mistra Urban Futures*

Stockholm. Project Plan for 2016. Mistra Urban Futures, Gothenburg, Sweden.

- » Colding, J., S. Barthel, E. Andersson and M. Schewenius. 2016. *Campus Albano, Stockholm: Creating a social-ecological 'best practices' campus area in the Baltic region for supporting learning, innovation, and sense of community*. Live Baltic Campus inventory report. Central Baltic Interreg. <http://livebalticcampus.eu/author/stockholm/>.

Conferences, workshops and presentations

- » Live Baltic Campus kick-off meeting and workshop, Helsinki Metropolia UAS, Helsinki, Finland, November 2015. Participant.
- » Mistra Urban Futures Stockholm meeting, Stockholm County Administration Board, Stockholm, December 2015. Presentation: *Opening up a Stockholm node within Mistra Urban Futures*.
- » Live Baltic Campus/Interreg Central Baltic study tour, Delft, Eindhoven, Amsterdam, The Netherlands, March 2016. Participant.
- » Live Baltic Campus: Campuses as innovation hubs, meeting with head and administration staff of Stockholm University. Stockholm Resilience Centre, Stockholm University, March 2016. Speaker: *What is Interreg Central Baltic?*
- » Seminar with key representatives of the Office of Regional Planning, Municipality of Stockholm, and Stockholm County Administration Board, Stockholm Resilience Centre, April 2016. Organiser, host and presentation: *Social-ekologiskt stadsbyggande: Möte om gemensam kunskapsutveckling (Social-ecological urban design: A meeting about collaborative knowledge development)*.
- » Seminar on academic research cooperation between Stockholm Resilience Centre, Chalmers University of Technology, KTH Royal Institute of Technology and University of Gävle. Stockholm Resilience Centre, April 2016. Organiser, host and presentation: *Akademisk forskningsamverkan (Academic research collaboration)*.
- » Live Baltic Campus partner meeting and Liveable City Forum/Helsinki Design Picnic, Turku University and Helsinki Metropolia UAS, Helsinki,

Finland, June 2016. Participant and keynote speaker: *An introduction to social-ecological urban design*.

Teaching and training

- » Co-supervisor of PhD candidate Caroline Schill and Master's student Rawaf al Rawaf (Stockholm Resilience Centre, Stockholm University).

Commissions

- » Member of the city planning group for Albano sustainable campus.
- » Member of the international working group within The Scandinavian Turfgrass Research Foundation for sustainable development of golf courses.
- » Founding member of research network 'Hej Tätort!' ('Hello Urbanity!'), Stockholm Resilience Centre and Beijer Institute, since 2016.
- » Reviewer for *Ecology and Society*.

Other

- » Member of Live Baltic Campus network group.
- » Popular science communications: Nytt miljonprogram – unik chans att lösa flera frågor (New large-scale housing project – a unique chance for new solutions). Barthel, S., M. Berghäuser Pont, J. Colding, Å. Gren, A. Legeby and L. Marcus, *Dagens Nyheter*, Stockholm, 25 April 2016. <http://www.dn.se/debatt/nytt-miljonprogram-unik-chans-att-losa-flera-fragor/>.
- » Live Baltic Campus on tour in Holland – some reflections on resilience building. Colding, J., S. Barthel, E. Andersson and M. Schewenius. Live Baltic Campus blog, 4 May 2016. <http://livebalticcampus.eu/>.
- » Träd i staden minskar luftföroreningar (Trees in the city reduce air pollution). Colding, J., *Svenska Dagbladet*, Stockholm, 1 June 2016. <http://www.svd.se/tufft-gratis-jobb-for-grona-tjanare>.



Anne-Sophie Crépin
PhD, Deputy Director

Research focus

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

Publications during the period

- » Homer-Dixon, T., B. Walker, R. Biggs, A.-S. Crépin, C. Folke, E. Lambin, G. Peterson, J. Rockström, M. Scheffer, W. Steffen and M. Troell. 2015. Synchronous failure: The emerging causal architecture of global crisis. *Ecology and Society* 20(3):6
- » Lindahl, T., A.-S. Crépin and C. Schill. 2016. Potential disasters can turn the tragedy into success. *Environmental and*

Resource Economics. First online. doi:10.1007/s10640-016-0043-1.

- » Lindahl, T., N. Oreskovic and A.-S. Crépin. Playing Safe: The Role of Quotas to Avoid Ecosystem Regime Shifts. In: Dinar, A. (ed.). *The WSPC Reference of Natural Resources and Environmental Policy in the Era of Global Change. Volume 4: Experimental Economics*. World Scientific Publishing Co. Pte. Ltd., Singapore. In press.

Conferences, workshops and presentations

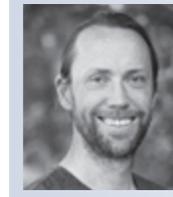
- » Askö 2015 meeting on Keystone Actors in the Anthropocene, Askö, and KVA, Stockholm, September 2015. Participant.
- » Workshop on Global Dynamics, Feedbacks and Telecouplings - Taking Stock and Moving Forward, Vår Gård, Saltsjöbaden, Sweden, September 2015. Co-organiser and participant.
- » Seminar to report results from research funded by Ebba and Sven Schwartz foundation, Stockholm Resilience Centre, February 2016. Presentation: *Regime shifts in the Anthropocene*.
- » Conference on Complex Systems 2015, Tempe, Arizona, USA, September/October 2015. Presentation: *Conditions for integrated ecosystem-based management in the Arctic*.
- » Beijer Young Scholars Workshop on Inequality and the Biosphere, KVA and Ekskåret, Stockholm, May/June 2016. Resource person and presentation: *Pitfalls of multidisciplinary science and recipes against them*.
- » 2016 Annual conference of the Association of Environmental and Resource Economists, Zürich, Switzerland, June 2015. Presentation: *Price versus quantity with hysteretic regime shifts*.

Teaching and training

- » Lecturer, Master's level course *Challenges of environmental decision making*, Stockholm Resilience Centre, Stockholm University, spring 2016.
- » Lecturer, PhD level course *Ecosystems, ecosystem services and economics*, KVA, Stockholm, March 2016.
- » Co-supervisor of PhD candidates Daniel Ospina-Medina and Caroline Schill (Stockholm Resilience Centre, Stockholm University).
- » Supervisor of Mäler scholar 2016 Claudia Aravena.

Commissions

- » Member of advisory board of the Global Challenges Initiative, Stockholm School of Economics.
- » Member of PhD evaluation committee for Shyam Rangathan (Department of Mathematics, Uppsala University), November 2015.
- » Reserve member of PhD evaluation committee for Emilie Lindkvist (Stockholm Resilience Centre, Stockholm University), May 2016.
- » Reviewer for the Arctic Resilience Assessment project.
- » Reviewer for the BIOTIP project.
- » Reviewer for the 2016 Annual Conference of the Association of Environmental and Resource Economists.
- » Reviewer for *Ecological Economics, Environmental and Resource Economics, International Journal of Sustainable Development, Journal of Economic Behavior & Organization* and *Proceedings of the National Academy of Sciences*.



Gustav Engström
PhD, Researcher

Research focus

Primary focus: 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: Urban economics and environment-related issues.

Publications during the period

- » Engström, G. and J. Gars. 2015. Optimal taxation in the macroeconomics of climate change. *Annual Review of Resource Economics* 7:127-150.
- » Engström, G. and J. Gars. 2016. Climatic tipping points and optimal fossil fuel use. *Environmental and Resource Economics*. First online. doi:10.1007/s10640-016-0042-2.

Teaching and training

- » Lecturer, Master's level course *Social-ecological systems: Challenges & approaches. Economic approaches to analyse ecosystem support of humanity*, Stockholm Resilience Centre, Stockholm University, autumn 2015.
- » Course organiser and lecturer, Master's level course *Challenges of environmental decision making*, Stockholm Resilience Centre, Stockholm University, spring 2016.

Commissions

- » Member of Licentiate evaluation committee for PhD candidate L. Jamila Haider (Stockholm Resilience Centre, Stockholm University), October 2015.



Carl Folke
Professor, Director

Research focus

Social-ecological systems, resilience thinking and stewardship of ecosystem services from local to global contexts, ecological economics, transformations reconnecting development to the biosphere.

Publications during the period

- » Allen, C.R., D.G. Angeler, G. Cumming, C. Folke, D. Twidwell and D.R. Uden. 2016. Quantifying spatial resilience. *Journal of Applied Ecology* 53:625-635.
- » Carpenter, S.R., W. Brocks, C. Folke, E. van der Nees and M. Scheffer. 2015. Allowing variance may enlarge the safe operating space for exploited ecosystems. *Proceedings of the National Academy of Sciences* 112:14384-14389.
- » Defeo, O., M. Castrejón, R. Pérez-Castañeda, J.-C. Castilla, N.L. Gutiérrez, T. Essington and C. Folke. 2015.

Co-management in Latin American small-scale shellfisheries: Assessment from long-term case studies. *Fish and Fisheries* 17:176-192.

- » Eriksson, H., H. Österblom, B. Crona, M. Troell, N. Andrew, J. Wilen and C. Folke. 2015. Contagious exploitation of marine resources. *Frontiers in Ecology and the Environment* 13:435-440.
- » Fischer, J., T.A. Gardner, E.M. Bennett, P. Balvanera, R. Biggs, S. Carpenter, T. Daw, C. Folke, R. Hill, T.P. Hughes, T. Luthe, M. Maass, M. Meacham, G. Peterson and C. Queiroz. 2015. Advancing sustainability through mainstreaming a social-ecological systems perspective. *Current Opinion in Environmental Sustainability* 14:144-149.
- » Folke, C. Resilience. In: Shugart, H. (ed.). *Oxford Research Encyclopedia of Environmental Science*. Oxford University Press, New York, USA. In press.
- » Homer-Dixon, T., B. Walker, R. Biggs, A.-S. Crépin, C. Folke, E. Lambin, G. Peterson, J. Rockström, M. Scheffer, W. Steffen and M. Troell. 2015. Synchronous failure: The emerging causal architecture of global crisis. *Ecology and Society* 20(3):6.
- » Mathevet, R., J.D. Thompson, C. Folke and S. Chapin III. 2016. Protected areas and their surrounding territory: Socioecological systems in the context of ecological solidarity. *Ecological Applications* 26:5-16.
- » Norström, A.V., M. Nyström, J.-B. Jouffray, C. Folke, N. Graham, F. Moberg, P. Olsson and G.J. Williams. Guiding coral reef futures in the Anthropocene. *Frontiers in Ecology and the Environment*. In press.
- » Österblom, H., B.I. Crona, C. Folke, M. Nyström and M. Troell. 2016. Marine ecosystem science on an intertwined planet. *Ecosystems*. First online. doi:10.1007/s10021-016-9998-6.
- » Troell, M., N. Kautsky, N. Beveridge, P. Henriksson, J. Primavera, P. Rönnbäck, M. Jonell and C. Folke. *Aquaculture*. In: Levin, S.A. (ed.). *Encyclopedia of Biodiversity*. Third Edition. Elsevier Science, New York, USA. In press.
- » Van den Bergh, J., C. Folke, S. Polasky, M. Scheffer and W. Steffen. 2015. What if solar energy becomes really cheap? A thought experiment on environmental problem shifting. *Current Opinion in Environmental Sustainability* 14:170-179.

Conferences, workshops and presentations

- » Global Resilience Partnership (Rockefeller Foundation, USAID, Sida) meeting, Bellagio Centre, Italy, July 2015. Keynote speaker.
- » Meeting with Swedish ministers, business leaders and Stockholm Resilience Centre, Stockholm, August 2015.
- » Film interview for Chile Television for J.C. Castilla, August 2015.
- » Biosfärens Mönster (Patterns of the Biosphere), talk at the Royal Opera for their leadership and sponsors together with Svenskt Tenn's CEO Maria Veerasamy, Royal Opera, Stockholm, September 2015.
- » Askö 2015 meeting on Keystone Actors in the Anthropocene, Askö and KVA, Stockholm, September 2015. Organiser and leader of the meeting.
- » Workshop on Global Dynamics, Feedbacks and Telecouplings - Taking Stock and Moving Forward, Vår Gård, Saltsjöbaden, Sweden, September 2015.
- » Schwartz Foundation, state of the art presentation, Stockholm Resilience Centre, September 2015.

- » Short introduction and handing over book *Reflections On People and the Biosphere* to Crown Princess HRH Victoria, Stockholm Resilience Centre, September 2015.
- » NorMER introduction seminar, KVA, September 2015.
- » NorMER/GreenMAR, Stockholm, September 2015. Presentation: *Biosphere-based sustainability science*.
- » Transformations 2015 conference People and the Planet in the Anthropocene, Stockholm University, October 2015. Keynote speaker: *Transformations to sustainability: Reconnecting to the biosphere*.
- » Linking Science and Policy for Implementing the 2030 Agenda for Sustainable Development, United Nations University and IAS, Tokyo, Japan, October 2015. Speaker and panellist.
- » Länsförsäkringar (County insurance), Stockholm, February 2016. Presentation: *Människan och biosfären (People and the biosphere)*.
- » Social-ecological links workshop, Ersta, Sweden, February 2016. Presentation.
- » Global Resilience Partnership (Rockefeller Foundation, USAID, Sida) meeting, Sigtuna, Sweden, February 2016. Keynote speaker.
- » GRAID (Guidance for Resilience in the Anthropocene: Investments for Development) collaborative workshop assessing resilience, Saltsjöbaden, Sweden, March 2016.
- » Workshop in honour of Malin Falkenmark, Stockholm Resilience Centre, March 2016.
- » Futura Foundation, state of the art meeting, Stockholm Resilience Centre, March 2016.
- » Insurance in ecosystem management workshop, Global Economic Dynamics and the Biosphere programme, KVA, April 2016.
- » Multifunctional Landscapes workshop, Stockholm Resilience Centre, May 2016.
- » Future Earth session speed talks, Stockholm Resilience Centre, May 2016. Short presentation.
- » Global Resilience Partnership (Rockefeller Foundation, USAID, Sida) meeting, Venice, Italy, May 2016. Keynote speaker with B. Reyers.
- » Stockholm Resilience Centre Board workshop, Villa Aske, Sweden, May 2016.
- » Royal Colloquium on Environmental Realities, Rethinking the Options, Rosersbergs Castle, Sweden, May 2016.
- » Beijer Young Scholars workshop on Inequality and the Biosphere, KVA and Ekskäret, May/June 2016. Presentation.
- » Workshop on Trajectories of the Planet in the Anthropocene, Stockholm Resilience Centre, June 2016.
- » Member of the Royal Swedish Academy of Sciences, since 2002.
- » Director of Programme on Ecosystem Change and Society (PECS), Future Earth/ICSU, since 2013.
- » Founding and board member of the Resilience Alliance, 1999-2015.
- » Member of the Environmental Research Committee of the Royal Swedish Academy of Sciences, since 2003.
- » Editor-in-chief of *Ecology and Society*, since 2002.
- » Advisory and editorial board member of *Ambio*, *Ecological Economics*, *Environmental Conservation*, *Environment and Development Economics*, *Environmental Innovation and Societal Transitions*, *Frontiers in Ecology and the Environment*, *Resilience: International Policies, Practices and Discourses*, *Reviews in Ecological Economics* and *Sustainability Science*.
- » Fellow of The Synergy programme on resilience and critical transitionS (SparcS), Wageningen, The Netherlands, since 2012.
- » Fellow of STIAS - Stellenbosch Institute for Advanced Study, since 2014.
- » Senior Fellow of IHOPE (Integrated History and future of People on Earth), since 2015.
- » Advisor to the Global Resilience Partnership, since 2015.
- » Scientific advisory board member of SARAS (South American Institute for Resilience and Sustainability Studies), Montevideo, Uruguay, since 2007.
- » Board member of UNU Institute for the Advanced Study of Sustainability, Tokyo, Japan, since 2014.
- » Scientific advisory board member of STEPS, University of Sussex, Brighton, UK, since 2010-2015.
- » Member of The International Scientific Advisory Council, The Waterloo Institute for Complexity and Innovation (WICI), University of Waterloo, since 2012.
- » Advisory board member of EAT and EAT Forum, since 2013.
- » Advisory board member of The International Network of Research on Coupled Human and Natural Systems (CHANS-Net), since 2009.
- » Associate faculty member of Earth System Governance Project, Future Earth, since 2009.
- » Scientific committee member of Volvo Environment Prize, since 2008, chair since 2012.
- » Selection committee member of The Kenneth Boulding Award, International Society for Ecological Economics, since 2013.
- » Member of the Ralph Yorke Society, since 1997.
- » Scientific committee of the Transformations 2015 conference People and the Planet in the Anthropocene.
- » Principal investigator (with Gretchen Daily) for *Advancing Fundamental Knowledge of Natural Capital, Resilience and Biosphere Stewardship* - a Research Exchange Program between Stanford University and Stockholm Resilience Centre, Stockholm University, funded by the Marianne and Marcus Wallenberg Foundation.
- » Co-principal investigator of the Centre of Excellence: *Nordic Centre for the Study of Climate Change Effects on Marine Ecosystems and Resource Economics* (NorMER) of The Top-level Research Initiative (TRI), a joint Nordic research and innovation initiative (NC Stenseth PI).
- » Partner investigator of Nereus Program - Predicting the Future Ocean, UBC, Canada, since 2010.

Teaching and training

- » Lecturer in undergraduate, Master's and PhD level courses at Stockholm University.
- » Co-supervisor of two PhD candidates in sustainability science and two Master's students (Stockholm Resilience Centre, Stockholm University).

Commissions

- » Director of science and founder, Stockholm Resilience Centre, since 2007.
- » Director of The Erling-Persson Family Academy Programme on Global Economic Dynamics and the Biosphere, since 2012.

Other

- » Exhibition *Reflections on People and the Biosphere* at: the Transformations 2015 conference People and the Planet in the Anthropocene, Stockholm University, October 2015; the Science, Sustainability and Art Conference, Exploring Tools for Transformation, University of Freiburg and Freiburg Scientific Theatre, Germany, November 2015; the SAMAK meeting of the Social Democratic Parties of the Nordic Countries, Lidingö, Sweden, January 2016.
- » Ebba and Sven Schwartz Scientific Award, February 22, 2016.
- » Recognition by KVA, Kungliga Patriotiska Sällskapet (The Royal Patriotic Society), March 31, 2016.
- » Recognised as Highly Cited Researcher by Thompson Reuters 2015.



Åsa Gren
PhD, Researcher

Research focus

General focus on quantification and valuation of ecosystem services, with particular focus on sustainable and resilient urban food production/security in the context of urban planning and design. Key focus on biodiversity using the ecosystem service of pollination as a proxy in an urban food production/security context and how to build resilience in the face of change in global drivers, such as climate change and change in global food markets.

Publications during the period

- » Noring, M., L. Hasselström, C. Håkansson, Å. Soutukorva and Å. Gren. 2016. Valuation of oil spill risk reductions in the Arctic. *Journal of Environmental Economics and Policy*. First online. doi: 10.1080/21606544.2016.1155499.

Conferences, workshops and presentations

- » C/O City Workshop No. 1 on Urban Obstacles to Pollination, Chalmers University of Technology, Gothenburg, February 2016. Participant.
- » Workshop on Urbanisation and Climate Change, Stockholm Resilience Centre, Stockholm archipelago, June 2016. Participant.
- » C/O City Workshop No. 2 on Urban Obstacles to Pollination, Chalmers University of Technology, Gothenburg, June 2016. Participant.

Teaching and training

- » Lecturer, PhD level course *Ecosystems, ecosystem services and economics*, KVA, Stockholm, March 2016.
- » Lecturer, undergraduate course *Stadsodling - planering, miljö och hälsa (Ecosystem services and sustainable urban development)*, Department of Physical Geography, Stockholm University, spring 2016.

Commissions

- » Member of the PhD evaluation committee for Maik

- » Hamann (Stockholm Resilience Centre, Stockholm University), March 2016.
- » Guest editor for *Ecological Indicators* on special issue: *Advancing Understanding of the Complex Nature of Urban Systems*.

Other

- » Talk on Stockholm Resilience Centre Urban Theme research in a global context for potential funders Temasek (Singapore), Stockholm Resilience Centre, June 2016.



Patrik Henriksson
PhD, Researcher

Research focus

Environmental evaluation of aquaculture, primarily using life cycle assessment (LCA).

Publications during the period

- » Henriksson, P.J.G. 2015. *Evaluating European Imports of Asian Aquaculture Products Using Statistically Supported Life Cycle Assessments*. Doctoral Thesis. Institute of Environmental Sciences (CML), Faculty of Science, Leiden University, The Netherlands.
- » Henriksson, P.J.G., A. Rico, W. Zhang, A.A. Nahid, R. Newton, L.T. Phan, Z. Zhang, J. Jaithiang, H.M. Dao, T.M. Phu, D.C. Little, F.J. Murray, K. Satapornvanit, L. Liu, Q. Liu, M.M. Haque, F. Kruijssen, G.R. de Snoo, R. Heijungs and J.B. Guinée. A comparison of Asian aquaculture products using statistically supported LCA. *Environmental Science and Technology*. In press.
- » Troell, M., N. Kautsky, N. Beveridge, P. Henriksson, J. Primavera, P. Rönnbäck, M. Jonell and C. Folke. Aquaculture. In: Levin, S.A. (ed.). *Encyclopedia of Biodiversity*. Third Edition. Elsevier Science, New York, USA. In press.

Reports

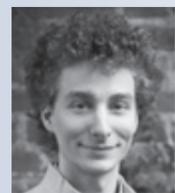
- » Phillips, M.J., P.J.G. Henriksson, N. Van Tran, C.Y. Chan, C.V. Mohan, U. Rodriguez, S. Suri, S. Hall and S. Koeshendrajana. 2015. *Exploring Indonesian Aquaculture Futures*. Program Report: 2015-39. WorldFish, Penang, Malaysia.

Conferences, workshops and presentations

- » World Aquaculture Society Meetings, Surabaya, Indonesia, April 2016. Presentation: *Exploring the future of Indonesia's aquaculture*.
- » Beijer Young Scholars Workshop on Inequality and the Biosphere, KVA and Ekskäret, Stockholm, May/June 2016. Participant.

Other

- » Popular science communication: Mer fish med gott samvete! (More fish with a clear conscience). Ziegler, F., M. Troell, S. Hornborg, P. Henriksson, M. Jonell, K. Bergman and P. Rönnbäck, *SVT Opinion*, Stockholm, 23 May 2016. <http://www.svt.se/opinion/mer-fisk-med-gott-samvete>.



Jean-Baptiste Jouffray
PhD candidate, Researcher

Research focus

Marine social-ecological systems, coral reefs, the global sustainability of fisheries.

Publications during the year

- » Norström, A.V., M. Nyström, J.-B. Jouffray, C. Folke, N. Graham, F. Moberg, P. Olsson and G.J. Williams. Guiding coral reef futures in the Anthropocene. *Frontiers in Ecology and the Environment*. In press.
- » Österblom, H., J.-B. Jouffray and J. Spijkers. 2016. Where and how to prioritize fishery reform? Letter. *Proceedings of the National Academy of Sciences*. In press.

Conferences, workshops and presentations

- » Askö 2015 meeting on Keystone Actors in the Anthropocene, Askö and KVA, Stockholm, September 2015. Participant.
- » NCEAS Ocean Tipping Points - All Hands Meeting, Santa Barbara, California, USA, September 2015. Participant.
- » Conference on Complex Systems 2015, Tempe, Arizona, USA, September 2015. Presentation of paper: *Transnational corporations as 'keystone actors' in marine ecosystems*.
- » Board meeting, Stockholm Resilience Centre, September 2015. Presentation: *Disentangling cross-scale driver interactions in marine social-ecological systems*.
- » Ecology in the Anthropocene workshop, Stockholm Resilience Centre, March 2016.
- » Corporate accounting and finance workshop, Amsterdam, The Netherlands, June 2016.
- » 13th International Coral Reef Symposium, Honolulu, Hawaii, USA, June 2016. Presentation of paper: *Disentangling the role of human and natural drivers of multiple reef regimes across the Hawaiian Archipelago*.

Teaching and training

- » Lecturer, Master's level course *Social-ecological systems: Challenges & approaches*, Stockholm Resilience Centre, Stockholm University, autumn 2015.
- » Co-supervisor of Master's student Linnéa Joandi (Stockholm Resilience Centre, Stockholm University).

Other

- » Vice-chairman of the PhD student council, Stockholm Resilience Centre, Stockholm University, since autumn 2015.



Chandra Kiran Krishnamurthy
PhD, Researcher

Research focus

Economics of climate change, energy economics, broad issues at the intersection of environmental and urban, agricultural issues, with particular focus on all aspects relating to water.

Publications during the period

- » Krishnamurthy, C.K.B. Optimal management of groundwater under uncertainty: A unified approach. *Environmental and Resource Economics*. In press.
- » Krishnamurthy, C.K.B. and B. Kriström. 2016. Determinants of the price-premium for green energy: Evidence from an OECD cross-section. *Environmental and Resource Economics* 64(2):173-204.
- » Vesterberg, M. and C.K.B. Krishnamurthy. Residential end-use electricity demand: Implications for real time pricing in Sweden. *Energy Journal*. In press.

Conferences, workshops and presentations

- » Climate Change, Natural Resource Management, and Sustainability Workshop, The Amrita School of Business, Amrita University, Coimbatore, India, January 2016. Presentation: *Issues in the economics of climate change*.
- » The Inaugural Sustainable Development Research Conference, Columbia University, New York, USA, April 2016. Presentation: *Water rights allocation, trade, and welfare: An exploration of linkages*.

Teaching and training

- » Sole instructor and course leader, Master's and PhD level course *Econometrics I*, Department of Economics/USBE, Umeå University, Sweden, autumn 2015.
- » Sole instructor and course leader, PhD level course *Econometrics II*, Department of Economics/USBE, Umeå University, Sweden, spring 2016.
- » Lecturer, PhD level course *Ecosystems, ecosystem services and economics*, Royal Swedish Academy of Sciences, Stockholm, March 2016.

Other

- » Organiser of a new seminar series, Stockholm Environmental and Resource Economics (SERE), a joint initiative between the Beijer Institute, GEDB and the Stockholm School of Economics.



Sofia-Kristin Kokinelis
MSc, Finance and HR Administrator

Sofia-Kristin is Finance and HR Administrator for both the Beijer Institute and the Family Erling Persson Academy Programme. More specifically, she is responsible for accounting issues and budgeting and provides support and financial information to researchers about their projects. She also prepares staff contracts and assists staff members with different issues.



Christina Leijonhufvud
BA, Chief administrator

Christina was responsible for the administration of the Board and Askö meetings in September 2015. She helped with the organization of the course *Ecosystems, ecosystem services and economics* 7-18 March, 2016 and worked on the selection process of the Mäler Scholar 2016 and 2017. She also organized the selection process of the new Beijer Young Scholars group as well as their first workshop 30 May– 3 June 2016 in Stockholm and its archipelago. During the spring of 2016 she handled the applications for and organization of the course *Valuing and Designing Payment Systems for Ecosystem Services* in Zürich, 21-22 June, 2016. She is responsible for the administration of guest research posts and deals with various office tasks.



Chuan-Zhong Li
Professor, Researcher

Research focus

Growth and the environment, the economics of tipping points, resilience and sustainability studies, applied microeconomics.

Publications during the period

- » Li, C.Z. and K.G. Löfgren. 2015. A dynamic price index theory for deflating green net national product: an illustrative application using data from the United States. *Environmental Economics* 6(2):21-29.
- » Li, C.Z. and R. Bali Swain. Growth, water resilience, and sustainability: A DSGE model applied to South Africa. *Water Economics and Policy*. doi:10.1142/S2382624X16500223. In press.
- » Li, C.Z., S. Villasante and X. Zhu. 2016. Regime Shifts and Resilience in Fisheries Management: A Case Study of the Argentinean Hake fishery. *Environmental and Resource Economics*. First online. doi:10.1007/s10640-016-0038-y.
- » Rao, L. and C.Z. Li. 2015. EU's conservation accreditation system for architects and its implications for China. *Journal of Sichuan University (Social Science Edition)* 6:86-94.
- » Wei, C. and C.Z. Li. Resource misallocation in Chinese manufacturing enterprises: Evidence from firm-level data. *Journal of Cleaner Production*. doi:10.1016/j.jclepro.2016.04.083. In press.

Teaching and training

- » Course leader, lecturer and examiner, Master's level course *Microeconomic theory*, Uppsala University, autumn 2015.

Conferences, workshops and presentations

- » PACE International Symposium on Environmental Economics and Policy in China, Nanjing, China, July 2015. Keynote speaker: *Discounting, climate change and sustainability*.
- » China Economists Society Conference, Shenzhen, China, June 2016. Presentation: *Labor quality, skill bias and pollution - evidence from Chinese provincial data*.

Commissions

- » Member of the board of directors, Professional Association of China's Environment (PACE), Beijing, China, since 2012.
- » Member of the editorial board of *Environmental Economics and Policy Studies*, since 2011.
- » Member of the Editorial Board of *International Review of Environmental and Resource Economics*, since 2012.
- » Guest editor for *Environmental and Resource Economics* on a special issue: *The Economics of Complex Systems*.
- » Member of the PhD evaluation committee for Ina Blind (Department of Economics, Uppsala University), October 2015.
- » Member of the PhD evaluation committee for Mathilda Eriksson (Department of Economics, Umeå University), spring 2016.



Therese Lindahl
PhD, Researcher

Research focus

Human behaviour as it relates to the biosphere, in the intersection of economics, psychology and systems ecology. Influence of complex ecosystem dynamics (e.g. threshold effects, uncertainty and resources interdependencies) on resource users' strategies for exploitation and cooperation and implications for the management of common resources. Alternative approaches to environmental policy based on psychological insights.

Publications during the period

- » Janssen, M., T. Lindahl and J. Murphy. 2015. Advancing the understanding of behavior in social-ecological systems: results from lab and field experiments. *Ecology and Society* 20(4):34.
- » Lindahl, T., A.-S. Crépin and C. Schill. 2016. Potential disasters can turn the tragedy into success. *Environmental and Resource Economics*. First online. doi:10.1007/s10640-016-0043-1.
- » Lindahl, T., N. Oreskovic and A.-S. Crépin. Playing Safe: The Role of Quotas to Avoid Ecosystem Regime Shifts. In: Dinar, A. (ed.). *The WSPC Reference of Natural Resources and Environmental Policy in the Era of Global Change. Volume 4: Experimental Economics*. World Scientific Publishing Co. Pte. Ltd., Singapore. In press.
- » Stikvoort, B.T., T. Lindahl and T. Daw. Thou shalt not sell nature: How taboo trade-offs can make us act

pro-environmentally, to clear our conscience. *Ecological Economics*. In press.

Conferences, workshops and presentations

- » Seminar, Almedalen, Visby, Sweden, July 2015. Invited speaker and panellist: *Is nudging the new black in policy?*
- » Klimathuset, conference on climate organised by the Swedish Society for Nature Conservation, Kulturhuset, Stockholm, October 2015. Invited speaker and panellist: *How to spark motivation for action.*
- » Seminar, Department of Economics, Umeå University, Sweden, December 2015. Invited speaker: *Dealing with abrupt ecosystem changes in common pool resource systems: Experimental evidence from a fishery community in Thailand.*
- » Workshop: Seeking sustainable pathways for land use in South America, SARAS Institute, Bella Vista, Uruguay, March 2016. Organiser.
- » Lecture series at the Royal Coin Cabinet, Stockholm, April 2016. Invited speaker: *Behaviour and the environment (Beteende och Miljö).*
- » EAT initiative workshop, Norefjell, Norway, April 2016. Presentation: *Human behaviour, the environment and food.*
- » EAT Science and Business collaboration workshop, Stockholm Resilience Centre, April 2015. Presentation: *Nudging towards sustainable meat consumption: Evidence from a natural field experiment.*
- » Psychology16 conference, Växjö, Sweden, April 2016. Invited speaker and panellist: *A talk about how to handle the climate threat (Samtal om att hantera klimathotet).*
- » EAT Stockholm Food Forum, Stockholm, June 2016. Moderator and speaker for: *Competence Forum: Retail nudging as a tool for healthy and sustainable customer choice.*
- » 2016 Annual conference of the Association of Environmental and Resource Economists, Zürich, Switzerland, June 2015. Presentation: *Dealing with abrupt ecosystem changes: Experimental evidence from a fishery community in Thailand.*

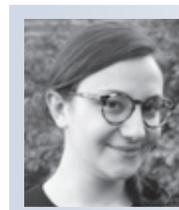
Teaching and training

- » Lecturer, Master's level course *Social-ecological systems: Challenges & approaches. Economic approaches to analyse ecosystem support of humanity*, Stockholm Resilience Centre, Stockholm University, autumn 2015.
- » Lecturer, Master's level course *Challenges of environmental decision making*, Stockholm Resilience Centre, Stockholm University, spring 2016.
- » Lecturer, undergraduate course *Ekologisk ekonomi (Ecological economics)*, Department of Physical Geography and Stockholm Resilience Centre, Stockholm University, spring 2016.
- » Lecturer, PhD level course *Ecosystems, ecosystem services and economics*, Royal Swedish Academy of Sciences, Stockholm, March 2016.
- » Main supervisor of PhD candidate Caroline Schill and Master's students Linda Lindström and Noah Linder (Stockholm Resilience Centre, Stockholm University).

Commissions

- » Scientific council member, Fores, Stockholm, since 2010.
- » Scientific advisor, EAT forum, Stockholm, since 2015.

- » Contributor to the EAT - Lancet Commission, since June 2016.
- » Guest editor for *Ecology and Society* on special issue: *Advancing the Understanding of Behavior in Social-Ecological Systems: Results from Lab and Field Experiments.*
- » Member of reference group for ESO, Expertgruppen för Studier i Offentlig ekonomi (expert group for studies in public economics).
- » Member of Licentiate evaluation committee for PhD candidate Matteo Giusti (Stockholm Resilience Centre, Stockholm University), May 2016.
- » Reviewer for *Ecological Economics*, *Journal of Environmental Economics and Management (JEEM)* and *Ecology and Society*.



Nikolina Oreskovic
MSc, Research Assistant

Research focus

Exploring linkages between ecological characteristics and human behaviour among common-pool resource users managing resources facing potential abrupt, drastic and persistent changes.

Publications during the period

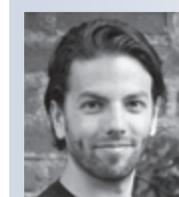
- » Lindahl, T., N. Oreskovic and A.-S. Crépin. Playing Safe: The Role of Quotas to Avoid Ecosystem Regime Shifts. In: Dinar, A. (ed.). *The WSPC Reference of Natural Resources and Environmental Policy in the Era of Global Change. Volume 4: Experimental Economics*. World Scientific Publishing Co. Pte. Ltd., Singapore. In press.

Conferences, workshops and presentations

- » Transformations 2015 conference People and the Planet in the Anthropocene, Stockholm University, October 2015. Participant.

Other

- » Developed and distributed survey regarding knowledge of and attitude towards potential regime shifts in a natural resource to Swedish fishermen.
- » Research assistant in ARTS (Accelerating and rescaling Transitions to Sustainability), Stockholm Resilience Centre, since December 2015.



Daniel Ospina-Medina
PhD candidate, Researcher

Research focus

Changes in rural landscapes and livelihoods in the context of

increasing global connectivity and urbanisation, particularly in Latin America. More specifically, research focus on understanding the conditions under which rural out-migration and remittances can drive forest resurgence.

Conferences, workshops and presentations

- » Workshop: Seeking sustainable pathways for land use in South America, SARAS Institute, Bella Vista, Uruguay, March 2016. Participant.

Other

- » Secretary of the PhD student council, Stockholm Resilience Centre, Stockholm University, since autumn 2015.
- » Research assistant for the Global Dynamics and Resilience theme.



Juan-Carlos Rocha
PhD, Researcher

Research focus

Critical transitions and emergent patterns, from regime shifts in ecological systems to collective action in society. Identification of resilience surrogates, mapping social-ecological systems archetypes, and identifying regime shifts in data-poor or developing country contexts.

Publications during the period

- » Rocha, J.C., G.D. Peterson and R. Biggs. 2015. Regime Shifts in the Anthropocene: Drivers, risks, and resilience. *PLOS ONE* 10:e0134639.

Conferences, workshops and presentations

- » Workshop on Global Dynamics, Feedbacks and Telecouplings - Taking Stock and Moving Forward, Vår Gård, Saltsjöbaden, Sweden, September 2015. Participant.
- » Conference on Complex Systems 2015, Tempe, Arizona, USA, September/October 2015. Presentations: *Regime Shifts in the Anthropocene* and *Detecting potential impacts on ecosystem services related to ecological regime shifts - a matter of wording.*
- » Cross-scale dynamics in the Baltic Sea workshop, Stockholm Resilience Centre, October 2015. Participant.
- » PECS (Program on Ecosystem Change and Society) 2015 Conference, Social-ecological dynamics in the Anthropocene, Stellenbosch, South Africa, November 2015. Presentation: *Regime Shifts in the Anthropocene* and *Detecting potential impacts on ecosystem services related to ecological regime shifts - a matter of wording*; and poster presentation: *The Regime Shifts Database.*
- » International Dryland Symposium, Scientific Ecological Society of Mexico, Instituto Potosino de Investigacion Cientifica y Tecnologica (public research centre), San Luis Potosi, Mexico, November/December 2016. Speaker:

Regime shifts in the Anthropocene and potential cascading effects in drylands.

- » Seminar, Magdalena University, Santa Marta, Colombia, February 2016. Invited speaker: *Transiciones criticas en socio-ecosistemas (Critical transitions in social-ecological systems).*
- » Workshop: Seeking sustainable pathways for land use in South America, SARAS Institute, Bella Vista, Uruguay, March 2016. Participant.
- » Beijer Young Scholars Workshop on Inequality and the Biosphere, Royal Swedish Academy of Sciences and Ek-skäret, Stockholm, May/June 2016. Participant.

Teaching and training

- » Lecturer and examiner, Master's level course *Regime Shifts*, Stockholm Resilience Centre, Stockholm University, spring 2015.
- » Supervisor of two Master's student trainees (Stockholm Resilience Centre, Stockholm University).



Caroline Schill
PhD candidate, Researcher

Research focus

Collective action, ecological complexities and social-ecological dynamics in social dilemmas. In particular, implications of non-linear ecosystem changes, and social and environmental uncertainties for sustainable management of shared natural resources.

Publications during the period

- » Lindahl, T., A.-S. Crépin and C. Schill. 2016. Potential disasters can turn the tragedy into success. *Environmental and Resource Economics*. First online. doi: 10.1007/s10640-016-0043-1.
- » Schill, C. 2015. *Making Complex Commons Work: Identifying critical social-ecological factors and mechanisms for sustainable ecosystem management*. Licentiate thesis in Sustainability Science. Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden.

Conferences, workshops and presentations

- » Workshop in Sustainability Economics: Experiments on Intergenerational Justice under Uncertainty, Camp Reinschlen, Germany, October 2015. Paper presentation: *Collective action and the risk of ecosystem regime shifts: insights from a laboratory experiment.*
- » PECS (Program on Ecosystem Change and Society) 2015 Conference, Social-ecological dynamics in the Anthropocene, Stellenbosch, South Africa, November 2015. Presentation: *Cooperation is not enough - critical social-ecological conditions for sustainable management of the commons.*
- » Seminar, Magdalena University, Santa Marta, Colombia, February 2016. Invited speaker (together with Juan-Carlos Rocha): *Transiciones criticas en socio-ecosistemas (Critical*

transitions in social-ecological systems).

- » Seminar to report results from research funded by Ebba and Sven Schwartz foundation, Stockholm Resilience Centre, February 2016. Presentation: *Collective action and the risk of ecosystem regimes shifts: Insights from a laboratory experiment*.
- » Beijer Young Scholars Workshop on Inequality and the Biosphere, Royal Swedish Academy of Sciences and Ek-skäret, Stockholm, May/June 2016. Participant.

Teaching and training

- » Teaching assistant, Master's level course *Social-ecological systems: Challenges & approaches. Economic approaches to analyse ecosystem support of humanity*, Stockholm Resilience Centre, Stockholm University, autumn 2015.
- » Lecturer, PhD level course *Ecosystems, ecosystem services and economics*, Royal Swedish Academy of Sciences, Stockholm, March 2016.
- » Lecturer and examiner, Master's level course *Governance and management of social-ecological systems. Module: Drama of the commons*, Stockholm Resilience Centre, Stockholm University, spring 2016.
- » Supervisor of a Master's student trainee (Stockholm Resilience Centre, Stockholm University).

Other

- » Education Team (Lärarkollegiet) representative of the PhD student council, Stockholm Resilience Centre, Stockholm University, autumn 2014 - autumn 2015



Britt Stikvoort
MSc, Research Assistant

Research focus

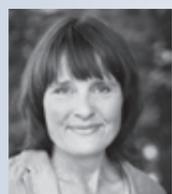
Behavioural economics and social psychology, focusing on environmentally friendly behaviour promotion.

Publications during the period

- » Stikvoort, B.T., T. Lindahl and T. Daw. Thou shalt not sell nature: How taboo trade-offs can make us act pro-environmentally, to clear our conscience. *Ecological Economics*. In press.

Other

- » PhD student at the Department of Psychology, Uppsala University, since March 2016.



Agneta Sundin
Communications officer

Agneta divides her time between the Beijer Institute and its partner, the Global Economic Dynamics and the Biosphere Programme (GEDB) of the Academy. Agneta's responsibilities include developing and editing the website, 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 (SRC) Communications team, Agneta is involved in activities arranged jointly by SRC, Beijer and Albaeco, for example the Stockholm Seminars series. In addition she has been co-organising the The new Stockholm Environmental and Resource Economics (SERE) Seminars during spring 2016, the Volvo Environment Prize seminar, November 2015 and the Beijer Young Scholars workshop 30 May– 3 June 2016.



Max Troell
Associate Professor, Researcher

Research focus

Environmental impacts and sustainability of aquaculture, governance of coastal and marine ecosystems, mangrove ecosystems, ecosystem services, ecosystem functions, biodiversity, resilience, regime shifts, food systems and food security, integrated aquaculture, environmental sustainability metric, LCA, eco-certification.

Publications during the period

- » Béné, C., R. Arthur, H. Norbury, E.H. Allison, M.C.M Beveridge, S. Bush, L. Campling, W. Leschen, D. Little, D. Squires, S. Thilsted, M. Troell and M. William. Contribution of fisheries and aquaculture to food security and poverty reduction: assessing the current evidence. *World Development*. In press.
- » Crona, B., X. Basurto, D. Squires, S. Gelcich, T.M. Daw, A. Khan, E. Havice, V. Chomo, M. Troell and E. Buchary. 2016. Towards a typology of interactions between small-scale fisheries and the global seafood trade. *Marine Policy* 65:1-10.
- » Eriksson, H., H. Österblom, B. Crona, M. Troell, N. Andrew, J. Wilen and C. Folke. 2015. Contagious exploitation of marine resources. *Frontiers in Ecology and the Environment* 13(8):435-440.
- » Homer-Dixon, T., B. Walker, R. Biggs, A.-S. Crépin, C. Folke, E. Lambin, G. Peterson, J. Rockström, M. Scheffer, W. Steffen and M. Troell. 2015. Synchronous failure: The emerging causal architecture of global crisis. *Ecology and Society* 20(3):6.
- » Krause, G., C. Brugere, A. Diedrich, M.W. Ebeling, S.C.A. Ferse, E. Mikkelsen, J.A. Pérez Agúndez, S.M. Stead, N. Stybel and M. Troell. 2015. A revolution without people? Closing the people-policy gap in aquaculture development. *Aquaculture* 447:44-55.
- » Moksnes, P.-O., D. Mirera, R. Lokina, J. Ochiewo, H. Mahudi, N. Jiddawi, M. Hamad and M. Troell. Feasibility of extensive, small-scale mud crab (*Scylla serrata*) farming in

East Africa. *Western Indian Journal of Marine Science*. In press.

- » Österblom, H., B.I. Crona, C. Folke, M. Nyström and M. Troell. 2016. Marine ecosystem science on an intertwined planet. *Ecosystems*. First online. doi: 10.1007/s10021-016-9998-6.
- » Troell, M., N. Kautsky, N. Beveridge, P. Henriksson, J. Primavera, P. Rönnbäck, M. Jonell and C. Folke. Aquaculture. In: Levin, S.A. (ed.). *Encyclopedia of Biodiversity*. Third Edition. Elsevier Science, New York, USA. In press.

Conferences, workshops and presentations

- » Elsevier Symposium: Cutting Edge Science in Aquaculture, Montpellier, France, August 2015. Invited keynote speaker: *Environmental implications of the growth of aquaculture - Resilience in aquaculture*.
- » Ninth WIOMSA Scientific Symposium, Durban, South Africa, October 2015. Session chair: *Marine aquaculture development*.
- » Sida Development talk: En grönare utvecklingspolitik, men hur? (A "greener" development policy, but how?), Sida, Stockholm, December 2015. Participant.
- » Workshop to develop fisheries / aquaculture synthesis paper on Myanmar's Fishery sector, WorldFish Myanmar office, Department of Fisheries, Pyin Oo Lwin, Burma, April 2016. Participant.
- » EAT initiative workshop, Norefjell, Norway, April 2016. Presentation: *EAT- SRC collaboration*.
- » EAT Science and Business collaboration workshop, Stockholm Resilience Centre, April 2015. Presentation: *EAT-SRC Research agenda*.
- » MASMA Programme Committee meeting, Western Indian Ocean Marine Science Association, Johannesburg, South Africa, May 2016.
- » Wiomsa workshop: Sustainable and Equitable Mariculture Development in the Western Indian Ocean - Development of a Policy Framework, WIOMSA, WorldFish, IORA, Zanzibar, May 2016. Organiser.
- » EAT Stockholm Food Forum, Stockholm, June 2016. Participant.

Teaching and training

- » Lecturer, PhD level course *Innovation for sustainable aquaculture*, Aquaculture Centre West, Gothenburg University, Sweden, August 2015.
- » Lecturer, Master's course *Management of aquatic resources in the tropics*, Stockholm University, February 2016.
- » Course leader and lecturer, PhD level course *Ecosystems, ecosystem services and economics*, Royal Swedish Academy of Sciences, Stockholm, March 2016.
- » Supervisor of PhD candidate Malin Jonell (Department of Ecology, Environment and Plant Sciences, Stockholm University); co-supervisor of PhD candidate M. Oyinlola (Nereus PhD fellowship, University of British Columbia, Vancouver, Canada) and member of supervisor committee for J. Timor (IFREMER, Plouzané, France).
- » Supervisor of post-doc Patrik Henriksson (Stockholm Resilience Centre, Stockholm University).

Commissions

- » Member of ICES working group, ICES: The Working

Group on Social and Economic Dimensions of Aquaculture (WGSEDA), since 2011.

- » Advisory board member of IDREEM, FP7 EU Project, since 2012.
- » Member of the MASMA Programme Committee, Western Indian Ocean Marine Science Association, since 2007.
- » Contributor to the EAT – Lancet Commission, since June 2016.
- » Opponent of PhD candidate Olivier Joffre (*Balancing Options for Shrimp Farming*, Wageningen University, The Netherlands), October 2015.
- » Internal reviewer for PhD thesis of Andrew Merrie (Stockholm Resilience Centre, Stockholm University), February 2016.
- » Reviewer for Grantee Meeting MASMA, Durban, South Africa, October 2015.
- » Reviewer for Food Climate Research Network (FCRN) report: *Lean, Green, Mean, Obscene...? What is Efficiency? And is it Sustainable?*, November 2015.
- » Review editor for *Journal of Aquaculture Environment Interactions* (AEI), since 2009.
- » Journal Reviewer for *Aquaculture Research*, *Aquaculture*, *AMBIO* and *Environmental Interactions* and *Frontiers in Marine Science*.

Other

- » Popular science communication: Mer fisk med gott samvete! (More fish with a clear conscience). Ziegler F., M. Troell, S. Hornborg, P. Henriksson, M. Jonell, K. Bergman and P. Rönnbäck, *SVT Opinion*, Stockholm, 23 May 2016. <http://www.svt.se/opinion/mer-fisk-med-gott-samvete>.

The Beijer Publication Series

SCIENTIFIC papers by Beijer staff or Beijer fellows, published in refereed journals or in books that have undergone review, are published in the BEIJER E-PRINT SERIES in order to facilitate the 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 506, of which 22 were published on our website between July 2015 and June 2016. The BEIJER DISCUSSION PAPER SERIES constitutes a forum for unpublished scientific papers with content that should be subject to discussion and comments. They can be downloaded from the Beijer website. 257 discussion papers have been produced since 1991.

E-Print Series

2016

- » **506.** EU's conservation accreditation system for architects and its implications for China (in Chinese). Rao, L. and C.Z. Li (2015). *Journal of Sichuan University (Social Science Edition)* 6:86-94.
- » **505.** Marine ecosystem science on an intertwined planet. Österblom, H., B.I. Crona, C. Folke, M. Nyström and M. Troell (2016). *Ecosystems*. First online. doi: 10.1007/s10021-016-9998-6.
- » **504.** Valuation of oil spill risk reductions in the Arctic.

- Noring, M., L. Hasselström, C. Håkansson, Å. Soukorporva and Å. Gren (2016). *Journal of Environmental Economics and Policy*. First online. doi: 10.1080/21606544.2016.1155499.
- » **503.** Protected areas and their surrounding territory: Socioecological systems in the context of ecological solidarity. Mathevet, R., J.D. Thompson, C. Folke and S. Chapin III (2016). *Ecological Applications* 26:5-16.
 - » **502.** Potential disasters can turn the tragedy into success. Lindahl, T., A.-S. Crépin and C. Schill. (2016). *Environmental and Resource Economics*. First online. doi: 10.1007/s10640-016-0043-1.
 - » **501.** Regime Shifts and Resilience in Fisheries Management: A Case Study of the Argentinean Hake fishery. Li, C.Z., S. Villasante and X. Zhu (2016). *Environmental and Resource Economics*. First online. doi: 10.1007/s10640-016-0038-y.
 - » **500.** Determinants of the price-premium for green energy: Evidence from an OECD cross-section. Krishnamurthy, C.K.B. and B. Kriström (2016). *Environmental and Resource Economics* 64(2):173-204.
 - » **449.** Climatic tipping points and optimal fossil fuel use. Engström, G. and J. Gars (2016). *Environmental and Resource Economics*. First online. doi: 10.1007/s10640-016-0042-2.
 - » **448.** Towards a typology of interactions between small-scale fisheries and the global seafood trade. Crona, B., X. Basurto, D. Squires, S. Gelcich, T.M. Daw, A. Khan, E. Havice, V. Chomo, M. Troell and E. Bucharly (2016). *Marine Policy* 65:1-10.
 - » **447.** Quantifying spatial resilience. Allen, C.R., D.G. Angeler, G. Cumming, C. Folke, D. Twidwell and D.R. Uden (2016). *Journal of Applied Ecology* 53:625-635.
 - » **446.** Optimal taxation in the macroeconomics of climate change. Engström, G. and J. Gars (2015). *Annual Review of Resource Economics* 7:127-150.
 - » **445.** Advancing the understanding of behavior in social-ecological systems: results from lab and field experiments. Janssen, M., T. Lindahl and J. Murphy (2015). *Ecology and Society* 20(4):34.
 - » **444.** A dynamic price index theory for deflating green net national product: an illustrative application using data from the United States. Li, C.Z. and K.G. Löfgren (2015). *Environmental Economics* 6(2):21-29.
 - » **443.** Regime Shifts in the Anthropocene: Drivers, Risks, and Resilience. Rocha, J.C., G.D. Peterson and R. Biggs (2015). *PLOS ONE* 10:e0134639.
 - » **442.** Contribution of Fisheries and Aquaculture to Food Security and Poverty Reduction: Assessing the Current Evidence. Béné, C., R. Arthur, H. Norbury, E.H. Allison, M.C.M Beveridge, S. Bush, L. Campling, W. Leschen, D. Little, D. Squires, S. Thilsted, M. Troell; M. Williams (2016). *World Development*, 79: 177-196.

2015

- » **441.** Comment on 'Water footprint of marine protein consumption—aquaculture's link to agriculture'. Troell, M. M. Metian, M. Beveridge, M. Verdegem, and L. Deutsch (2014). *Environmental Research Letters* 9, 109001 (4pp).
- » **440.** A revolution without people? Closing the people-policy gap in aquaculture development. Krause, G., C. Brugere,

- A. Diedrich, M.W. Ebeling, S.C.A. Ferse, E. Mikkelsen, J.A. Pérez Agúndez, S.M. Stead, N. Stybel and M. Troell (2015). *Aquaculture*, 44:44-55.
- » **439.** What if solar energy becomes really cheap? A thought experiment on environmental problem shifting. van den Bergh, J., C. Folke, S. Polasky, M. Scheffer, and W. Steffen (2015). *Current Opinion in Environmental Sustainability* 14:170-179.
 - » **438.** Advancing sustainability through mainstreaming a social-ecological systems perspective. Fischer, J., T.A. Gardner, E.B. Bennett, P. Balvanera, R. Biggs, S.R. Carpenter, T. Daw, C. Folke, R. Hill, T. Hughes, T. Luthe, M. Maass, M. Meacham, A.V. Norström, G. Peterson, C. Queiroz, R. Seppelt, M. Spierenburg and J. Tenhunen (2015). *Current Opinion in Environmental Sustainability* 14:144-149.
 - » **437.** Synchronous failure: the emerging causal architecture of global crisis. Homer-Dixon, T., B. Walker, R. Biggs, A.-S. Crépin, C. Folke, E. F. Lambin, G. D. Peterson, J. Rockström, M. Scheffer, W. Steffen and M. Troell (2015). *Ecology and Society* 20(3): 6.
 - » **436.** Contagious exploitation of marine resources. H. Eriksson, H. Österblom, B. Crona, M. Troell, N. Andrew, J. Wilen, C. Folke. (2015). *Front Ecol Environ* 13(8): 435-440
 - » **435.** Allowing variance may enlarge the safe operating space for exploited ecosystems. S. R. Carpenter, W. A. Brock, C. Folke, E.H. van Nes and M. Scheffer (2015). *Proceedings of the National Academy of Sciences of the United States of America* 112:14384-14389.

Discussion Papers

- » **257.** Climate Change Policy under Spatial Heat Transport and Polar Amplification. William Brock and Anastasios Xepapadeas. 2016.
- » **256.** Non-Cooperative and Cooperative Responses to Climate Catastrophes in the Global Economy: A North-South Perspective. Frederick van der Ploeg and Aart de Zeeuw. 2016.
- » **255.** Optimal Management of Ecosystem Services with Pollution Traps: The Lake Model Revisited. Dieter Grass, Anastasios Xepapadeas and Aart de Zeeuw. 2015.
- » **254.** Managing renewable resources facing the risk of regime shifts. Aart de Zeeuw and Xiaoli He. 2015.



1.



3.



6.



8.



2.



4.



5.



7.

THE BEIJER INSTITUTE OF ECOLOGICAL ECONOMICS

ANNUAL REPORT 2015/2016

1. Agneta Sundin and Neil Adger at Askö.
2. Field work team Colombia (see page10): Back row (left to right): Jaime González Cueto, Gloria De León Martínez, Juan-Carlos Rocha, Nidia Andrea Vanegas Perez, Jesús Jiménez Torres, Alisson Soche Forero, Christian Marrugo Marmolejo Front row: Lina Maria Saavedra-Díaz, Caroline Schill, María de los Angeles González Pabón, Darlin Botto Barrios.
3. Sailing trip during the BYS meeting (see pages 20-21) Having fun and building trust in line with Beijer Institute philosophy.
4. BYS group discussion. From left: Amir Jina (in red), Patrik Henriksen, Andrew Tilman, Caroline Schill, Robert Heilmayer.
5. Christina Leijonhufvud and Paul Ehrlich on the boat to Askö.
6. Juan-Carlos Rocha, Jean-Baptiste Jouffray, Daniel Ospina-Medina at the board dinner in September 2015.
7. Steve Polasky and Anne-Sophie Crépin enjoying the Stockholm archipelago during the BYS workshop.
8. Art and Science exercise during the SARAS workshop (see page 30.)
9. Therese Lindahl and Marten Scheffer at the SARAS workshop.

Photos: 1, Christina Leijonhufvud. 2, Caroline Schill. 3, 4, 5, 6, 7, Agneta Sundin. 8, 9, Daniel Ospina-Medina.

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 1 July 2015 – 30 June 2016.

www.beijer.kva.se