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The Beijer Institute of Ecological Economics

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Director's column

THERE ARE TURBULENT TIMES. Human rights and extremism, climate agreements and refugees, well-being and inequalities, collaboration and conflict. We have learned from our work at the Beijer Institute and from colleagues that variance tends to increase close to major tipping points. Buzz Holling always used to say that in such situations of change, a Gandhi or a Hitler may arise. But there are hopeful signs of the beginning of a new age of enlightenment where humanity is increasingly realising its dominant role in the biosphere and what this means for our future.

The Beijer Institute works to enhance understanding of complex social, economic and ecological interactions and what it means for guiding human actions into human wellbeing and prosperity within the capacity of the biosphere, within planetary boundaries. The great acceleration of the past fifty years has placed humanity in the driving seat of the Anthropocene. Knowing how to drive may be easy, but steering towards global sustainability is a different game.

In complex adaptive systems, agents often interact in unplanned and unpredictable ways that underlie the emergence of broader-scale patterns, which feed back to the system and influence the interactions of the agents.

Sustainable development is all about understanding the role of humans, from the family level or local enterprises to multinational keystone actors, governments and global institutions, and the significance of human behaviour for creating a prosperous future for the 9-10 billion people envisioned to inhabit Earth.

In September 2016, we celebrated 25 years of the Beijer Institute of Ecological Economics, an amazing milestone, joined by colleagues from around the world. It was exceptionally rewarding to realise the numerous ways in which our curiosity-driven science has influenced thinking and action and generated new pathways and platforms for collaboration.

The Keystone Actors dialogues have been a major influence. Ten of the 13

multinational companies identified as shaping the oceans and their future are now part of the dialogue. The Keystone Actors have formed a collaborative initiative, SeaBOS – Seafood Business for Ocean Stewardship, with an action plan now set in motion. HRH Crown Princess Victoria is playing a significant role in the process. The hope is to shift and expand the major seafood players from food producers to custodians of our oceans.

“Knowing how to drive may be easy, but steering towards global sustainability is a different game.”

Such shifts in norms and values are the focus of the elegant paper ‘Social norms as solutions’ published in *Science*, under the impressive leadership of the Chair of the Board Karine Nyborg and the BENN programme directors Marty Anderies and Therese Lindahl, an output of yet another exciting Askö meeting.

Over the year we have hosted several workshops and meetings, such as the Beijer Young Scholars 2.0 that gathered again in Stockholm in the spring. Caroline Schill defended her excellent PhD thesis, impressive work on human behaviour. The collaborations with Stockholm Resilience Centre and Global Economic Dynamics and the Biosphere Academy programme (GEDB) are flourishing and new work on antibiotic resistance is in the pipeline, as well as an emerging collaboration with the new Academy institute on global health transitions, SIGHT. The collaboration with Svenskt Tenn, the top quality design store in Stockholm, continues in exciting ways.

Professor Kenneth Arrow was devoted to the Beijer since the start in 1991. He passed away in February, ninety-five

years old. Ken was with us at the Askö 2016 meeting and at the 25th Anniversary celebrations. An impressive human, a true genius, not only in the mind but also in the heart. We will miss him immensely, but what he gave, in his pleasant and insightful way, will keep us inspired and engaged for decades to come.

Looking ahead, it is very stimulating to envision the new discoveries for sustainability that will emerge during the coming 25 years, during times of rapid change. The Beijer Institute will no doubt play a significant role in these discoveries. The long-term support of the Beijer Foundation is fundamental and invaluable. We are deeply grateful to Anders Wall and the members of the Beijer Foundation for their strong engagement and commitment to the Beijer Institute. And as always, the professional support of the Academy is very much appreciated.

I hope you enjoy reading about the progress of our research programmes and about all our other activities in this Annual Report.



Photo: Cecilia Nordstrand

Carl Folke, Director
Stockholm, August 2017

25th anniversary of the Beijer Institute



Karl-Göran Mäler, Christina Leijonhufvud and Carl Folke.

ON 12 SEPTEMBER 2016, the Beijer Institute celebrated its 25th anniversary together with partners and friends from near and far. An afternoon at the Royal Swedish Academy of Sciences was devoted to reflecting on the Institute's research contributions and their significance for international environmental politics and for creating new research fields. The challenges facing the world and researchers, now and in the future, were also the subject of much discussion.

Twenty-eight of our Beijer Fellows, world-leading researchers in research fields closely related to the work of the Beijer Institute, took the time to come to Stockholm for the anniversary. Members of the Beijer Foundation and colleagues from Stockholm Resilience Centre and from the Academy were also among the guests.

The guests were welcomed by the secretary general of the Academy, Göran K. Hansson, and then the chair of the Beijer Institute Board, Karine Nyborg from Oslo University, began the afternoon session. She highlighted the ability of the Beijer Institute to promote good collaboration, not only through bringing together different competences and personalities, but also through creating a relaxed and creative atmosphere.

Carl Folke then presented the Institute's research, activities and policy interactions, showing how this work has had an impact in various ways and not only within academia and education. The results have also been taken up and implemented in practice within the entire global society, for example in UN documents, EU decisions and national measures in different countries, and at local level in cities and companies.

In a conversation between former board members Stephen Polasky, University of Minnesota, and Stephen Carpenter, University of Wisconsin, with Agneta Sundin as moderator, both these professors claimed that the contributions of the Beijer Institute to interdisciplinary research have been critical

in increasing consideration of social and ecological factors when seeking solutions to environmental problems.

"Collaboration between disciplines is a natural approach now for many young researchers, but not long ago ecologists and economists had widely differing world views and never worked together", said Stephen Polasky. As close and long-term research partners, both professors also described how the Beijer Institute has promoted trust between individuals and how important this has been for success.

Deputy director Anne-Sophie Crépin and Beatrice Crona, director of GEDB, chaired a panel discussion on future challenges with four heavyweights within research and policy. Partha Dasgupta, University of Cambridge, cited population growth as an important component of sustainable development, but also pointed out the importance of researchers reaching out with their message: "We need to develop a better vocabulary to raise the profile of natural resources", he said. Jane Lubchenco, former head of NOAA and advisor to president Obama, pointed out the importance of the sea for climate and food supply. She claimed that it is more difficult to get people to recognise the threats to the sea, because most of these threats literally occur under the surface. Simon Levin, Princeton University, mentioned antibiotic resistance as one of the really major challenges that must be tackled at both local and global level. Gretchen Daily, Stanford University, reflected on how successful solutions at local level can be implemented on a larger scale.

To exploit the fact that so many members of the Beijer Institute's unique research network were present, five informal sessions were held where younger researchers and students had an opportunity to discuss relevant research topics with a total of ten Beijer Fellows (with one economist and one ecologist in every session).



Stephen Carpenter, Stephen Polasky and Agneta Sundin.



Lisen Schultz.



Partha Dasgupta, Jane Lubchenco, Simon Levin and Gretchen Daily. The stage was decorated by Svenskt Tenn.

However, the 25th anniversary celebrations involved not only interesting discussions, but also recognitions and awards. All who had held the post of chair of the Beijer Institute Board received a gift from the chairman of the Beijer Foundation, Anders Wall. Karl-Göran Mäler, the former director of the Institute, and Christina Leijonhufvud, who has been the organisational hub of the Institute from the start, received prolonged and enthusiastic applause when they appeared on stage to receive their awards. There was also spontaneous applause for the Institute's long-term partner, Kenneth Arrow, who sadly passed away only five months later.

Delightful music was provided by Lisen Schultz, researcher at Stockholm Resilience Centre, and her sister Irma Schultz Keller, and by opera singer and recipient of the Anders Wall scholarship, Sofie Asplund.

Photos: Cecilia Nordstrand



Anders Wall and Göran K. Hansson.



Beijer Fellows Terry Chapin and Fikret Berkes discussing issues concerning local to global management and stewardship with Beijer and SRC researchers and students.

In memory of Kenneth Arrow

LONG-STANDING Beijer Fellow and Economics Laureate Kenneth Arrow has left us. He passed away at his home in California on 21 February 2017, at the age of 95. Kenneth (Ken) Arrow was considered by many of his peers to be the most influential economist of his generation and as such he played an immense role for the Beijer Institute, taking part in research programmes, in capacity building efforts in developing countries and as a regular participant of the Askö meetings. For that, and for his personal qualities, he will always be remembered with much warmth at the Beijer Institute.

Ken Arrow was an exceptional academic who was awarded the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel in 1972 for “pioneering contributions to general economic equilibrium theory and welfare theory”. However, he made many more contributions to economics. His work on social choice theory, notably ‘Arrow’s impossibility theorem’, and on general equilibrium analysis, learning by doing, and the economics of information, are but a few examples.

Ken had a standing invitation to attend the annual Askö meetings, a unique forum for discussions between ecologists and economists, and he took part year after year. “I wouldn’t miss this”, he used to say. His last visit was in autumn 2016, when he was acknowledged with a spontaneous standing ovation at the Beijer Institute’s 25th anniversary celebrations. He attended no less than 17 Askö meetings over the years, and he took the lead on three Askö publications. One of these, entitled ‘Economic growth carrying capacity and the environment’, which is among his most frequently cited publications, provides a nuanced picture of the links between growth, the environment and the ability of nature to produce resources and ecosystem services. The paper ‘Managing ecosystem resources’ investigates problems arising from unsustainable use of natural resources, while ‘Are we consuming too much?’ examines the links between consumption, population growth and sustainability, still a highly relevant issue. He played an active part in the latest publication from Askö, ‘Social norms as solutions’, and in January 2017, shortly before his death, he sent detailed comments on the unpublished manuscript from what would be his last Askö meeting.

Despite his great age, jet-lag and the long journey from California to Stockholm, Ken was always a highly engaged participant, making the most brilliant inputs. He had an exceptionally good memory and cited literature he had read throughout his long career, occasionally also with the correct page reference. He also had in-depth knowledge within a number of other

disciplines and was able to cite highly relevant examples from biology, history and other areas.

Ken was a brilliant academic but we also came to know another side of him, as a friendly, humorous and considerate human being who treated everyone he met with respect, whether leading professor, newly appointed PhD student or assistant. He was incredibly curious and was always the one to ask what others were working on. “It is so far from anything I do, I must be interested” he would say, eager to learn new things.

It has been a privilege to know Ken Arrow. His great intellect was always evident, he was a novel thinker and was knowledgeable, interested and committed. Genius does not grow on trees. We here at the Beijer Institute will miss his presence, but will carry with us his gifts of wisdom and humility.



Photo: Cecilia Nordstrand.

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

THE FOOD SYSTEM IS A MAJOR driver of global environmental change and future food systems need to produce sufficient volumes in sustainable ways, while the food produced needs to contain adequate nutrients to support healthy populations. Seafood is increasingly playing a significant role for transformation towards sustainability, as it contributes positively to human health and can cause less environmental degradation than many types of meat production on land. However, seafood varies widely and different products have different environmental and social impacts. Some highlights from recent research within the Aquaculture and Sustainable Seafood programme at the Beijer Institute include:

LCA for sustainability mapping

One research area focuses on measuring the environmental performance of different seafood systems using life cycle analysis (LCA). The LCA methodology is also a core component within a new research project (see below) that aims to investigate different avenues for sustainable seafood production and consumption in Sweden. The strengthened collaboration with Worldfish has resulted in several LCA-based analyses, including work on the uncertainties in LCA studies and on aquaculture sustainability in Indonesia, Vietnam and Egypt.

References:

- Heijungs, R., P.J.G. Henriksson, and J.B. Guinée. 2017. Pre-calculated LCI systems with uncertainties cannot be used in comparative LCA. *International Journal of Life Cycle Assessment* 22(3):461.
- Heijungs, R., P.J.G. Henriksson, and J.B. Guinée. 2016. Measures of difference and significance in the era of computer simulations, meta-analysis, and big data. *Entropy* 18(10):361.
- Henriksson, P.J.G., M. Dickson, A.N. Allah, D. Al-Kenawy, and M. Phillips. 2017. Benchmarking the environmental performance of best management practice and genetic improvements in Egyptian aquaculture using life cycle assessment. *Aquaculture* 468:53-59.
- Henriksson, P.J.G., C.V. Mohan, and M.J. Phillips. 2017. Evaluation of Different Aquaculture Feed Ingredients in Indonesia Using Life Cycle Assessment. *Indonesian Journal of Life Cycle Assessment and Sustainability* 1(2):13-21.
- Järviö, N., P.J.G. Henriksson, and J.B. Guinée. 2017. Including GHG emissions from mangrove forests LULUC in LCA: a case study on shrimp farming in the Mekong Delta, Vietnam. *International Journal of Life Cycle Assessment*. In press.
- Nhu, T.T., T. Schaubroeck, P.J.G. Henriksson, R. Bosma, P. Sorgeloos, and J. Dewulf. 2016. Environmental impact of non-certified versus certified (ASC) intensive *Pangasius* aquaculture in Vietnam, a comparison based on a statistically supported LCA. *Environmental Pollution* 219:156-165.
- Tran, N., U.-P. Rodriguez, C.Y. Chan, M.J. Phillips, C.V. Mohan, P.J.G. Henriksson, S. Koeshendrajana, S. Suri, and S. Hall. 2017. Indonesian aquaculture futures: An analysis of fish supply and demand in Indonesia to 2030 and role of aquaculture using the AsiaFish model. *Marine Policy* 79:25-32.

Programme director: Max Troell



Women preparing soap from local ingredients, at the Seaweed Centre in Paje, Zanzibar. Photo: M. Troell.

Seafood Business for Ocean Stewardship (SeaBOS)

Results from Beijer Institute research on seafood sustainability have been feeding into the Keystone dialogue (keystone-dialogues.earth), an ongoing initiative targeting the seafood business for improving ocean stewardship. Ten of the largest seafood companies in the world have been brought together with the ambition of transforming this industry towards sustainable seafood production and healthy oceans. This year's efforts resulted in signed commitments by company CEOs to: improve transparency and traceability; reduce illegal, unreported and unregulated fishing; improve fisheries and aquaculture management; and eliminate modern slavery. Read more in the Science in Society section.

References:

- Crona, B., and M. Troell (eds) with support from Jonell, M., and J.-B. Jouffray. 2017. Trade, people and ecosystems. Background Brief, the Stockholm Dialogue.
- Österblom, H., and J.-B. Jouffray (eds) with support from Troell, M., and M. Oyinola. 2016. Aquaculture. Background Brief 4, the Soneva Dialogue.
- Österblom, H., and J.-B. Jouffray (eds) with support from Merrie, A., and M. Troell. 2016. Innovations and Market Dynamics. Background Brief 7, the Soneva Dialogue.
- Troell, M., and M. Jonell (eds) with support from Henriksson, P. 2017. Seafood for human and planetary health. Background Brief, The Stockholm Dialogue.

In their article, Gephart et al. review different water use concepts and how they relate to seafood production. The figure indicates major water flows (blue lines) and product flows (black lines) in seafood production systems. Inland pond, coastal pond, cage and capture fisheries are depicted, as well as fish meal/fish oil and aquafeed production.



Small fish market selling the catch of the day from waters outside Dili, East Timor. Photo: M. Troell.

Shocks in seafood systems

Shocks are commonplace in food systems and the global seafood system is no exception. Few analyses have used a generalised, data-driven approach to detect and understand why shocks in the seafood system have occurred. To get a clearer picture, a data-driven approach was applied to analyse global fisheries and shocks they suffered between 1976 and 2011. This included analysing seafood production in 127 countries, using FAO statistics from both aquaculture and capture fisheries. Read more about this study at page 21.

References:

- Gephart, J.A., L. Deutsch, M.L. Pace, M. Troell, and D.A. Seekell. 2017. Shocks to fish production: Identification, trends, and consequences. *Global Environmental Change* 42:24-32.

Seafood freshwater footprints

Despite a growing focus on sustainability in seafood production, freshwater use in this sector is generally forgotten. In addition, there has been much confusion regarding how freshwater should be accounted for in seafood production. This triggered a recent review of different water use concepts and how they relate to seafood production. The study applied several different methods for quantifying water use, for example that developed by the "Water Footprint Network", which enabled identification of freshwater use hotspots and discussions about regional water scarcity. Three case studies highlighted different water use concerns in aquaculture and provided suggestions for new ways to integrate seafood production into broader food-water analysis. This could improve future food-water scenarios and lead to more well-informed decision making and policy considerations.

References:

- Gephart, J.A., M. Troell, P.J.G. Henriksson, M.C.M. Beveridge, M. Verdegem, M. Metian, L.D. Mateos, and L. Deutsch. 2017. The 'seafood gap' in the food-water nexus literature — issues surrounding freshwater use in seafood production chains. *Advances in Water Resources*. In press.

Seafood, consumers and certification

The number of seafood certification schemes is growing and understanding of the factors that prompt people to buy sustainable certified seafood has increased. However, knowledge is scarce about how the consumers' self-reported purchasing behaviour regarding eco-labelled seafood is connected to their environmental knowledge. In a study addressing this gap, consumer data from Stockholm, Sweden, were used to correlate consumers' stated purchasing of eco-labelled seafood to nine variables: environmental knowledge regarding seafood production, familiarity with eco-labels, subjective knowledge, pro-environmental self-identification, sense of personal responsibility, concern for negative environmental impacts from seafood production, belief that their choices will lead to improved production, gender and education. Two of these were identified as the most important reasons for choosing eco-labelled seafood: recognition and understanding of eco-labels for seafood, and concern for negative environmental impacts associated with seafood production. Surprisingly, environmental knowledge was a weaker predictor.

References:

- Jonell, M., B. Crona, K. Brown, P. Rönnbäck, and M. Troell. 2016. Eco-Labeled Seafood: Determinants for (Blue) Green Consumption. *Sustainability* 8(9):884.

New grant to increase sustainable seafood production and consumption

Programme director Max Troell and colleagues have been granted SEK 10 million in funding by the Swedish research council Formas for research on how to sustainably increase production and consumption of seafood in Sweden. The project aims to investigate the environmental performance of some innovative Swedish aquaculture methods, for instance farms that integrate aquaculture and agriculture, growing their

own fish feed and using by-products from aquaculture on their fields, or using closed recirculating systems on land. The team will quantify impacts such as greenhouse gas emissions, nutrient losses, acidification and land use. Project partners in Gothenburg and Canada will also study fishing practices aimed at minimising by-catch.

“Increased knowledge on effective mechanisms in improving the sustainability of fisheries and aquaculture can be of great importance for stimulating change.”

Moreover, in experimental behavioural studies the interdisciplinary team will look at what drives or hinders people from eating more sustainable and healthy seafood. They will also study the role played by eco-certification, as well as other policy measures.

The project, named Seawin, is teaming up with public and private partners to maximise value for society and the findings will be used to improve existing seafood guides (WWF) aimed at consumers, retailers and producers. Increased knowledge on effective mechanisms in improving the environmental performance of fisheries and aquaculture can be of great importance for stimulating change, both in Sweden and globally.

Project members:

Beijer Institute (Max Troell (PI), Patrik Henriksson, Therese Lindahl), Stockholm Resilience Centre, SP Technical Research Institute of Sweden, Uppsala University, Sweden, Dalhousie University, Canada, Århus University, Denmark. Project collaborators: WWF, EAT, Vegafish, Gårdsfisk, Nofima, Krav, Livsmedelsverket, ICA.

Behaviour, Economics and Nature Network - BENN

MOST ENVIRONMENTAL problems we face today, such as global warming, biodiversity loss, deforestation and pollution, are rooted in human behaviour. In fact, the link between environmental problems and human behaviour is so strong that any sustainable solution will require large-scale behavioural change.

BENN research activities respond to this challenge by focusing on improving understanding of human behaviour and decision making with respect to the natural environment and the many potential services it provides. It does so by addressing human behaviour on three scales. First is the 'individual scale', where behavioural questions relate to how individuals make decisions given a range of economic, social, technological and ecological constraints. Next is the 'local community' scale, where individual decisions are affected by the decisions of others, giving rise to natural resource dilemmas and the need for collective action. Last is the 'global scale', where questions revolve around how behaviour is driven by, and contributes to, large-scale societal forces.

Over the past year, BENN resources have been focused mainly at the individual and community scales (some recent examples of this work are detailed below). While nurturing projects at these scales, BENN is also building capacity to address behavioural questions at the global scale.

Cooperation is not enough to secure sustainable resource use

The late Nobel Laureate Elinor Ostrom demonstrated that, contrary to earlier beliefs, people are capable of preventing overuse of shared natural resources (such as fisheries, forests and grasslands) upon which they depend by implementing their own rules. To succeed with this, resource users must collaborate. But is cooperation enough to achieve sustainable use of these common-pool resources? According to a study published in the journal *PLOS ONE*, the short answer is no. In the study, Beijer researchers together with



Masai herdsmen, Kenya. Research shows that to achieve sustainable use of a common resource, a group of resource users needs at least one member with relevant ecological knowledge and confidence and willingness to share that knowledge.

Photo: Curt Wiler / Alamy Stock Photo.

colleagues from Stockholm Resilience Centre, looked at what other factors, beyond those typically studied such as trust and social preferences, are important for a group to use a shared natural resource sustainably. They found that a group of resource users also needs at least one member with relevant ecological knowledge, confidence in that knowledge and a willingness to share that knowledge with the others. Moreover, what is also crucial is that the other group members are willing to adapt their respective knowledge which, in turn, depends upon their knowledge confidence (if they are too confident in their own knowledge, they may not be willing to adapt).

To arrive at this conclusion, the authors developed an agent-based model based on results and observations from behavioural laboratory experiments within the BENN programme (see the previous annual report and references

Programme director: J. Marty Anderies
Programme manager: Therese Lindahl

Reference:

Schill, C., N. Wijermans, M. Schlüter, and T. Lindahl. 2016. Cooperation Is Not Enough - Exploring Social-Ecological Micro-Foundations for Sustainable Common-Pool Resource Use. *PLOS ONE* 11(18):e0157796.

Lindahl, T., A-S. Crepin and C. Schill. 2016. Potential disasters can turn the tragedy into success. *Environmental and Resource Economics* 65: 657-676.

Nature experiences and psychological health

There is compelling evidence showing how valuable nature is for people's psychological health. Nature experiences reduce stress, anxiety and rumination and improve cognitive functions and the ability to regulate emotions.

In recent years, unprecedented rates of urbanisation, growing detachment of people from nature and the observation that some psychiatric illnesses have increased among people living in cities have sparked research into possible connections between these concurrent trends.

There is now enough evidence to confirm that some of these illnesses can indeed be explained by urbanisation and detachment from nature, making it possible to create models of these causal connections. A model could be an important tool for urban planners, as well as in making decisions about conserving nature outside cities.

To this end, an international working group has been formed consisting of renowned scholars from different disciplines, all contributing at the frontier of this research field. This initiative is a collaboration between Stanford University and Stockholm Resilience Centre, made possible thanks to the Wallenberg

Foundation. The group, which includes Carl Folke and Therese Lindahl, is currently working on a research paper, soon to be submitted, where they present a conceptual framework for policy makers. The aim is that this initial model will be followed by empirical studies testing the model's predictions and used in real-world applications. For example, there is increasing demand among a range of government agencies, NGOs and other institutions for such models for making decisions on prioritisation of green infrastructure investments to create health outcomes.

Social norms as solutions

Formal institutions, like laws and international agreements and treaties, are not always able to enforce collectively desirable outcomes. In such cases, informal institutions, such as social norms, can be important. In a recently published paper in *Science* involving several Beijer researchers, the authors concluded that if certain conditions are right, policy can support social norm changes, helping address even global environmental problems such as climate change and biodiversity loss. Read more at page 22.

Reference:

Nyborg, K., J.M. Anderies, A. Dannenberg, T. Lindahl, C. Schill, M. Schlüter, W.N. Adger, K.J. Arrow, S. Barrett, S. Carpenter, F.S. Chapin III, A.-S. Crépin, G. Daily, P. Ehrlich, C. Folke, W. Jager, N. Kautsky, S.A. Levin, O.J. Madsen, S. Polasky, M. Scheffer, B. Walker, E.U. Weber, J. Wilen, A. Xepapadeas, and A. de Zeeuw. 2016. Social norms as solutions. *Science* 354:42-43.

More on human behaviour in social-ecological systems

In previous reports (including last year's), insights obtained from several behavioural laboratory and field experiments have been highlighted. This work continues; data from further laboratory and field experiments are currently being analysed, new experiments are being planned and insights from previous experiments are also being published (see list of publications below).

The first BENN PhD student, Caroline Schill, graduated in May. She defended her thesis entitled 'Human Behavior in Social-Ecological Systems: Insights from Economic Experiments and Agent-based Modelling'. Read more at page 24.

Other programme publications:

Cárdenas, J.C., M.A. Janssen, M. Ale, R. Bastakoti, A.M. Bernal, J. Chalermphol, Y. Gong, H.C. Shin, G. Shivakoti, Y. Wang, J.M. Anderies. 2017. Fragility of the provision of local public goods to private and collective risks. *Proceedings of the National Academy of Sciences USA* 114(5): 921-925.

Lindahl, T., N. Orescovic, and A.-S. Crépin. 2016. Playing safe: The role of quotas to avoid ecosystem regime shifts. In: Botelho, A. (ed). *The WSPC Reference on Natural Resources and Environmental Policy in the Era of Global Change. Volume 4: Experimental Economics*. World Scientific, London, UK. Pp. 121-150.

Schill, C. 2017. *Human Behaviour in Social-Ecological Systems: Insights from economic experiments and agent-based modelling*. Doctoral thesis in Sustainability Science. Stockholm Resilience Centre, Stockholm University.

“Nature experiences reduce stress, anxiety and rumination and improve cognitive functions and the ability to regulate emotions.”

Hikers on the Kungsleden trail, Lapland, Sweden.
Photo: Alamy Stock Photo.

Complex Systems

THE AIM OF THIS research programme is to develop economic theory and policy instruments to improve the management of social-ecological systems. By employing small-scale models that integrate multiple important aspects of the problem, we explore the essential links, feedbacks and thresholds in complex systems, as well as their implications for resource management strategies. Where data is available, we also conduct empirical analyses to guide resource management.



Photo: Ivan Kmit / Alamy Stock Photo.

The economics of tipping points

A special issue on “The economics of tipping points”, guest-edited by Aart de Zeeuw and Chuan-Zhong Li, was published in the journal *Environmental and Resource Economics* in November 2016. The selected papers originate from a 2014 workshop organised by the Beijer Institute. The aim of the workshop was to take stock of current research trends on the economic aspects of regime shifts. The introduction is available in open access. It provides background on the research area, defining some of the important concepts, and gives a brief summary of the seven accepted papers. Beijer researchers contributed four articles to this issue. Two of these contributions deal with the implications

of climate tipping points for the economy. In particular, Van der Ploeg and de Zeeuw provide evidence of the importance of cooperation between North and South when designing carbon taxes in different countries. Engström and Gars meanwhile focus on the effect of the limited availability of fossil fuels and show that a higher carbon tax to reduce the risk of climate tipping does not necessarily mean that people will use fossil fuels less. Li, Villasante

and Zhu study tipping points in hake fishery in Argentina. They quantify fishery values in the cases of tipping risk, no tipping risk and ignoring the tipping risk. They determine appropriate tax rates and show how the tax rate should respond to particularly low fish stocks to take account of the potential regime shift in the fishery. Lindahl, Crépin and Schill perform an experiment to investigate whether or not groups of people adapt their resource management to the possibility of a tipping point. They show that the threat of tipping triggers more communication within the group, generating commitment to cooperation and knowledge sharing about resource dynamics, and thus leading to a better performance.

Programme directors:
Chuan-Zhong Li and Aart de Zeeuw

Other contributions deal with the implications of climate tipping points for the economy, focusing on feedbacks between climate damage to forests and the loss of forests, which in turn increases the effects of climate change; the politics of climate policy; and methods development to study problems of this kind.

Reference:
De Zeeuw, A.D., and C.Z. Li. 2016. The economics of tipping points. *Environmental and Resource Economics* 65:513-517.

Poverty traps

Poverty traps are an important concept in the literature on poverty alleviation, referring to a self-reinforcing mechanism that causes the persistence of poverty. Many factors can contribute to this, for example a lack of credit or access to markets, environmental degradation etc. Research and policy studies have mostly focused on one-dimensional interventions, such as financial or technological inputs, that have had some success, but unexpected failures have also been observed with serious ecological and social consequences that have reinforced poverty. In an article in the journal *Science Advances*, Gustav Engström and his colleagues at Stockholm Resilience Centre have developed poverty trap models that incorporate dimensions such as nature and cultural aspects. They show that policies that ignore these aspects can reinforce poverty. Read more about this on page 23.

Reference:
Lade, S.J., L.J. Haider, G. Engström, and M. Schlüter. 2017. Resilience offers escape from trapped thinking on poverty alleviation. *Science Advances* 3(5):e1603043.

Aurora Photos/Alamy Stock Photo.

Regime shifts and resilience

In their paper ‘Managing a renewable resource facing the risk of a regime shift in the ecological system’, Aart de Zeeuw and Xiaoli He have developed an optimal management model for renewable resources when there is a risk of a regime shift. Their results indicate that careful harvesting is recommended if the risk of a regime shift increases with a low stock size. However, this result is context-dependent and they identify situations in which it would be better to harvest more instead.

Reference:
de Zeeuw, A., and He, X. (2017), Managing a renewable resource facing the risk of a regime shift in the ecological system. *Resource and Energy Economics* 48, 42-54.

Developing empirically based theory

While complex systems research at the Beijer Institute has traditionally been geared towards theories and models, some research projects have aimed to test the models using empirical data or to gather data to build new empirically based theory. Experimental methods in particular have been used extensively to gather data on resource users’ behaviour in complex systems. More details on this work are available under the BENN programme, page 12-13. Mäler scholars Claudia Aravena and Herbert Ntuli have both been part of this

Other References:
Grass, D., Xepapadeas, A., and A. de Zeeuw. Optimal management of ecosystem services with pollution traps: The lake model revisited. *Journal of the Association of Environmental and Resource Economists*. In press.

Wei, C., and C.Z. Li. Resource misallocation in Chinese manufacturing enterprises: evidence from firm-level data. *Journal of Cleaner Production*. In press.

Li, C.Z., Villasante, S., and X. Zhu. 2016. Regime shifts and resilience in fisheries management: a case study of the Argentinean hake fishery. *Environmental and Resource Economics* 65, (3), 623-637.

empirical endeavour in collaboration with Anne-Sophie Crépin. Aravena and Crépin are working on a review of empirical methods to value the impacts of regime shifts, while Herbert Ntuli spent the spring at the Institute developing an experimental design to study the potential impact of management and human behaviour on the collapse of wildlife populations in Zimbabwe. He has been collecting data which will be analysed with Crépin upon his return to the Beijer Institute in the autumn.

Urban Social-Ecological Systems

BY 2050, the world’s urban population is expected to have reached 6 billion. This would entail an areal expansion equivalent to the whole of Spain, Germany and France put together. How these urban areas are built and managed will impact greatly on climate change and biodiversity. This programme analyses cities as truly integrated social-ecological systems, with research geared at providing a deeper understanding of the interplay between ecological systems and the social and economic development both within and outside cities. The programme aim is to conduct research on urban sustainability that provides fundamental theoretical insights and solutions to applied problems. Particular focus is on how the physical patterns, layouts and structures, collectively called urban form, together with institutions and the urban discourse, influence the generation and maintenance of ecosystem services. By formulating principles and applications that are useful for policy makers and practitioners, with the goal of strengthening resilience and the capacity to sustain human welfare, the insights of this research programme are intended to be applied and adopted in both national and international urban governance and management.

Strengthened collaborations

Active steps have been taken to strengthen the programme’s collaborations with public society actors and with an academically strong international research network. This is reflected e.g. in the building of closer links to the Future Earth research initiative at the Royal Swedish Academy of Sciences, and the GRAID and EAT programmes at Stockholm Resilience Centre (SRC). Links with Stockholm University (SU) have also been strengthened through participation in the Research Area-7 of the Bert Bolin Centre. It is devoted to research around multi-scale processes of climate, biodiversity, ecosystem services and adaptive governance across landscapes. A research proposal for Research Area-7 was submitted in May, focusing on

how to build more climate-smart cities by providing bee-friendly human habitats. Other links to SU are the engagement with the new Campus Albano and the new grant provided by Stockholm County Council for analysing compact city developments in a global and local context. The grant is directly linked to SU and will potentially involve SU Master’s students (read more below). An initiative for closer collaboration within the Beijer Institute’s BENN programme has also been taken, examining to what extent it is possible to use nudging to make the urban form better in reconnecting people to nature and producing ecosystem services.

“Today, city densification in all its forms is taken for granted as an environmentally friendly approach.”

How smart are smart cities?

Of particular interest has been the monitoring and examination of the Smart City framework – an urban development concept to integrate information and communication technology and the so-called Internet of Things (IoT) technology to manage and control the many services and responsibilities of cities. The Smart City framework is by far the fastest growing in the current urban sustainability literature. In an upcoming review, this framework is analysed through a social-ecological resilience lens. The literature reviewed to date proposes the idea of environmental modernisation, a paradigm placing particular emphasis on enhancing economic and social sustainability through modern technology. However, there is hardly any emphasis on ecological sustainability in the literature, nor does it

Programme director: Johan Colding

include the role of ecosystem services for improving urban resilience.

Project members:
Stephan Barthel, SRC and Johan Colding, the Beijer Institute and SRC.

New grant to examine the concept of city compaction

It is often proposed that new urban developments should be concentrated in already urbanised environments through infilling and densification. This is the basic premise behind Smart Growth – an approach that strives for compact, walkable, bicycle-friendly land use, with development concentrated along the transit lines of trains, buses etc. (transit-oriented development). Today, city densification in all its forms is taken for granted as an environmentally friendly approach based on the notion that Smart Growth designs reduce greenhouse gas emissions. However, many scientists have recently questioned this notion.

The Beijer Institute has been granted 1.5 million SEK from Stockholm University and Stockholm County Council for a 3-year research project with the aim of increasing understanding of the environmental pros and cons of city compaction, focusing on the Stockholm region. The project aims to critically review arguments for city compaction in the academic literature; build knowledge concerning the kind of land used for compaction in the Stockholm region; and investigate, together with architecture researchers, how compaction can be designed to better promote biodiversity and ecosystem services.

Project members:
Johan Colding, the Beijer Institute and SRC and Åsa Gren, the Beijer Institute.



Densely built neighbourhood under construction on the site of a former gasworks in Stockholm. A new Beijer Institute project will examine the pros and cons of city densification. Photo: Agneta Sundin.

The Live Baltic Campus project

The Live Baltic Campus project is aimed at developing campuses as innovation hubs in the Baltic region by novel urban design and participatory planning. During the year, three inspiring and successful Live Baltic Campus Partner Meetings and Livable City Forums have been held in Uppsala (Sweden), Tartu (Estonia) and Riga (Latvia). These meetings included seminars and research exchanges among urban scholars and practitioners, city mayors, university rectors, city governments and city architects. Several scientific reports have been produced within the project, with

further upcoming scientific journal articles in preparation. The last meeting is planned to take place at SRC in Stockholm in December 2017, to which leading university leaders, urban practitioners and researchers will be invited.

The pioneering work with the development and design of the new Albano Campus in Stockholm is proceeding well. The student and researcher accommodation and the university buildings are expected to be ready by 2018 and 2019, respectively. The Urban Social-Ecological Systems programme has been contributing to this project since the start. Programme researchers are

members of the Albano Campus Reference Group, which has held several meetings on the detailed construction design and architectural shape of buildings and spaces between buildings. The ambitious social-ecological design that will brand the campus as a world-leading sustainable university campus seems well on the way to becoming a reality.

Project members:
Stephan Barthel, SRC and Johan Colding, the Beijer Institute and SRC.

Global Dynamics and Resilience

HUMAN activities are rapidly changing the entire planet, creating serious, interlinked problems such as climate change, ocean acidification, declining fisheries, antibiotic resistance and recurring energy, food and water crises. These types of problems could intensify and interact in the future to create massive shocks to ecosystems and societies. If so, the impacts on human welfare world-wide would be substantial. Today, these problems are often addressed separately by individual countries or authorities. With this programme, we aim to better understand the global social-ecological system as a whole by investigating the likelihood and consequences of multiple shocks that interact, and how society responds to shocks. We are also looking for solutions and analysing different policy options and other initiatives that can improve the odds of good outcomes.

Including critical earth processes in economic policies

The planetary boundaries framework has been identified as a new paradigm for thinking about human interaction with the planet. This framework identifies nine global environmental processes that govern and sustain human life on Earth and highlights the biophysical linkages between these processes. Apart from biophysical linkages, many of the processes are also strongly interconnected through economic markets and public policies. Consequently, efforts to avoid transgressing one boundary may, through economic interaction, either contribute to or steer away from transgressing another boundary.

On 1-2 September, with funding support from the Ragnar Söderberg Foundation, the programme hosted a small workshop entitled 'The economics of planetary boundaries'. The goal was to discuss the economic linkages between policies and to try to determine the extent to which policies might potentially conflict with each other. Since then, the group has been working on a joint developing a stylised model, featuring key economic sectors identified

as drivers of planetary boundary processes. This framework allows simple policy questions to be asked, such as whether a sufficiently large global carbon tax would help us stay within the planetary boundaries or whether supplementary policies for other boundaries would also be needed.

“A global carbon policy would need to be accompanied by land use policies specifically targeted at agriculture.”

The analysis so far suggests that, although a global carbon tax could help reduce pressure on the climate, ocean acidification, biogeochemical and freshwater boundaries, it would also raise the demand for agricultural land. Therefore, in order to avoid increasing the pressure on land use (also a key driver of biodiversity loss), a global carbon policy would need to be accompanied by

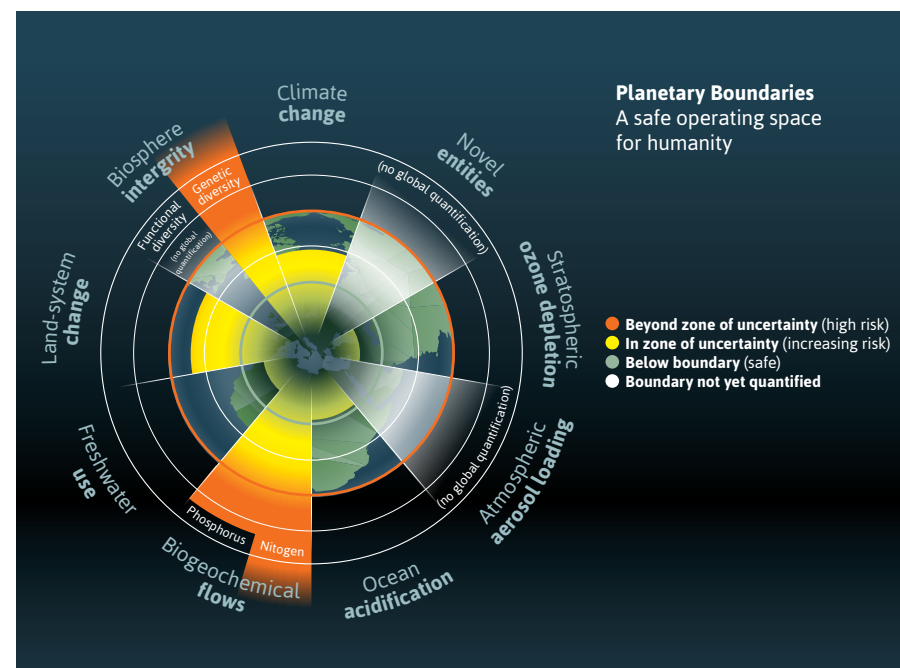
land use policies specifically targeted at agriculture. However, the analysis also suggests that such a two-tier policy will result in higher food prices, which could worsen world hunger problems and increase the pressure on global fisheries.

Project members:

Gustav Engström and Chandra Kiran, the Beijer Institute, Johan Gars, GEDB, with Raphael Calel, Georgetown University, Therese Lindahl, the Beijer Institute and Daniel Spiro, Uppsala University.

Policies to stay within the Planetary Boundaries

Another project based on the planetary boundaries concept, developed by a research group including Carl Folke and colleagues from Stockholm Resilience Centre (SRC), was initiated during the year. Anne-Sophie Crépin, Johan Rockström, SRC, and Thomas Sterner Gothenburg University, started a collaboration to analyse how institutions and policies can be designed to ensure that we stay within the planetary boundaries. A workshop was organised in Gothenburg, December 2016, convening a group of 25 scientists with



Programme director: Anne-Sophie Crépin



Lunch break discussions at the Askö meeting. Photo: Brian Walker.

backgrounds in economics, political science, earth system science and other natural sciences, including several Beijer researchers and Beijer Fellows. The aim was to write an overview article on the topic. The resulting manuscript has now been submitted as a Policy Forum contribution to the journal *Science*.

Rural to urban migration and forest cover

During the year, PhD candidate Daniel Ospina continued his thesis work under the supervision of Anne-Sophie Crépin and Garry Peterson, SRC. The purpose of this work is to build a systematic understanding of the effects of migration from countryside to cities on rural landscapes. The mechanisms through which migration and the remittances that migrants send home may lead to the

abandonment of farmland and forest regrowth are being investigated. An existing model of social-ecological regime shifts focusing on farmland abandonment is being extended by introducing remittances. Remittances can be used in different ways, e.g. for household consumption or for hiring more agricultural labour. This has implications for the theory of forest transitions, which proposes that urbanisation generally leads to forest regrowth.

In parallel, Daniel Ospina is reviewing literature from different disciplines on the effects of rural out-migration on agricultural practices and land use. Based on that review, he will construct an agent-based model to be used as a 'virtual laboratory' for investigating the conditions under which the processes identified can lead to forest regrowth.



Participants at the Gothenburg workshop, December 2016, initiating a collaboration to analyse how institutions and policies can be designed to ensure that we stay within the planetary boundaries.

The Global Economic Dynamics and the Biosphere programme (GEDB)

Global Economic Dynamics and the Biosphere (GEDB) is a five-year research programme at the Royal Swedish Academy of Sciences, that was initiated as a spin-off of early activities in the Global Dynamics and Resilience programme. In 2016-2017, GEDB continued to publish ground-breaking research, with more than 30 peer-reviewed articles, many in high-ranking journals.

Several reviews and syntheses developed by GEDB (alone or in collaboration) include work that demonstrates the significance of a healthy biosphere for human wellbeing, which has major implications for practice and policy.

There has also been collaborative work combining the challenges of sustainable food systems, human health and biosphere stewardship, issues that have previously not been well integrated in academia or in the policy sector. The majority of this work has involved new forms of knowledge interaction and often also collaboration with practice, policy and business.

Other activities

Following up on the EU's 7th framework project Arctic Climate Change, Economy and Society, a special issue of the journal *AMBIO* is under preparation. It will cover topics related to the impacts of Arctic climate change on the global economy and society. The special issue is expected for publication at the end of 2017. Anne-Sophie Crépin is a member of the editorial board, together with Oran Young, University of California Santa Barbara, Jean-Claude Gascard, Université Pierre et Marie Curie, and Michael Karcher, Alfred-Wegener-Institut and O.A.Sys Ocean Atmosphere Systems GmbH. Several Beijer researchers have contributed manuscripts to this special issue.

The theme of the Askö meeting in 2016 was *Human population and the global commons*. Partha Dasgupta and Scott Barrett led the discussions. These addressed global population growth and its associated challenges on a planet with limited resources, in particular the issue of overconsumption in some parts of the world contrasting with poverty and high population growth in other parts.

Guiding coral reef futures

The 2016 coral bleaching event that destroyed vast tracts of valuable coral reefs, due to El Niño and climate change, was the most widespread in recorded history. Many are now asking how much more warming, in combination with overfishing, pollution and other human pressures, the world's coral reefs can endure. The current state of knowledge was, for the first time ever, synthesised at global level in an article published in *Frontiers in Ecology and the Environment* by Carl Folke and PhD student Jean-Baptiste Jouffray, together with colleagues at Stockholm Resilience Centre (SRC) and from the UK, USA and Australia.

Safe operating spaces

“Ensuring that reefs and the many benefits they provide to human societies endure will require fishing, water quality and climate change to stay within acceptable levels or ‘safe operating spaces’”, says lead author Albert Norström, SRC.

Defining these safe levels is challenging because coral reefs in different parts of the world will respond differently to human pressures. There is also a lack of data and research on how much reef organisms will be able to adapt to change.

“The values we provide should be regarded as guidelines, which will become more accurate with further studies and greater understanding”, Norström says.

The concept follows the precautionary principle, with the aim of confining human pressures far enough away from really dangerous levels, or thresholds, that might trigger abrupt and permanent degradation. The team of scientists chose this approach because, despite the importance of thresholds and recent advances in predicting them, they are extremely hard to generalise globally.

The authors hope that a better understanding of safe operating spaces might help bring issues of coral reef sustainability to the international negotiating table. This is important because they believe that local management efforts alone will not be able to keep pace with the escalating pace of social,

technological and ecological changes that challenge these safe operating spaces.

“Conventional approaches like marine protected areas can offer local socio-economic and ecological benefits, but are usually far too narrow in scope and small in scale, and often suffer from weak compliance and enforcement”, explains Magnus Nyström, SRC.

New kind of management

Coral reef management is, however, slowly shifting toward more holistic strategies that are collaborative and adaptive and target both social and ecological interactions on larger scales. This is crucial, as coral reefs are increasingly challenged by global drivers of change, such as trade, human migration and land use change.

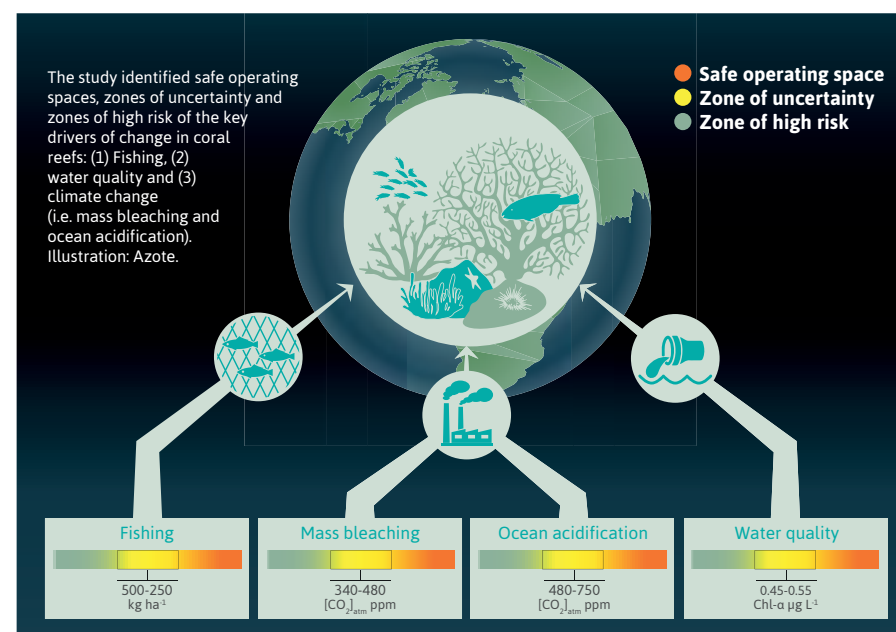
On a more optimistic note, the study concludes that the socio-economic and environmental issues facing reefs and other marine ecosystems are finally receiving similar attention to those affecting land ecosystems. For instance, Goal

14 of the newly adopted United Nations Sustainable Development Goals encompasses ten targets for the world's oceans. This recent global attention is crucial, as reefs are no longer suffering solely from the impacts of overfishing and coastal pollution, which can be managed successfully at local scales.

Social-ecological approach

To keep human drivers of change within safe operating spaces, coral reef scientists should engage more in research with a social-ecological approach and not concentrate on local and regional scales. More research in the field must be devoted to understanding social and ecological interactions across scales, from local to global, and transferring this knowledge to key policy arenas.

“Coral reef scientists around the world should engage more with the international policy arena to work toward sharp reductions in greenhouse gas emissions and implementation of the Sustainable Development Goals”, concludes Jean-Baptiste Jouffray.



Reference:

Norström, A., M. Nyström, J-B. Jouffray, C. Folke, N. Graham, F. Moberg, P. Olsson and G. Williams. 2016. Guiding coral reef futures in the Anthropocene. *Frontiers in Ecology and the Environment* 14(9):490–498.

Shocks to fish production

In recent decades, there have been numerous shocks to food systems, such as the 1990s collapse of the Newfoundland cod fishery and the grain crisis in 2008, to name a few.

Looking back on these and other events that have been disruptive to capture fisheries and aquaculture worldwide has value in both understanding and learning what to do in the event of a shock. While many cases have been studied in detail, few analyses have taken a more generalised, data-driven approach to detect and understand why shocks to food systems have occurred. Even fewer quantitative studies have attempted to understand shocks to fisheries production around the world.

However, in a paper published in *Global Environmental Change*, a team of researchers, including Beijer Institute researcher Max Troell, applied a data-driven approach to understanding global fisheries and shocks they endured between 1976–2011.

Differences across the globe

To examine shocks that occurred in global fisheries, Troell and colleagues looked at seafood production in 127 countries between 1976 and 2011, using FAO statistics. They characterised seafood production in two different systems, aquaculture and capture fisheries, and examined different types of shocks, such as political, natural disaster, diseases, overfishing etc.

In the 35-year study period, the analysis revealed a total of 48 seafood production shocks worldwide. The study showed that the rate of shocks to seafood production systems was highest in the Caribbean and Central America, followed by Africa, Asia and Europe. In other words, the Caribbean and Central America experience shocks more often than the other regions.

However, while they experience the most shocks, the Caribbean, Central America and also Africa tend to recover rapidly, whereas a seafood production shock in Asia or Europe tends to be greater.

Political factors also tend to be a very common trigger for seafood production shocks.

“Overfishing, political changes and many other shocks have repeated themselves in history, and there is value in generalising and learning from past mistakes.”

On comparing seafood production shocks in capture and aquaculture fisheries, the researchers found that both experience the same magnitude and recovery time when it comes to production shocks, but the shock rates in aquaculture have been higher from 1980 onwards.

“While the cause of this difference is unknown, aquaculture is vulnerable to

shocks from disease outbreaks and possibly also from rapid growth over-shooting environmental carrying capacity”, explains Max Troell.

The study also detected three different coping mechanisms used by affected countries, and analysed when these different mechanisms are applied.

Learning from history

Understanding sustainable fishery production levels helps to define sustainable fishing quotas, and in turn avoid stressing the system into a seafood production shock.

Overfishing, political changes and many other shocks have repeated themselves in history, and there is value in generalising and learning from past mistakes. As lead author Jessica Gephart concludes, “The capacity of countries and communities to respond and adapt to shocks to seafood production speaks to their resilience. Learning from historical examples of shock causes, impacts and responses provides opportunities to build resilience.”

Reference:

Gephart, J.A., L. Deutsch, M.L. Pace, M. Troell and D.A. Seekell. 2017. Shocks to fish production: Identification, trends, and consequences. *Global Environmental Change* 42:24–32.



Farmed tilapia. Photo: Morley Read / Alamy Stock Photo.

Tipping from vicious to virtuous

Group behaviour in societies tends to change slowly, sometimes over many generations, even when our habits are killing us. If your friends, family and colleagues smoke, the chances of you smoking too are higher.

In the journal *Science*, a team of economists, psychologists and ecologists analysed unexpected and rapid changes in social norms that buck this trend. These include rapid changes in average family size, smoking indoors, foot binding in China and littering the streets. Unravelling the causes of such tipping points might help find solutions for some of the world's greatest challenges, for example climate change, biodiversity loss and gender inequality.

Lead author and chair of the Beijer board, Karine Nyborg from the University of Oslo, says, "Humans are social animals and we have good reason to co-ordinate our behaviour with others. But social norms can create both vicious and virtuous cycles."

Tipping points in behaviour

The interdisciplinary group of authors who met at the annual Askö meeting 2015, organised by the Beijer Institute, applied the concept of tipping points to how groups conform to one behaviour, then shift rapidly to a new norm.

"Indoor smoking and foot binding are examples of vicious cycles. If everyone prefers to behave like others,

for social, economic, political or practical reasons, our expectations can be self-fulfilling and the result can be harmful to society as a whole. Virtuous cycles behave in the same way, promoting good habits and healthy lifestyles", says co-author Therese Lindahl, Beijer Institute economist.

When more voters are cyclists, there is more political pressure to extend networks of cycle paths: the virtuous cycle is literally reinforced!

Behaving like most others

Anti-smoking laws in Norway, Sweden, the UK and elsewhere helped trigger a change in social norms almost overnight, say the authors. Although formal enforcement was limited, smokers began expecting social sanctions and started to go outside to smoke, even in unregulated areas like private homes.

"Very soon smoking indoors became a social taboo", says Nyborg. If the smoking ban were removed, the new norm would in all likelihood remain. However, the paper points out that Greece's smoking ban, introduced in 2010, failed, possibly due to people's low expectations that the new rules would affect social disapproval of indoor smoking.

"Vicious and virtuous cycles arise when, taking all factors into account, individuals tend to want to behave like most others", the authors say.

"Vicious cycles can be stable and

hard to break", says Karine Nyborg. "However, the good thing about them is that they can sometimes be turned into virtuous cycles, which can also be very stable."

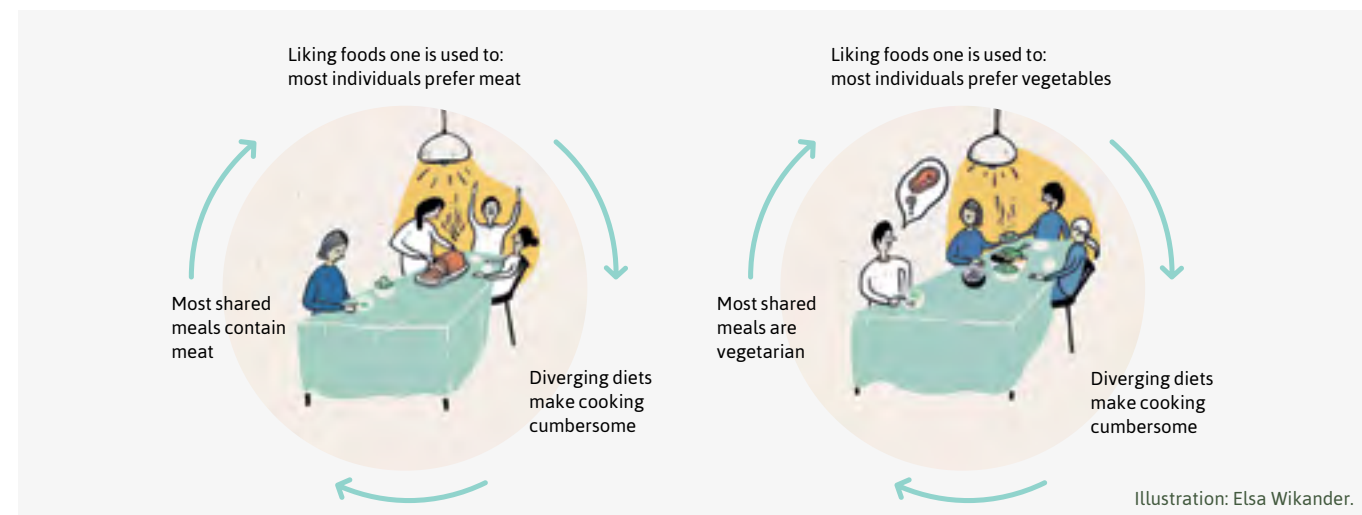
Changing expectations about others

If a behaviour is easy for neighbours, friends, family and colleagues to observe, social approval and disapproval can sustain socially beneficial behaviours. The paper uses kerbside recycling as an example. However, harmful pollutants such as carbon dioxide, whether from individuals or from companies, are largely invisible. Similarly, it is difficult to know whether others are misusing antibiotics. If behaviour is out of sight, it is less likely to be affected by social approval and disapproval.

"A potentially powerful role of policy is to provide reasons for people to change their expectations about the behaviour of others", the authors conclude.

Reference:

Nyborg, K., J.M. Anderies, A. Dannenberg, T. Lindahl, C. Schill, M. Schlüter, W.N. Adger, K.J. Arrow, S. Barrett, S. Carpenter, F.S. Chapin III, A.-S. Crépin, G. Daily, P. Ehrlich, C. Folke, W. Jäger, N. Kautsky, S. A. Levin, O. J. Madsen, S. Polasky, M. Scheffer, B. Walker, E.U. Weber, J. Wilen, A. Xepapadeas and A. de Zeeuw 2016. Social norms as solutions. *Science* 354 (6308):42-43.



Breaking the cycle of poverty

Development aid has reached a new peak of 142.6 billion USD, according to recent data from the OECD. A study in the journal *Science Advances* calls into question a cornerstone of development aid: the "poverty trap" and the associated "Big Push" solution whereby aid agencies inject cash, for example for seeds, fertilisers and machinery, into rural economies caught in a vicious cycle of underdevelopment (the poverty trap). In theory, this is intended to push these economies "over the barrier" to become better functioning economies. However, this solution has long been criticised for leading to more persistent poverty in some places, because culture and nature are ignored. The study provides a way to extend poverty-trap thinking to include more fully the links between financial wellbeing, nature and culture.

Limits to current strategies

With 78% of the world's poorest people living in rural areas, development aid is often targeted at quick-fix financial and technological farming solutions. Development agencies often encourage farmers to grow single cash crops, or monocultures, such as genetically modified cotton in India, that they can sell to rise out of poverty – with mixed results. While successful in many places, it can lead to deforestation or nitrogen and phosphorus pollution, to name but a few environmental consequences. In some instances, it has created a cycle of poverty where 'improved' seed varieties fail, due to neglect of local environmental conditions and culture, leaving the land in a worse condition than before and with valuable local knowledge being lost – reinforcing the poverty trap.

Adding a third strategy

The team's new approach classifies three types of solutions to alleviate poverty. The first is the standard Big Push 'over the barrier'. The second is to 'lower the barrier', which can include training farmers to change their behaviour and practices. These two categories form the backbone of current aid strategies.



Farmers' group in Uganda organised by an aid organisation learning to make organic compost. Photo: Sean Sprague.

However, the researchers introduce a third classification they call 'transform the system'.

The classification is fundamentally about rethinking the intervention strategy, for example by encouraging farmers to devote a portion of their intensively farmed land to local crops, grown using traditional practices, to maintain resilient seed varieties.

"If poverty in an area is causing environmental degradation, then maybe a Big Push will work. But if the land has been managed sustainably for generations, then development agencies need an approach which takes that knowledge into consideration", says co-lead author Jamila Haider, Stockholm Resilience Centre.

This seems obvious, but intervention strategies can become blinded by powerful yet simplistic economic models, according to Jamila Haider. The study shows how development interventions need to vary based on different relationships between poverty and the environment.

Transformation built on successful practices

The models in the study could be used in development planning to make explicit available knowledge and assumptions of different cases. Rather than increasing production through inputs of physical capital, the transformation delivers increased production due to increases in natural capital and cultural capital.

"This is an alternative approach to analysing investments for intervention. Where risks are high that conventional aid will fail, it provides options to explore and implement alternative strategies that focus on transformation built on historically successful cultural practices to manage the local ecology", the authors conclude.

Reference:

Lade, S.J., L.J. Haider, G. Engström and M. Schlüter. 2017. Resilience offers escape from trapped thinking on poverty alleviation. *Science Advances* 3(5):e1603043.

Our first doctor of sustainability science

CAROLINE SCHILL successfully defended her PhD thesis, *Human Behaviour in Social-Ecological Systems: Insights from Economic Experiments and Agent-based Modelling*, on 17 May 2017. Caroline started at the Beijer Institute as a research assistant within the BENN programme in 2011 and in 2012 went on to pursue a PhD in Sustainability Science jointly at Stockholm Resilience Centre (SRC), Stockholm University.

Progress towards sustainability requires changes in individual and collective behaviour. Yet fundamental understanding of behaviour in relation to environmental change and its inherent uncertainties remains severely limited. With her thesis, Caroline wanted to advance understanding of human behaviour in social-ecological systems. In particular, her thesis examines factors and mechanisms that are critical for the sustainability of common-pool resources and provides one of the first accounts of human behaviour and collective action in relation to ecological regime shifts.

Caroline's main supervisor was Therese Lindahl, with whom she worked closely within the BENN programme for three of her thesis articles. Her three co-supervisors were also from the Beijer Institute, which she describes as "a vibrant and inspiring academic environment and a workplace made for humans". She also points out Beijer's unique network.

"It is such a privilege to have access to these world-leading experts, already as a PhD student. And the connection to SRC, its researchers and especially also its diverse group of PhD students was also something from which I benefited immensely."

With an MSc in Management from University of Mannheim in her native Germany and an MSc in Ecosystems, Resilience and Governance from SRC, Caroline is one of the first generation of interdisciplinary sustainability science PhD candidates at SRC. The reflections of Caroline and her fellow PhD students on this resulted in an article in the journal *Sustainability Science*.

"It has its pros and cons to be part of this first generation", Caroline explains. "The academic world is dominated by established disciplines which made it challenging for me to find my identity as a scholar at first. But interdisciplinary science is where my heart is and I strongly believe that it is needed to address the sustainability challenges of our time, we cannot just look through one single lens. And it forces me to continuously challenge my assumptions and formulate my thoughts distinctly."

Following the interdisciplinary route, in the future Caroline wants to continue studying human behaviour in relation to escalating environmental change with all its complexities and uncertainties, and combining behavioural experiments and agent-based modelling, as she did in her thesis, but also trying out new ways and combinations of approaches.

When asked about the highlights of her PhD period, she



Caroline Schill with her defence committee and opponent. From left: Maricela De La Torre Castro, Emily Boyd, Juan Camilo Cárdenas and Fredrik Carlsson.

mentions some diverse experiences:

"The fieldwork I did in Colombia was certainly a highlight. After conducting hundreds of lab experiments in Stockholm, taking the experiments to the field made me reflect on the methods and questions in completely different ways."

Caroline also mentions being part of the Askö meeting on social norms, leading to a publication in *Science* (see page 22), and of BENN workshops with leading experts in her field. "Those meetings provided me with so much inspiration and insights", she says.

Finally, Caroline points to the thesis defence itself:

"I felt so honoured that Juan Camilo Cárdenas came all the way from Colombia to act as my opponent and how he, as well as the other committee members, engaged with my work and discussed it with me. I was told before: 'try to enjoy this special moment' and I managed to do that".

Main supervisor: Therese Lindahl, the Beijer Institute. Co-supervisors: Johan Colding, Anne-Sophie Crépin and Opponent: Juan Camilo Cárdenas, Department of Economics, Universidad de los Andes, Bogotá, Colombia. Committee: Emily Boyd, LUCSUS, Lund University, Sweden; Fredrik Carlsson, Department of Economics, Gothenburg University, Sweden; and Maricela De La Torre Castro, Department of Physical Geography, Stockholm University.

Reference: Schill, C. 2017. *Human Behaviour in Social-Ecological Systems: Insights from economic experiments and agent-based modelling*. Doctoral thesis in Sustainability Science. Stockholm Resilience Centre, Stockholm University.

The Beijer Young Scholars

A NEW BEIJER Young Scholars Programme was initially established in 2012 with the aim of creating an international network of young researchers and stimulating the emergence of new research pathways and modes of cooperation across disciplines to address the global challenges facing humanity. The second workshop with the second generation of Beijer Young Scholars was held from 29 May to 2 June 2017 at the Royal Swedish Academy of Sciences and on the island of Ekskäret in the Stockholm Archipelago.

After their first gathering last year, the group accepted an invitation from the journal *Annual Review of Environment and Resources* to submit a paper on 'Inequality and the Biosphere', a subject they had been exploring together. Over the course of the year, three working groups have developed a database of case studies, a literature review and figures for the study.

The Beijer Young Scholars also organised a session based on the study for the conference Resilience 2017, which took place in Stockholm in August, and the abstract for the session also describes the content of the upcoming article, which is due for submission in January 2018:

"To ensure everyone on the planet enjoys a good quality of life and prosperity, we need to understand the links and feedbacks between the biosphere and human wellbeing. A major factor increasingly shaping these feedbacks in the Anthropocene is inequality. In this session we explore the role of inequality in the interplay between ecological systems and socioeconomic development by considering various dimensions of inequality, including disparities in income, risk exposure and access to natural resources.

We examine the effect of biosphere changes on inequality and the impact of inequality on the biosphere and its stewardship."

Fortunately, all 18 post-docs, young faculty members (within five years of completing their PhD) and advanced PhD students who make up the Beijer Young Scholars group were able to attend this year's meeting too. They come from Europe, North and South America and Asia with backgrounds in economics, ecology, political science, sustainability science and related disciplines.

Beijer Fellow Marty Anderies along with Anne-Sophie Crépin and Carl Folke were present to provide advice.

The Beijer Institute is supporting this generation of Beijer Young Scholars for a total of three years and there are plans to hold one further workshop in Stockholm. We are very grateful to the Anna-Greta and Holger Crafoord Foundation for its financial support of this year's workshop.



Photo: the Beijer Institute.

Beijer Young Scholars Workshop 2017

Back row: Kevin Berry, University of Alaska; Alon Shepon, Weizmann Institute of Science; Juan-Carlos Rocha, the Beijer Institute; Andrew Tilman, Princeton University; Tom Chaigneau, University of Exeter; Amir Jina, University of Chicago; Robert Heilmayer, University of California, Santa Barbara; Patrik Henriksson, Beijer Institute; Matias Piaggio, Environment and Development Center for Central America, and University of the Republic, Uruguay

Middle row: Tong Wu, Arizona State University; Emmi Nieminen, University of Helsinki; Emelie Lindqvist, SRC; Inge van den Bijgaart, University of Gothenburg; Caroline Schill, Beijer Institute; Maike Hamann, Stellenbosch University; Agneta Sundin, Beijer Institute

Front row: Marty Anderies, Arizona State University; Yolanda Lopez, University of Munich; Carl Folke, the Beijer Institute; Tracie Curry, University of Alaska Fairbanks; Jiangxiao Qiu, University of Florida; Jonas Hentati Sundberg, Swedish University of Agricultural Sciences.

SeaBOS - Seafood Business for Ocean Stewardship

In a scientific paper published in 2015, Henrik Österblom, Stockholm Resilience Centre (SRC), Jean-Baptiste Jouffray, Carl Folke and colleagues from the Beijer Institute and SRC identified thirteen corporations in the seafood industry that dominate global production revenues and volumes, control globally relevant segments of production, connect ecosystems globally through subsidiaries, and influence global governance processes and institutions. They operate as 'keystone actors' on the planet, with a unique ability to influence change and take on a leadership role in ocean stewardship.

Since then, the scientific discovery of 'keystone actors' in marine ecosystems has moved on to a collaborative process that, for the first time, connects wild capture fisheries to aquaculture businesses, European and North American companies to Asian companies and the global seafood business to science. Two dialogues have been held, with several interactions in between, and a new initiative for sustainable ocean stewardship has been developed.

The first keystone dialogue, the Soneva Dialogue *Transformative Risks and Opportunities for the Global Seafood Industry*, was generously hosted by the Soneva Fushi resort in the Maldives in November 2016. HRH Crown Princess Victoria of Sweden acted as patron for the dialogue and eight of the keystone actors participated, together with a group of researchers including Carl Folke and Jean-Baptiste Jouffray, who were part of the organising team. A new unique global ocean initiative emerged out of this dialogue: *SeaBOS* - Seafood Business for Ocean Stewardship, with the ambition to

lead a global transformation towards sustainable and healthy oceans. A joint statement signed by the keystone actors was produced.

In the statement, the seafood companies commit to improving transparency and traceability and reducing illegal, unreported and unregulated fishing in their supply chains. Antibiotic use in aquaculture, greenhouse gas emissions and plastic pollution will also be high priorities. They also commit to eliminating any products in their supply chains that may have been obtained through modern slavery, including forced, bonded and child labour.

“synergy between world-class research and societal impact”

The second keystone dialogue, the Stockholm Dialogue *Advancing the Seafood Business for Ocean Stewardship Initiative*, was hosted at the Royal Swedish Academy of Sciences by the Beijer Institute, the Global Economic Dynamics and the Biosphere programme (GEDB) and SRC in May 2017. Two additional keystone actor companies took part. HRH Crown Princess Victoria of Sweden and Sweden's deputy prime minister Isabella Lövin participated actively and action was agreed upon.



HRH Crown Princess Victoria of Sweden and dialogue facilitator Lisen Schultz, flanked by participants in the second keystone dialogue in Stockholm, May 2017.



HRH Crown Princess Victoria addressing fellow participants in the first keystone dialogue in the Maldives, November 2016.

SeaBOS currently includes the two largest seafood companies by revenue, Maruha Nichiro and Nippon Suisan Kaisha; two of the largest tuna specialists, Thai Union Group and Dongwon Industries; the two largest companies manufacturing feeds for aquaculture, Nutreco (parent company of Skretting) and Cargill Aqua Nutrition; the two largest farmed salmon companies, Marine Harvest and Cermaq (subsidiary of Mitsubishi); and, recently, the Japanese tuna purse seine company Kyokuyo and the agro-industrial conglomerate CP Foods.

During the UN Oceans conference in New York in early June 2017, Henrik Österblom and Knut Nesse, CEO of Nutreco, a global leader in animal nutrition and aquafeed, presented the SeaBOS initiative. Accompanied by HRH Princess Victoria, who is advocate for the UN Sustainable Development Goals, and deputy prime minister Lövin, they presented a statement that called for action to protect our oceans.

The keystone actors' science and business collaboration received the Sweden Impact Award 2017 in the category

Social Sciences and Humanities. The citation commended the “synergy between world-class research and societal impact” The presence of keystone actors represents an increasingly important feature of the human-dominated world. Sustainable leadership by actors could result in cascading effects throughout the entire seafood industry and enable a critical transition towards improved stewardship for healthy oceans.

The keystone actors' process is initiated and operated by researchers at SRC, the Beijer Institute and the Global Economic Dynamics Academy programme.

Read more:

Read more about the SeaBOS initiative, the dialogues and statements keystonedialogues.earth.

Reference: Österblom, H., Jouffray, J.-B., Folke, C., Rockström, J. 2017. Emergence of a global science-business initiative for ocean stewardship. *Proceedings of the National Academy of Sciences of the United States of America*. In press.

EAT and EAT-Lancet commission

The EAT-Lancet commission, also featured in last year's report, has been progressing over the past year. It is a global assessment that will investigate the connections between diet, human health and the state of the planet, with the aim of 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 commission report, which will be published in the medical journal *The Lancet*, will be submitted to the publisher later this year. The focus of the commission in the past year has been to synthesise the results of the different working groups. To this end, two larger meetings involving all commissioners and contributing authors and several smaller meetings have taken place over the year. The EAT-Lancet Commission consists of 20 world-renowned scientists. It is co-chaired by Professor Johan Rockström, SRC, and Professor Walter Willet, Harvard School of Public Health, and Beijer researchers Therese Lindahl and Max Troell belong to the team of supporting co-authors. An EAT-Lancet commission website was launched this year, where more details about the report and progress can be found.

The commission is part of EAT, an initiative aiming to reform the global food system and enable us to feed a growing global population with healthy food from a healthy planet by bringing together science, policy and business. At the annual EAT forum held in June 2017 in Stockholm, topics ranged from innovation and biotechnology to the economics of food systems. Max Troell organised an EAT Competence Forum session titled *Fish Futures – sustainable seafood* to support the SDGs. Carl Folke is member of the EAT advisory board.

Read more and see presentations at:
foodplanethealth.org, eatforum.org

The Ideas Salon

The 24th World Congress of Science and Factual Producers took place in Stockholm in December 2016. In one of the sessions, called the Ideas Salon, some of the world's leading science documentary broadcasters and producers had the opportunity to hold discussions with six researchers from some of the top academic fields in Sweden, including e.g. artificial intelligence, virtual medicine, climate change and exploration, and cosmology. Therese Lindahl from the Beijer Institute represented behaviour and sustainability science. The aim for the event was to spark ideas and invigorating discussions about what the next big science breakthroughs in the respective fields might be. The discussions covered questions such as: What do consumer and industrial robotics have in store for humanity? What is the nature of dark matter? What risks are associated with emerging and future technologies and what can we do to protect humanity? and To what extent can psychology help fix sustainability challenges associated

with the current food system, climate change, biodiversity, health and antibiotic resistance?. The session was organised by Maia Krall Fry with funding from the Swedish research Council (Vetenskapsrådet).



Sustainable seafood partnership

A new project, funded by the Swedish research council Formas, will investigate how to sustainably increase production and consumption of seafood in Sweden. The project, named *Seawin* and led by Max Troell, is teaming up with public and private partners to maximise value for society. The findings will be used to improve existing seafood guides (WWF) aimed at consumers, retailers and producers. Although the project has a Swedish focus, increased knowledge of effective mechanisms in improving the environmental performance of fisheries and aquaculture can be of great importance for stimulating change, both in Sweden and globally.

Read more and see presentations at:
www.seawin.earth

Nudging project for more recycling

By using nudging, Master's student Noah Linder, SRC, supervised by Beijer researcher Therese Lindahl, managed to encourage residents in a Stockholm suburb to recycle more of their food waste. Nudging is a concept in behavioural science that proposes positive reinforcement and indirect suggestions or, simply put, a gentle push in the right direction, to make



Photo: Alamy

people change their behaviour. Noah Linder teamed up with a major Stockholm landlord (Stockholmshem) when designing a leaflet urging tenants to recycle more. The message was based on studies showing people's general unwillingness to deviate from the collective norm, and used phrases such as "Do as your neighbour..." and "On our street we recycle". Two recycling bags were also provided, in order to make it easy for residents to get going. The results from the experiment indicated a significant increase in food waste collected and a corresponding decrease in household waste. The endeavour was so successful that the landlord will use the leaflet as a template for future campaigns in other neighbourhoods.

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 up 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.



Design students interpret coral reef research

IN 2016 successive warnings were issued that coral is corals are dying, with high water temperatures causing the worst coral bleaching to date on the Great Barrier Reef. But it is not too late to save these precious reefs. In an exhibition staged in Stockholm on 17-29 January 2017, entitled 'A world that can live forever', design students offered their interpretation of research on vital life in the oceans.

The exhibition was a joint project between the Beijer Institute, Beckman's College of Design and the Swedish design company Svenskt Tenn in Stockholm, where the exhibition was held. Through the Kjell and Märta Beijer Foundation, Svenskt Tenn's profits support research at the Beijer Institute.

"The situation facing the world's coral reefs has never been as acute as it is now, and it feels important to highlight Swedish research being conducted in this area. Students at Beckmans are a new generation of designers who have a new perspective on the world, and they were given free rein to interpret the research", said Thommy Bindefeld, Svenskt Tenn's Marketing Manager, at the exhibition opening.

Researchers from the Beijer Institute and Stockholm Resilience Centre gave introductory lectures and provided background reading and tuition to the students during a five-week course. The result was 16 very diverse interpretations, ranging from pictures and posters to candles and textiles. 3D printouts of cryopreserved corals, an informative board game and 'fake' man-made corals created with the help of fractal design software were just a

few examples of the students' creations. A digital exhibition was also produced.

"The survival of coral reefs is extremely important for communities around the world". The species-rich reefs provide people with food, attract lucrative tourism and provide natural protection against erosion around islands and coastal cities. This exhibition shows the threats of overfishing and global warming, but also that it is not too late to stop coral from dying out if we use all the knowledge we have today", said Carl Folke.

The opening also featured the soprano saxophone artist and co-founder of the

organisation Coral Guardians, Anders Paulsson, who played his own composition Danjungan Sanctuary.

The exhibition has since been shown at a gala in Stockholm on 23 April to mark the launch of a campaign to highlight the dire state of the world's oceans, with a particular focus on plastic pollution, set up by the Keep the Ocean Clean (Håll havet rent) network. Sweden's Minister for the Environment, Karolina Skog, gave the opening speech.

This project is the result of a continuous and highly fruitful collaboration with Svenskt Tenn, which began in 2015 with the exhibition 'Patterns of



All photos: Svenskt Tenn.



the Biosphere'. This exhibition is continuing to be shown, and will be shown at the Resilience 2017 conference in Stockholm in August 2017 and during the Stockholm Act festival that month at the Stockholm House of Culture (Kulturhuset). Future projects include a new course and exhibition with students from Beckmans and a collection of trays illustrating Beijer Institute research.

Digital exhibition:
<http://2017.beckmans.space/svenskttenn/>



Photo: Jean-Baptiste Jouffray.



Supporting Environmental Economics networks

THE BEIJER INSTITUTE cooperates with four regional networks on environmental economics in Africa (CEEPA/RANESA), Asia (EEPSEA 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.

The Mäler Scholarship

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 to use 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.



Herbert Ntuli going through the experiment design in a village next to Gonarezhou National Park in Zimbabwe.



Mäler Scholar 2016

- Dr Claudia Aravena Novielli

Dr Claudia Aravena Novielli (LACEEP), recently took up a position as assistant professor in energy economics at Heriot-Watt University, Edinburgh, UK. She visited the institute in June 2016 and then September-December 2016.

During her stay, Claudia focused mainly on two areas of research: conservation and environmental valuation of regime shifts. She developed a paper on balancing tourism and environmental conservation in the Galapagos Islands (Ecuador) and, together with Anne-Sophie Crépin, initiated a study on methodologies to value the impacts of different regime shifts, with special focus on developing countries. She greatly appreciated the ideas and feedback she received from people at the Beijer Institute and SRC:

“It helped me improve my research and to develop new research ideas. In addition, my stay at the Beijer Institute extended my views on multidisciplinary aspects of research. It made me realise that there is an infinite world beside the classical environmental and ecological economics.

While experiencing Stockholm change from autumn to winter, Claudia claims she gained inspiration from the goals and work methods of the institute.

“I learned how to use research to advise policy and industry, how research and work can be strict and fun at the same

time. I learned how you can build groups in the most inspiring and active environment, where competition becomes collaboration and enthusiasm drives work to the highest quality standards.”

Mäler Scholar 2017 - Dr Herbert Ntuli

Dr Herbert Ntuli, University of Cape Town, visited the Beijer Institute for three months and he will return for a second visit during autumn 2017. He holds a PhD in Economics from the University of Cape Town and an MSc in Agricultural & Applied Economics from the University of Zimbabwe.

Herbert spent the spring at the institute developing an experimental design to study the potential impact of management and human behaviour on wildlife populations in Zimbabwe. Wildlife is increasingly becoming an important livelihood activity for most rural households living adjacent to national parks in sub-Saharan Africa and a significant proportion of wildlife is managed by local communities as a common pool resource. However, a high incidence of poaching and resource overexploitation in some areas are still major concerns for policymakers in the region. From a policy perspective, it is crucial to examine the link between human behaviour and ecological characteristics.

During the first half of his stay, Herbert developed a background and literature review under the supervision of Anne-Sophie Crépin. He also developed the design for his experiment and instructions for participants, which he later tested with students at the University of Cape Town before proceeding to the field. Field experiments conducted during

the summer of 2017 will examine communities that are conserving wildlife under the banner of the CAMPFIRE programme in Zimbabwe and Herbert will make a second stay at the Beijer Institute to analyse and write up the results.

Environment and Development Economics

The journal Environment and Development Economics (EDE) was founded by, and is published in association with, the Beijer Institute. EDE is positioned at the intersection of environmental, resource and development economics and encourages submissions from researchers in both developed and developing countries. The editor is Eswaran Somanathan.

The number of submissions to EDE has been steadily rising over the years, with 2016 showing a record number of submissions (260). In 2017, the number of submissions is projected to be slightly lower.

Geographical distribution

Submissions from developing areas are almost 62% of the total, while developed areas contribute about 38% of the total number of submissions. In 2016, submissions from Latin America increased, while submissions from Africa remained nearly the same and submissions from Asia (developed and developing regions) showed a slight decrease. The figures indicate the effectiveness of the journal in addressing one of its primary objectives, which is capacity building in developing areas of the world.

A submission is classified as being from a developing area if the submitting author (or the majority of co-authors) is from

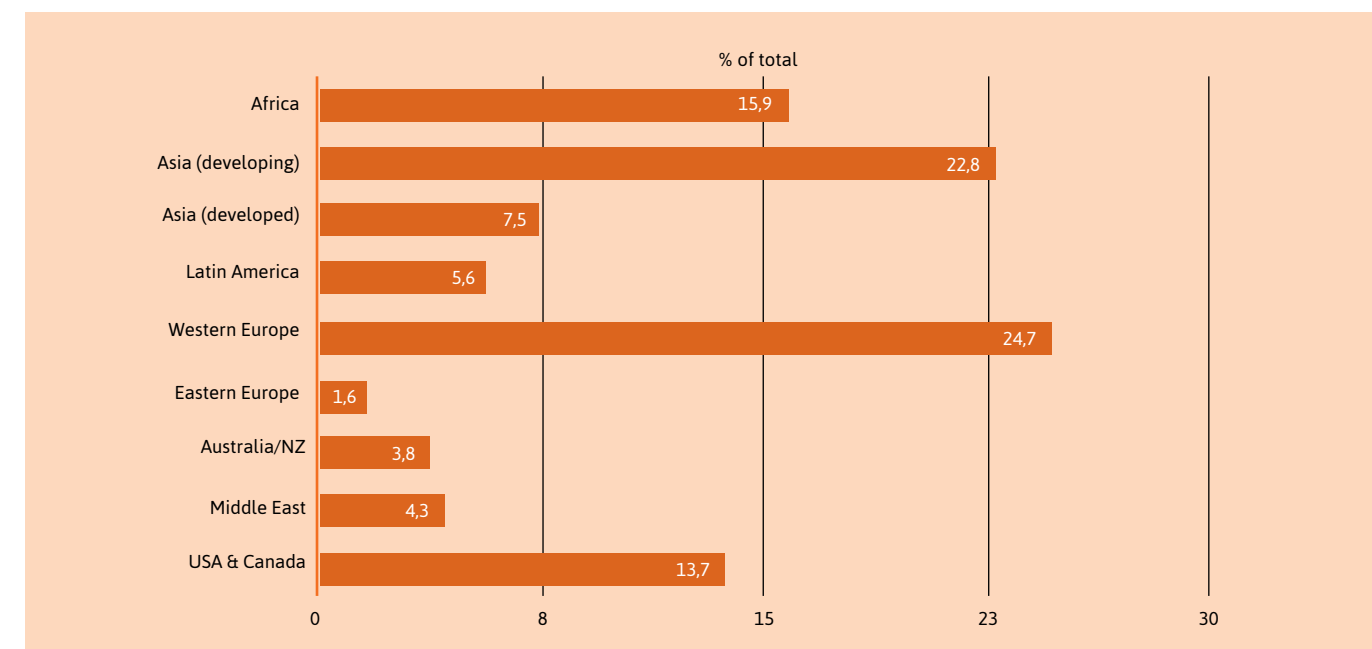
outside the US, Canada, Western Europe, Australia/New Zealand or the developed areas of Asia. Developed areas of Asia are classified as Japan, Korea, Taiwan, Singapore and Hong Kong.

The acceptance rate is now 17%. This is down from earlier years, since the number of submissions has increased while the number of papers published has remained stable. The journal continues to promote articles and authors from the developing world, with 46% of articles published in 2016 coming from these areas.

Future Targets

The December 2017 issue of EDE will be the special issue on ‘Recent Advances in Empirical Research on Growth and Environment’ (guest editors George Halkos and Shunsuke Managi). A special issue on ‘Climate Change and Poverty’ (guest editors Stephane Hallegatte, Marianne Fay and Edward B. Barbier) will be published in 2018, and a special issue on ‘Natural Resources and Economic Development: A Local Perspective’ (guest editors John Cockburn, Hélène Maisonnave and Luca Tiberti) is in the early stages of development.

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



Geographical breakdown of paper submissions from January 2016 to June 2017 (% of the total.)

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

THE GEDB PROGRAMME of the Academy focuses on unexplored interfaces and areas of scientific inquiry with the aim of better understanding global economic dynamics in a biosphere context and uncovering the drivers, mechanisms and effects on social-ecological systems and their resilience on multiple scales. The programme combines competencies to develop sustainability science by:

- » Connecting knowledge and competencies of researchers from disciplines that seldom interact
- » Combining whole areas of work that have previously not been combined
- » Enabling new forms of collaboration between science, practice and business for human wellbeing and biosphere stewardship

The programme is structured around three themes that all have made substantial progress: 'Macro)economy and the biosphere', 'Marine resource trade and its effects on social-ecological systems' and 'Interactions between financial markets and the biosphere'. There are also two cross-cutting themes that have emerged: 'Cross-scale dynamics' and 'Systems transformation'. The former is a common theme running throughout much of the ongoing work of GEDB and the latter has emerged through a focus on factors that bolster or impede transformative change, for instance in the area of antimicrobial resistance.

There is continuous collaboration between the Beijer Institute, GEDB and Stockholm Resilience Centre (SRC), with joint workshops and seminars being organised. Beatrice Crona is executive director of the programme. Beijer Fellow James Wilen, Professor of Economics at the University of California Davis, visits Stockholm a few times a year to take part in research, guide and mentor young scholars within GEDB and provide senior academic expertise in economics. There is an advisory board with several Beijer researchers involved and with Beijer Fellows providing synergies. As we envisioned, GEDB has become a significant channel for research, synthesis and synergies between the Beijer Institute and SRC and there is also collaboration with Future Earth, researchers at Princeton University and other networks and organisations like the UNEP Finance Initiative.

www.gedb.se

Stockholm Resilience Centre and Stanford University

The interaction with Stockholm Resilience Centre (SRC) continues in a very productive fashion with many synergies and benefits and close collaborations through joint projects, grants, PhD candidates workshops and publications. Beijer Institute researchers are engaged with the themes and streams of SRC and collaborate and participate in seminars, teaching, supervision etc. The communication, outreach and policy engagements of the Beijer Institute are substantially magnified through SRC. The work with two significant grants is progressing and strengthens and extends 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 Beijer Fellow 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.

The programme is now up and running and the overall focus is to advance fundamental research in four key areas:

- » 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

The ongoing research is structured in four themes that address one or several research areas. These four themes connect people and nature through food systems, urbanisation and the challenges of biosphere stewardship. They range from nature experiences and mental health, to reconnecting urban development to natural capital and ecosystem services, to the role of the food system in human affairs and to scenarios for transforming development into sustainability pathways. Each theme is co-led by a minimum of two senior researchers each from SRC/Beijer and Stanford University, and a postdoc or early career scientist is assigned to each of the themes.

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 Academy has played a central role in the development of a decentralised Future Earth Secretariat with a strong Swedish presence. The Beijer Institute and GEDB are central in the Academy's profile on issues of global sustainability in collaboration with SRC. The Beijer Institute is especially active in the Future Earth core project, the Programme on Ecosystem Change and Society (PECS), chaired by Beijer Fellow Stephen Carpenter, with the International Programme Office hosted by 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. PECS and the Southern African PECS (SAPECS) serve as important links between the GRAID programme and the Wallenberg programme with Stanford University of the SRC.

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

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. Belinda 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 (Read more under 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, 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. The Resilience Alliance 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. Researchers in the Resilience Alliance Young Scholars (RAYS) are also engaged in the Beijer Young Scholars (BYS). The journal *Ecology and Society* is owned by the Resilience Alliance, with Beijer Director Carl Folke as the editor-in-chief together with Lance Gunderson.

www.resalliance.org

SARAS - The South American Institute for Resilience and Sustainability Studies

Since 2007, the Beijer Institute has been engaged in the South American Institute for Resilience and Sustainability Studies (SARAS). SARAS is an interdisciplinary research institute based in Maldonado, Uruguay, 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 the journal *Ecology and Society*. Carl Folke and Beijer Fellows Marten Scheffer, Steve Carpenter, and Frances Westley have been deeply engaged with SARAS as, more recently, have Juan Carlos Rocha, Beijer Institute, and Henrik Österblom, SRC.

www.saras-institute.org



Notes from SARAS workshop.

The GreenMAR programme

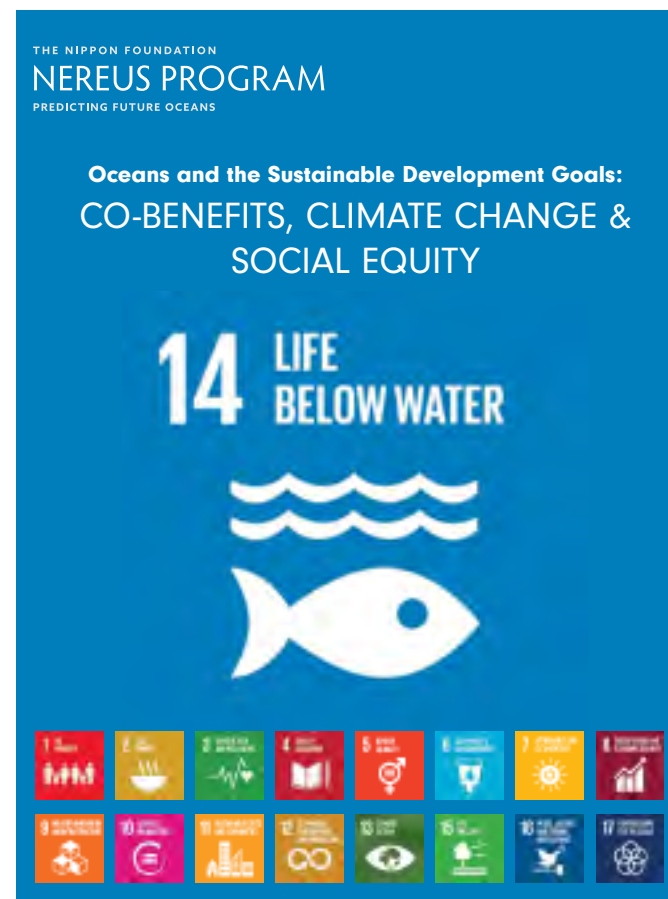
GreenMAR, funded by Nordforsk, is a network that aims at understanding to what extent the ecological and social components of complex marine systems are capable of adapting to growing stress factors, such as overfishing or climate change, and to provide corresponding management recommendations that can ensure green growth. Beijer Fellow Simon Levin serves on the Advisory Panel for NorMER and participates in GreenMAR, representing the Princeton node, and Beijer Fellows James Wilen and Partha Dasgupta are members of the advisory board of GreenMAR. Carl Folke lead the Stockholm node together with Thorsten Blenckner, SRC.

www.greenmar.uio.no

Nereus – Predicting the Future Ocean

The Nereus programme 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 SRC/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



Friendship. Creativity. Excellence.

AFTER SEVEN YEARS as a member of the Beijer Institute's Scientific Advisory Board – the last three of them as the Board's Chair – I am reluctantly acknowledging that my term is coming to an end. So let me use this opportunity to share with you some reflections from this period.

Interdisciplinary research collaboration is often praised, but less often practised – partly because doing it successfully is so difficult. Scholars from different disciplines struggle to communicate. We use different words for the same concepts. We use the same words for different concepts. We may frown at each other's methods, assumptions, interpretations, without understanding that we are not even trying to answer remotely similar questions. And should the collaboration produce a decent joint paper, it might be difficult to publish – since, after all, editors, reviewers and potential readers must struggle with the same communication barriers we had to face ourselves.

The Beijer Institute is one of the very few research institutes I know of where successful collaboration across disciplines is the rule rather than the exception. How do they do it?

The first thing that strikes one when entering a Beijer Board meeting, the Beijer lunch room or an Askö or BENN workshop is the extraordinarily friendly atmosphere. Leaders, staff and other guests immediately make one feel at home. (In fact, I use the word "reluctantly" above because when my Board term comes to an end, they will stop inviting me regularly to what I have come to regard – let me admit this – as a sort of family party.)

A second unusual aspect of the Beijer Institute is its use of the arts. As a researcher, one is easily lost in technical detail and the desire to publish ever more, forgetting the initial motivation for it all. When the heart and mind have lost sight of each other, art can help reunite them – facilitating their cooperation; and the Beijer Institute possesses this insight, applying it actively. Indeed, a surprisingly large share of the Beijer's staff and Board members are artists as well as researchers: painters, musicians, writers, actors, filmmakers. I suspect that this is no coincidence.

Finally, an impressive aspect of the Beijer Institute is, of course, the sheer excellence of its interdisciplinary research network. At the Askö meeting in 2014, we discussed environmental impacts of vicious and virtuous cycles of social behaviour (Nyborg et al. 2016). The Beijer Institute's own research networks are in themselves prime cases of virtuous social interaction cycles: so many brilliant scholars want to participate



Photo: Anne E S Enger.

in the Askö meetings precisely because each expects so many brilliant scholars to participate.

This, I believe, is the recipe: Friendship, to promote collaboration rather than competition and scepticism. Creativity, making us remember why our work is needed. Within-discipline excellence, helping the work move in fruitful directions.

These are just elements of the recipe, however. The true artist is the cook. The final actor is crucial: the small, but highly competent team in Stockholm, some of whom specialise in interdisciplinary collaboration, others who specialise in taking care of and organising diverse groups of demanding individuals. This team is the gem: the glue that keeps us all together.

Karine Nyborg, Chair of the Board
Oslo, June 2017

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 Beijer Institute was elected on 5 June 1991. The 26th annual board meeting was held at the Royal Swedish Academy of Sciences on 9 September 2016.

At this meeting, Professor Rosamond Naylor and Professor Scott Taylor reached the end of their term. The Beijer Institute wishes to express its warmest gratitude for their great efforts for the Institute over the years.

This meeting was the first for Professor Jason Shogren, University of Wyoming, USA (who was elected in 2015 but



Board meeting September 2016. Göran K. Hansson, M. Scott Taylor, J. Marty Anderies, Anne-Sophie Crépin, Jeroen van den Bergh, Carl Folke, Stuart “Terry” Chapin, Karine Nyborg, James Wilen, Neil Adger, Rosamond Naylor, Jason Shogren, Eric Lambin.

could not join the Board meeting that year) and Professor Jeroen van den Bergh, Universitat Autònoma de Barcelona, Spain, who were welcomed as new members of the board.

Staff news

Anne-Sophie Crépin

was promoted to Associate Professor in Economics by the Faculty of Social Sciences at Stockholm University, 20 March 2017. Anne-Sophie Crépin joined the Beijer Institute already in 1996 as a research assistant. She continued that work in parallel with pursuing a PhD at the Department of Economics, Stockholm University, graduating in 2002. Since then she has had a research position with the Beijer Institute, leading the Global Dynamics and Resilience program and, since 2009, in the role as Deputy Director.

Carl Folke

was awarded the 2016 Planet and Humanity Medal, the International Geographical Union’s (IGU) most prestigious award, which is given to individuals who have made outstanding contributions to environmental issues. Previous recipients have included Al Gore, Gro Harlem Brundtland, Mikhail Gorbachev and Nelson Mandela. He received the medal at a ceremony on 25 October at the Royal Swedish Academy of Sciences.

Carl Folke was also elected to the U.S. National Academy of Sciences, 2 May 2017. Members are elected to the National Academy of Sciences in recognition of their distinguished and continuing achievements in original research. Membership is a widely accepted mark of excellence in science and is considered one of the highest honours that a scientist can receive.

Caroline Schill

successfully defended her PhD thesis ‘Human Behavior in Social-Ecological Systems’ at the Faculty of Natural Sciences, Stockholm University, on 17 May 2017 as a joint PhD candidate of The Beijer Institute and Stockholm Resilience Centre, Stockholm University. Read more on page 24.

BEIJER FELLOW PRIZES, HONOURS & AWARDS

Gretchen Daily

Recipient of the Blue Planet Prize 2017 (with Hans Joachim Schellnhuber) recognising outstanding efforts in scientific research or applications of science that contribute to solving global environmental problems.

Terry Hughes

Listed in Nature as one of “Ten people who made a difference in science in 2016”.

Jane Lubchenco

Awarded the 2017 Public Welfare Medal by the US National Academy of Sciences, its most prestigious award.

Marten Scheffer

2017 BBVA Foundation Frontiers of Knowledge Award in the Ecology and Conservation Biology, together with Gene Likens.

Staff members Beijer

Carl Folke

Professor, Director

Anne-Sophie Crépin

Associate Professor, Deputy Director

J. Marty Anderies

Professor, Programme Director

Johan Colding

Associate Professor, Programme Director

Gustav Engström

PhD, Researcher

Johan Gars

PhD, Researcher

Tobias Granwald

Research Assistant



Carl Folke with Anders Wall, chair of the Beijer Foundation (left), Christina Moberg, President of the Royal Swedish Academy of Sciences and Michael Meadows, Secretary General of the International Geographical Union (IGU), when receiving the Planet and Humanity Medal.

Åsa Gren

PhD, Researcher

Patrik Henriksson

PhD, Researcher

Jean-Baptiste Jouffray

PhD candidate

Chandra Kiran Krishnamurthy

PhD, Researcher

Sofia-Kristin Kokinelis

MSc, Finance and HR Administrator

Christina Leijonhufvud

BA, Chief Administrator

Chuan-Zhong Li

Professor, Programme Director

Therese Lindahl

PhD, Programme Manager

Daniel Ospina

PhD candidate

Caroline Schill

PhD (since May), researcher

Agneta Sundin

Communications Officer

Max Troell

Associate Professor, Programme Director

Jeffrey Vincent

Professor, Senior Advisor

Aart de Zeeuw

Professor, Programme Director

Visiting scientists

Aart de Zeeuw

Tilburg University, 7-10 August 2016

Claudia Aravena Novielli

University of Dublin Trinity College, 2 September-19 December 2016

James Wilen

University of California, Davis, 6-19 September 2016

Marty Anderies

Arizona State University, 22-28 January 2017

James Wilen

University of California, Davis, 1-22 February, 2017

Herbert Ntuli

University of Cape Town, 2 February-30 April 2017

J. Marty Anderies

Arizona State University, 3 April-26 June 2017

James Wilen

University of California, Davis, 10-30 May 2017

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 2016 and 30 June 2017 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.

Governance and management of social-ecological systems: Challenges of environmental decision making – Master’s course

This course is part of 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.

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

The seminars are given at the Royal Swedish Academy of Sciences and attended by a large audience, including scientists, students, media and policymakers in the public and private sector.

Between July 2016 and June 2017, the following seminars were held:

2016

- » **16 September:** Dr. Malin Pinsky *Global Change: How odd are the oceans?*
- » **1 November:** Dr. Andrew Gonzalez *Biodiversity science to address the challenges of global change*
- » **7 December:** Prof. Katrina Brown *Resilience, development and global change: Resistance, rootedness and resourcefulness*

2017

- » **28 March:** Prof. Bert J.M. de Vries *Ethics, finance and the sustainable development goals: A reflection*
- » **9 May:** Prof. J. Marty Anderies *Smallholder agricultural systems,*

food security and the provision of local public goods

- » **29 May:** Associate Prof. Elena Bennett *Exploring pathways to a better Anthropocene*
- » **8 June:** Prof. W. Brian Arthur *Economics, complexity and nonequilibrium*
- » **13 June:** Dr. David Grinspoon *The emergence of planetary intelligence: An astrobiological perspective on the Anthropocene*

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 2016 was *Human population and the global commons*.

Staff members’ publications and activities

All portraits by Cecilia Nordstrand, except Chandra Kiran Krishnamurthy (by Agneta Sundin).



Research focus

Urban social-ecological systems.

Publications during the period

- » Colding, J. and S. Barthel. An urban ecology critique on the “Smart City” model. *Journal of Cleaner Production*. In press.

Reports

- » Barthel, S., J. Colding, M. Schewenius and E. Andersson. 2016. *The Participatory Design Process that Led to the Vision of Campus Albano*. Science report for the Live Baltic Campus Project (2015-2018). Central Baltic Interreg.
- » Schewenius, M., H. Erixon Aalto, R. al Rawaf, S. Barthel, J. Colding and E. Andersson. 2017. *Campus Albano - On Integrated Planning and Social-ecological Urban Design*. Science Report for the Live Baltic Campus Project (2015 – 2018). Central Baltic Interreg.
- » Schewenius, M., H. Erixon Aalto, R. al Rawaf, S. Barthel, J. Colding and E. Andersson. 2017. *Integrated Planning and Social-ecological Urban Design. On Sharing and Developing Best Practices in Urban Planning and Design*. Science report for the Live Baltic Campus Project (2015-2018). Central Baltic Interreg.

Conferences, workshops and presentations

- » FORMAS frukostseminarium ‘Smarta städer’ (Breakfast seminar on Smart Cities), Nobelmuseet (Nobel museum), Stockholm, September 2016. Participant.
- » Live Baltic Campus Partner Meeting and Liveable City Forum, Uppsala University, November 2016. Keynote speaker: *Urban green commons*

and Campus Albano.

- » Seminar on Social-Ecological Urbanism, Högskolan i Gävle (Gävle University College), November 2016. Keynote speaker: *Institutions, property rights and urban green commons.*
- » Conference RUFs (Regional Development Plan for Stockholm conference), ‘Läget i Stockholmsregionen 2016’ (The situation in the Stockholm Region), Tillyväxt och Regionplaneförvaltningen (Stockholm County Council), Stockholm, December 2016. Participant.
- » Seminar: Multifunktionella landskap – Nordiska golfanläggningars möjligheter och utmaningar (Multifunctional landscapes – Challenges and opportunities for Nordic golf courses), Kungl. Skogs- och Lantbruksakademien (The Royal Swedish Academy of Agriculture and Forestry) and STERF (Scandinavian Turfgrass and Environment Research), Stockholm, February 2017. Keynote speaker: *Golfbanans dammar och vatten – en arena för biologisk mångfald och grön infrastruktur för vattenlevande organismer (The role of ponds and water on golf courses as arenas for green infrastructure and aquatic species).*
- » Liveable City Forum, Tartu University, Estonia, March 2017. Keynote speaker: *University and resilient urban environment.*
- » Forum: City perspectives (including the Deputy Mayor of Tartu, the city council and city architect of Tartu), SPARK Tartu, Estonia, March 2017. Moderator.
- » Årsstämma-seminarium (annual general meeting) 2017 at Akademiska Hus, School of Architecture at KTH Campus, Stockholm, April 2017. Invited member of panel on green campus transformation.
- » Social-ecological urbanism workshop with teachers, students and stakeholders from Riga City Council, Riga Planning Region administration and municipalities, University of Latvia and Riga Technical University, May 2017. Co-leader of the workshop and presentation: *Social-ecological urbanism.*

Other

- » Member of Live Baltic Campus network group.
- » Popular science communications: Arkitektturnytt: Vad bör göras? Ju

- tätare stad, desto större behov av grönska. (What to do? The denser the city, the more need for green infrastructure). Colding, J. Arkitektur 6:27.
- » Framtidens städer har hus av trä och gröna artärer (Future cities have buildings of wood and green arteries). Dagens Nyheter, Stockholm, 6 April 2017. Available online
 - » A critical perspective on the “smart city” model. Colding, J. and S. Barthel. Live Baltic Campus blog, 11 January 2017.
 - » Latest news of Campus Albano. Barthel, S. and J. Colding. Live Baltic Campus blog, 27 February 2017.



Anne-Sophie Crépin
Associate Professor, Deputy Director

Research focus

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

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* 65:657-676.
- » Lindahl, T., N. Orescovic and A.-S. Crépin. 2016. Playing safe: The role of quotas to avoid ecosystem regime shifts. In: Botelho, A. (ed). *The WSPC Reference on Natural Resources and Environmental Policy in the Era of Global Change. Volume 4: Experimental Economics*. World Scientific, London, UK. pp. 121-150.
- » Nyborg, K., J.M. Anderies, A. Dannenberg, T. Lindahl, C. Schill, M. Schlüter, W.N. Adger, K.J. Arrow, S. Barrett, S. Carpenter, F.S. Chapin III, A.-S. Crépin, G. Daily, P. Ehrlich, C. Folke, W. Jager, N. Kautsky, S.A. Levin, O.J. Madsen, S. Polasky, M. Scheffer, B. Walker, E.U. Weber, J. Wilen, A. Xepapadeas and A. de Zeeuw. 2016. Social norms as solutions. *Science* 354:42-43.

Reports

- » Havenhand, J., A.-S. Crépin, H.L. Filipsson, S. Jagers, D. Langlet, S. Matti, S. Niiranen, M. Troell and L.G. Anderson. 2017. *Acidification of Swedish seas in a Changing Environment: Causes, Consequences, and Responses – An Interdisciplinary Review of Current Knowledge, Knowledge Gaps, and Implementation Needs*. Report of the Environmental Committee of the Royal Swedish Academy of Sciences, Stockholm, Sweden. Available online.

Conferences, workshops and presentations

- » Askö 2016 meeting on Human Population and the Global Commons, Askö and the Royal Swedish Academy of Sciences, September 2016. Participant.
- » Policies for the Anthropocene workshop, School of Business, Economics and Law, University of Gothenburg, November 2016. Participant.

- » 24th Ulvön conference on Environmental Economics, Ulvön, Sweden, June 2017. Presentation: *Operationalising a social-ecological systems perspective on the Arctic ocean*.

Teaching and training

- » Lecturer and examiner, Master’s level course *Governance and management of social-ecological systems: Challenges of environmental decision-making*, Stockholm Resilience Centre, Stockholm University, spring 2017.
- » Co-supervisor of PhD candidates Daniel Ospina and Caroline Schill (PhD defence May 2017); and main supervisor of Master’s student Sophie Gripenberg (Stockholm Resilience Centre, Stockholm University).
- » Main supervisor of Mälar scholars (postdocs) Claudia Aravena (2016) and Herbert Ntuli (2017).

Commissions

- » Member of advisory board of the Global Challenges Initiative, Stockholm School of Economics, Stockholm, since 2016.
- » Member of the Strategic Advisory Committee at Stockholm Resilience Centre, Stockholm University, since 2016.
- » Member of the Strategic Advisory Committee for Johan Rockström’s European Research Council Advanced Grant Project ‘Earth Resilience in the Anthropocene’, Stockholm Resilience Centre, Stockholm University, since 2017.
- » Reviewer for the 2017 Annual Conference of the Association of Environmental and Resource Economists.
- » Reviewer for *Bioscience, Ecological Economics, Environment and Development Economics, Environmental and Resource Economics, Nature Ecology and Evolution* and *Proceedings of the National Academy of Sciences*.

Other

- » Popular science communication: Så minns vi Kenneth Arrow från mötena på Askö (This is how we remember Kenneth Arrow from the meetings at Askö). Crepin, A.-S., C. Folke and T. Lindahl. *Ekonomistas* (blog), Stockholm, 28 February 2017. Available online.



Gustav Engström
PhD, Researcher

Research focus

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

Publications during the period

- » Ando, M., M. Dahlberg and G. Engström. 2017. The risks of nuclear disaster and its impact on housing prices. *Economics Letters* 154:13-16.
- » Engström, G. and Å. Gren. 2017. Capturing the value of green space in urban parks in a sustainable urban planning and design context: Pros and cons of hedonic pricing. *Ecology*

- » and *Society* 22(2):21.
- » Lade, S.J., L.J. Haider, G. Engström and M. Schlüter. 2017. Resilience offers escape from trapped thinking on poverty alleviation. *Science Advances* 3(5):e1603043.

Conferences, workshops and presentations

- » The economics of the planetary boundaries workshop, the Royal Swedish Academy of Sciences, September 2016. Organiser.
- » On the use of geocoded data in economic research workshop, CESifo, München, Germany, October 2016. Co-organiser.
- » Policies for the Anthropocene workshop, School of Business, Economics and Law, University of Gothenburg, November 2016. Participant.

Teaching and training

- » Lecturer, Master’s level course *Ecosystem support for humanity: Economic approaches to analyse ecosystem support of humanity*, Stockholm Resilience Centre, Stockholm University, autumn 2016.
- » Course leader and lecturer, Master’s level course *Governance and management of social-ecological systems: Challenges of environmental decision-making*, Stockholm Resilience Centre, Stockholm University, spring 2017.

Commissions

- » Reviewer for *Journal of the European Economic Association*.



Carl Folke
Professor, Director

Research focus

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

Publications during the period

- » Bousquet, F., A. Botta, L. Alinovi, O. Barreteau, D. Bossio, K. Brown, P. Caron, M. D’Errico, F. DeClerck, H. Dessard, E. Enfors Kautsky, C. Fabricius, C. Folke, L. Fortmann, B. Hubert, D. Magda, R. Mathevet, R.B. Norgaard, A. Quinlan and C. Staver. 2016. Resilience and development: Mobilizing for transformation. *Ecology and Society* 21(3):40.
- » Crona, B., T. Daw, W. Swartz, A. Norström, M. Nyström, M. Thyresson, C. Folke, J. Hentati-Sundberg, H. Österblom, L. Deutsch and M. Troell. 2016. Masked, diluted, drowned out: global seafood trade weakens signals from marine ecosystems. *Fish and Fisheries* 17:1175-1182.
- » Folke, C. 2016. Resilience (Republished). *Ecology and Society* 21(4):44. [Reprint of Folke, C. 2016. Resilience. In: Shugart, H. (ed). *Environmental Science: Oxford Research Encyclopaedias*. Subject: Framing Concepts in Environmental Science. Oxford University Press, New York, USA. Online Publication Date: Sep 2016.]
- » Folke, C., R. Biggs, A.V. Norström, B. Reyers and J. Rockström.

2016. Social-ecological resilience and biosphere-based sustainability science. *Ecology and Society* 21(3):41.

- » Norström, A.V., M. Nyström, J.-B. Jouffray, C. Folke, N.A. Graham, F. Moberg, P. Olsson and G.J. Williams. 2016. Guiding coral reef futures in the Anthropocene. *Frontiers in Ecology and the Environment* 14(9):490-498.
- » Nyborg, K., J.M. Anderies, A. Dannenberg, T. Lindahl, C. Schill, M. Schlüter, W.N. Adger, K.J. Arrow, S. Barrett, S. Carpenter, F.S. Chapin III, A.-S. Crépin, G. Daily, P. Ehrlich, C. Folke, W. Jager, N. Kautsky, S.A. Levin, O.J. Madsen, S. Polasky, M. Scheffer, B. Walker, E.U. Weber, J. Wilen, A. Xepapadeas and A. de Zeeuw. 2016. Social norms as solutions. *Science* 354:42-43.
- » Österblom, H., B.I. Crona, C. Folke, M. Nyström and M. Troell. 2017. Marine ecosystem science on an intertwined planet. 20th Anniversary Paper. *Ecosystems* 20:54-61.
- » Tengö, M., R. Hill, P. Malmer, C.M. Raymond, M. Spierenburg, F. Danielsen, T. Elmqvist and C. Folke. 2017. Weaving knowledge systems in IPBES, CBD and beyond: lessons learned for sustainability. *Current Opinion in Environmental Sustainability* 26-27:17-25.
- » Troell, M., N. Kautsky, M. Beveridge, P. Henriksson, J. Primavera, P. Rönnbäck, C. Folke and M. Jonell. 2017. Aquaculture. In: *Reference Module in Life Sciences*. Elsevier, ISBN: 978-0-12-809633-8.

Conferences, workshops and presentations

- » Stockholm Resilience Centre staff retreat, Stora Karlsö, Sweden, September 2016. Presentation: *Resilience and development*.
- » Askö 2016 meeting on Human Population and the Global Commons, Askö and the Royal Swedish Academy of Sciences, September 2016. Participant.
- » Beijer Institute 25th anniversary seminar, the Royal Swedish Academy of Sciences, September 2016. Organiser and presentation.
- » Princeton day with scholars and representatives from Princeton University, Stockholm Resilience Centre, September 2016.
- » Opening of the exhibition ‘Närodlad Design’ (Locally produced design), Svenskt Tenn, Stockholm, September 2016. Invited speaker.
- » Stockholm Resilience Centre Advisory Board meeting, London, UK, October 2016.
- » Presentation of research of GRAID (Guidance for Resilience in the Anthropocene: Investments for Development) and Stockholm Resilience Centre to the Sida leadership, Stockholm Resilience Centre, Stockholm, October 2016. Oral presentation.
- » The Erling-Persson Family Foundation meeting, the Royal Swedish Academy of Sciences, October 2016. Presentation.
- » Who owns the planet? Challenges and opportunities related to ownership of land, water and biodiversity. Seminar with His Majesty the King of Sweden, Ulriksdals Castle, Stockholm, October 2016.
- » The Amazon in the new globalised context. Seminar, the Royal Swedish Academy of Sciences, November 2016.
- » Volvo Environment Prize meeting, the Beijer Institute, November 2016. Presentation.

- » The Soneva dialogue: Transformative Risks and Opportunities for the Global Seafood Industry, SeaBOS (Seafood Business for Ocean Stewardship) initiative, Keystone dialogues, Soneva Fushi, Maldives, November 2016. Co-organiser and presentations.
- » Global Resilience Partnership and GRAID meeting, Stockholm Resilience Centre, February 2017. Presentation.
- » Futura Foundation, state of the art meeting, Stockholm, March 2017.
- » Gastronomiskt Forum (Gastronomic forum), Nyköping, Sweden, March 2017. Keynote speaker.
- » Volvo Environment Prize, scientific committee meeting, the Beijer Institute, April 2017.
- » SRC Advisory Board meeting, SRC, April 2017. Presentation for new members.
- » The Stockholm dialogue: Advancing the Seafood Business for Ocean Stewardship Initiative, SeaBOS (Seafood Business for Ocean Stewardship) initiative, Keystone dialogues, the Royal Swedish Academy of Sciences, May 2017. Co-organiser and presentations.
- » Beijer Young Scholars workshop on Inequality and the Biosphere, the Royal Swedish Academy of Sciences and Ekskäret, May/June 2017.
- » SIGHT (Swedish Institute for Global Health Transformation) inaugural workshop, the Royal Swedish Academy of Sciences, June 2017. Presentation.
- » EAT Advisory Board meeting, Stockholm, June 2017.
- » Features of a resilient global food system, workshop, Saltsjöbaden, Stockholm, June 2017.
- » Volvo Environment Prize meeting, the Beijer Institute, June 2017.
- » Transformations workshop, Saltsjöbaden, Stockholm, June 2017.

Teaching and training

- » Lecturer in undergraduate and PhD level courses at Stockholm University.
- » Co-supervisor of one PhD candidate in Sustainability Science and one Master’s student (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.
- » Director of Programme on Ecosystem Change and Society (PECS), Future Earth/ICSU, since 2013.
- » Member of the Royal Swedish Academy of Sciences, since 2002.
- » Member (Foreign) of the US National Academy of Sciences, since May 2017.
- » 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*, *Global Sustainability*, *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.
- » 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.
- » Member of the EU independent tripartite High Level Group on Innovation Policy Management.
- » 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 Yorque Society, since 1997.
- » Member of the Scientific Committee of the Symposium on Learning and Innovations in Resilient Systems, March 2017, Open University, the Netherlands.
- » Member of the Scientific Committee of the Resilience 2017 conference ‘Resilience frontiers for global sustainability’, Stockholm.
- » 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.
- » Partner investigator, Nereus Program – Predicting the Future Ocean, UBC, Canada, since 2010.
- » 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.

Other

- » Recipient of the Planet and Humanity Medal, International Geographical Union, Beijing, China, August 2016. Medal ceremony at the Royal Swedish Academy of Sciences, October 2016.
- » Participated in drafting the SeaBOS (Seafood Business for

- Ocean Stewardship) statement, November 2016.
- » Recognised as Highly Cited Researcher by Thompson Reuters 2016.



Research focus

Creating resilient, sustainable and healthy urban areas, by integrating ecosystem services into spatial urban planning and design; development of sustainable management plans in the Arctic by identifying knowledge gaps using a social-ecological systems lens; the application of an ecosystem service lens for assessing different economic valuation methods.

Publications during the period

- » Engström, G. and Å. Gren. 2017. Capturing the value of green space in urban parks in a sustainable urban planning and design context: Pros and cons of hedonic pricing. *Ecology and Society* 22(2):21.
- » Lindborg, R., L.J. Gordon, R. Malinga, J. Bengtsson, G. Peterson, R. Bommarco, L. Deutsch, Å. Gren, M. Rundlöf and H.G. Smith. 2017. How spatial scale shapes the generation and management of multiple ecosystem services. *Ecosphere* 8(4):e01741.
- » 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* 5(3):298-317.

Teaching and training

- » Lecturer, Master’s level course *Sustainable development and the design professions*, Chalmers, Gothenburg, autumn 2016.
- » Lecturer, undergraduate level course *Världens Eko (Urban ecosystem services)*, Stockholm Resilience Centre, Stockholm University, autumn 2016.
- » Lecturer, undergraduate level course *Stadsodling, planering, miljö och hälsa (Urban agriculture, planning, environment and health)*, Department of Physical Geography, Stockholm University, spring 2017.
- » Main-supervisor of Bachelor’s student Katerina Lindström (Department of Biology, Stockholm University).

Commissions

- » Co-editor of special issue in *Ecological Indicators*.
- » Reviewer for *Urban Ecosystems and Ecological Economics*.



Research focus

Environmental assessments of aquaculture production chains, using life cycle assessments (LCAs) and other environmental proxies; exploring issues related to land use change and antimicrobials.

Publications during the period

- » Gephart, J.A., M. Troell, P.J.G. Henriksson, M.C.M. Beveridge, M. Verdegem, M. Metian, L.D. Mateos and L. Deutsch. The ‘seafood gap’ in the food-water nexus literature — issues surrounding freshwater use in seafood production chains. *Advances in Water Resources*. In press.
- » Heijungs, R., P.J.G. Henriksson and J.B. Guinée. 2017. Pre-calculated LCI systems with uncertainties cannot be used in comparative LCA. *International Journal of Life Cycle Assessment* 22(3):461.
- » Heijungs, R., P.J.G. Henriksson and J.B. Guinée. 2016. Measures of difference and significance in the era of computer simulations, meta-analysis, and big data. *Entropy* 18(10):361.
- » Henriksson, P.J.G., M. Dickson, A.N. Allah, D. Al-Kenawy and M. Phillips. 2017. Benchmarking the environmental performance of best management practice and genetic improvements in Egyptian aquaculture using life cycle assessment. *Aquaculture* 468:53-59.
- » Henriksson, P.J.G., C.V. Mohan and M.J. Phillips. 2017. Evaluation of different aquaculture feed ingredients in Indonesia using life cycle assessment. *Indonesian Journal of Life Cycle Assessment and Sustainability* 1(2):13-21.
- » Henriksson, P.J.G., N. Tran, C.V. Mohan, C.Y. Chan, U.-P. Rodriguez, S. Suri, L.D. Mateos, N.B. Priyo Utomo, S. Hall and M.J. Phillips. 2017. Indonesian aquaculture futures – Evaluating environmental and socioeconomic potentials and limitations. *Journal of Cleaner Production* 162:1482-1490.
- » Järvio, N., P.J.G. Henriksson and J.B. Guinée. Including GHG emissions from mangrove forests LULUC in LCA: A case study on shrimp farming in the Mekong Delta, Vietnam. *International Journal of Life Cycle Assessment*. In press.
- » Nhu, T.T., T. Schaubroeck, P.J.G. Henriksson, R. Bosma, P. Sorgeloos and J. Dewulf. 2016. Environmental impact of non-certified versus certified (ASC) intensive Pangasius aquaculture in Vietnam, a comparison based on a statistically supported LCA. *Environmental Pollution* 219:156-165.
- » Tran, N., U.-P. Rodriguez, C.Y. Chan, M.J. Phillips, C.V. Mohan, P.J.G. Henriksson, S. Koeshendrajana, S. Suri and S. Hall. 2017. Indonesian aquaculture futures: An analysis of fish supply and demand in Indonesia to 2030 and role of aquaculture using the AsiaFish model. *Marine Policy* 79:25-32.
- » Troell, M., N. Kautsky, M. Beveridge, P.J.G. Henriksson,

- J. Primavera, P. Rönnbäck, C. Folke and M. Jonell. 2017. Aquaculture. In: *Reference Module in Life Sciences*. Elsevier, ISBN: 978-0-12-809633-8.
- » Troell, M., F. Ziegler and P.J.G. Henriksson. 2016. Is fish a fish - adding fish to the global food sustainability transformation. eLetter. *Science* 353(6305):1202-1204.

Reports

- » Troell, M. and M. Jonell (eds) with support from P. Henriksson. 2017. *Seafood for human and planetary health*. Background Brief, the Stockholm Dialogue.

Conferences, workshops and presentations

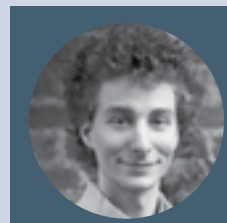
- » LCA Food Conference, University College Dublin, Dublin, Ireland, July 2016. Presentation: *Challenges and best practices of seafood supply chains LCA and assessing alternative scenarios for the Indonesian aquaculture sector up to 2030 using exploratory LCA*.
- » CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS) 2017 Scientific Conference, NUI Galway, Galway, Ireland, April, 2017. Participant.
- » Beijer Young Scholars Workshop on Inequality and the Biosphere, the Royal Swedish Academy of Sciences and Ekskåret, Stockholm, May/June 2017. Participant.
- » Life Cycle Assessments workshop (Seawin project), the Beijer Institute and Stockholm Resilience Centre, Askö, Sweden, June 2017. Co-organiser.

Commissions

- » Guest editor for special issue in *The International Journal of Life Cycle Assessment*: Challenges and best practice in LCAs of seafood and other aquatic products.
- » Reviewer of *Aquaculture*, *The International Journal of Life Cycle Assessment*, *Journal of Cleaner Production*, *Environmental Science and Technology*, *AMBIO* and *Sustainability*.

Other

- » WorldFish visiting scholar, Penang, Malaysia, January-April 2017.



Jean-Baptiste Jouffray
PhD candidate, Researcher

Research focus

Marine socio-ecological systems, coral reefs, global seafood sustainability.

Publications during the period

- » Bejarano, S., J.-B. Jouffray, I. Chollett, R. Allen, G. Roff, A. Marshall, R. Steneck, S.C. Ferse and P.J. Mumby. 2017. The shape of success in a turbulent world: Wave exposure filtering of coral reef herbivory. *Functional Ecology* 31(6):1312–1324.
- » Norström, A.V., M. Nyström, J.-B. Jouffray, C. Folke, N.A. Graham, F. Moberg, P. Olsson and G.J. Williams. 2016. Guiding coral reef futures in the Anthropocene. *Frontiers*

in Ecology and the Environment 14(9):490-498.

- » Österblom, H., J.-B. Jouffray and J. Spijkers. 2016. Where and how to prioritize fishery reform? *Proceedings of the National Academy of Sciences* 113 (25):E3473-E3474.

Reports

- » Österblom, H. and J.-B. Jouffray (eds) with support from C. Folke, F. Moberg, O. Gaffney and J. Rockström. 2016. *People and the Planet*. Background Brief 1, the Soneva Dialogue. Available online.
- » H. Österblom, and J.-B. Jouffray (eds) with support from V. Lam, and B. Worm. 2016. *Wild Capture Fisheries*. Background Brief 3, the Soneva Dialogue. Available online.
- » H. Österblom, and J.-B. Jouffray (eds) with support from M. Troell and M. Oyinlola. 2016. *Aquaculture*. Background Brief 4, the Soneva Dialogue. Available online.
- » H. Österblom, and J.-B. Jouffray (eds) with support from W. Cheung and R. Rykaczewski. 2016. *Climate Change*. Background Brief 5, the Soneva Dialogue. Available online.
- » H. Österblom, and J.-B. Jouffray (eds) with support from A. Merrie, S. Danielsson and R. Blasiak. 2016. *Governance and Regulations*. Background Brief 6, the Soneva Dialogue. Available online.
- » H. Österblom, and J.-B. Jouffray (eds) with support from A. Merrie and M. Troell. 2016. *Innovations and Market Dynamics*. Background Brief 7, the Soneva Dialogue. Available online.
- » B. Crona, and M. Troell (eds) with support from M. Jonell and J.-B. Jouffray. 2017. *Trade, People and Ecosystems*. Background Brief, the Stockholm Dialogue.

Conferences, workshops and presentations

- » Corporate accounting and finance in the seafood sector, workshop, Stockholm, October 2016. Participant.
- » The Soneva dialogue: Transformative Risks and Opportunities for the Global Seafood Industry, SeaBOS (Seafood Business for Ocean Stewardship) initiative, Keystone dialogues, Soneva Fushi, Maldives, November 2016. Co-organiser and presentation: *Reconnecting to the biosphere*.
- » Corporate accounting and finance in the seafood sector, workshop, Vaxholm, Sweden, January 2017. Participant. Presentation: *Finance and the seafood industry*.
- » The Stockholm dialogue: Advancing the Seafood Business for Ocean Stewardship Initiative, SeaBOS (Seafood Business for Ocean Stewardship) initiative, Keystone dialogues, the Royal Swedish Academy of Sciences, May 2017. Co-organiser and presentation: *Keystone actors in the seafood industry*.

Teaching and training

- » Lecturer, Master's level course *Social-ecological systems: Challenges and approaches*, Stockholm Resilience Centre, Stockholm University, autumn 2016.
- » Co-supervisor of Master's student Emmy Wassenius (Stockholm Resilience Centre, Stockholm University).

Commissions

- » Abstract reviewer for II Conference of the Programme on Ecosystem Change and Society 'Place-based transdisciplinary research for global sustainability'.
- » Advisor to the Fish Tracker Initiative, since 2016.

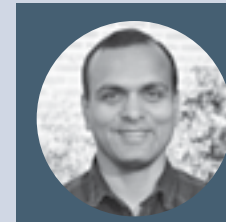
Other

- » Chair of the PhD student council at Stockholm Resilience Centre, Stockholm University, since autumn 2016.



Sofia-Kristin Kokinelis
MSc, Finance and HR Administrator

Sofia-Kristin is Finance and HR Administrator for both the Beijer Institute and the Global Economic Dynamics and the Biosphere Academy Programme (GEDB). 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.



Chandra Kiran Krishnamurthy
PhD, Researcher

Research focus

Resource Economics; Climate, the Environment and Welfare; Economics of Energy; Applied Microeconometrics.

Publications during the period

- » Fishman, R. and C.K.B. Krishnamurthy. 2017. Beijer Discussion Paper 259: An ecological golden rule. *Beijer Discussion Paper Series*.
- » Krishnamurthy, C.K.B. 2017. Optimal management of groundwater under uncertainty: A unified approach. *Environmental and Resource Economics* 67(2):351-377.
- » Vesterberg, M. and C.K.B. Krishnamurthy. 2016. Residential end-use electricity demand: Implications for real time pricing in Sweden. *Energy Journal* 37(4):141-164.

Conferences, workshops and presentations

- » The economics of the planetary boundaries workshop, the Royal Swedish Academy of Sciences, September 2016. Co-organiser.

Teaching and training

- » Course Instructor and examiner, Master's level course *Econometrics I*, Umeå University, Autumn 2016.
- » Lecturer, Master's level course *Environmental and resource economics*, Umeå University, spring 2017.

Commissions

- » Reviewer for *Journal of Environmental Economics and Management* (JEEM), *American Journal of Agricultural Economics*, *The Energy Journal*, *Journal of the American Environmental and Resource Economics Association* and *Annals of Operations Research*.



Christina Leijonhufvud
BA, Chief Administrator

Christina was responsible for the administration of the Board and Askö meetings in September 2016. She also organised the 'Beijer Institute 25 years' in connection with these meetings. In May 2017 she organised the 'Stockholm Dialogue: Advancing the Seafood Business for Ocean Stewardship Initiative' at the Royal Swedish Academy of Sciences and in May/June the 'Beijer Young Scholars Workshop' at the Academy and on the island of Ekskåret. She is responsible for the administration of guest research posts and deals with various office tasks.



Chuan-Zhong Li
Professor, Programme Director

Research focus

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

Publications during the period

- » De Zeeuw, A.D. and C.Z. Li. 2016. The economics of tipping points. *Environmental and Resource Economics* 65:513-517.
- » Li, C.Z. and R. Bali-Swain. 2016. Growth, water resilience, and sustainability: A DSGE model applied to South Africa. *Water Economics and Policy* 2:1-23.
- » 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* 65(3):623-637.
- » Wei, C. and C.Z. Li. 2017. Resource misallocation in Chinese manufacturing enterprises: Evidence from firm-level data. *Journal of Cleaner Production* 142:837-845.

Teaching and training

- » Course leader, lecturer and examiner, Master's level course *Microeconomic theory*, Uppsala University, autumn 2016.

Conferences, workshops and presentations

- » PACE International Symposium on Environmental Economics and Policy in China, Nanjing, China, July 2016. Key-note speaker: *Discounting, climate change and sustainability*.
- » China Economists Society Conference, Nanjing, China, June 2017. Presentation: Income threshold, home appliances and electricity consumption in urban China: A microeconomic analysis.

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.
- » Opponent of PhD candidate George Marbua (Department of Economics, SLU), autumn 2016.



Therese Lindahl
PhD, Program Manager

Research focus

Human behaviour in social-ecological systems, at the intersection of economics, psychology and systems ecology. Influence of complex ecosystem dynamics (e.g. threshold effects, uncertainty, spatial dynamics) on resource users' strategies for exploitation and cooperation and implications for natural resource management. Alternative approaches to environmental policies based on psychological insights.

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* 65:657-676.
- » Lindahl, T., N. Orescovic and A.-S. Crépin. 2016. Playing safe: The role of quotas to avoid ecosystem regime shifts. In: Botelho, A. (ed). *The WSPC Reference on Natural Resources and Environmental Policy in the Era of Global Change. Volume 4: Experimental Economics*. World Scientific, London, UK. pp. 121-150.
- » Nyborg, K., J.M. Anderies, A. Dannenberg, T. Lindahl, C. Schill, M. Schlüter, W.N. Adger, K.J. Arrow, S. Barrett, S. Carpenter, F.S. Chapin III, A.-S. Crépin, G. Daily, P. Ehrlich, C. Folke, W. Jager, N. Kautsky, S.A. Levin, O.J. Madsen, S. Polasky, M. Scheffer, B. Walker, E.U. Weber, J. Wilen, A. Xepapadeas and A. de Zeeuw. 2016. Social norms as solutions. *Science* 354:42-43.
- » Schill, C., N. Wijermans, M. Schlüter and T. Lindahl. 2016. Cooperation is not enough - exploring social-ecological micro-foundations for sustainable common-pool resource use. *PLOS ONE* 11(18):e0157796.

Reports

- » Lindahl, T. 2016. *The Combined Impact of Regime Shifts and Institutional Arrangements on the Management of Common Pool Resources*. Final report to Riksbankens Jubileumsfond (project nr P12-0894:1).

Conferences, workshops and presentations

- » Special Session at the World Congress of Science and Factual Producers (WCSFP), *The Ideas Salon*, December 2016. Panellist.
- » EAT/Stockholm Resilience Centre Stockholm Food Forum Workshop, Stockholm, January 2017. Participant.
- » Workshop for the EAT-Lancet commission: 'Our food in the Anthropocene', London, February 2017. Participant.
- » Workshop on nature and mental health, Annual Symposium of NatCap, Stanford, Palo Alto, USA, March 2017. Participant.
- » Webinar, FResH workstream on consumer behaviour change, World Business Council for Sustainable Development (WBCSD), Geneva, April 2017. Presentation: *Five entry points to consumer behaviour change*.
- » Workshop for the EAT-Lancet commission: 'Our food in the Anthropocene', Stockholm, June 2017. Participant.

Teaching and training

- » Lecturer, Master's level course *Ecosystem support for humanity: Economic approaches to analyse ecosystem support of humanity*, Stockholm Resilience Centre, Stockholm University, autumn 2016.
- » Lecturer, Master's level course *Governance and management of social-ecological systems: Challenges of environmental decision-making*, Stockholm Resilience Centre, Stockholm University, spring 2017.
- » Lecturer, undergraduate course *Ekologisk ekonomi (Ecological economics)*, Department of Physical Geography and Stockholm Resilience Centre, Stockholm University, spring 2017.
- » Main supervisor of PhD candidate Caroline Schill, co-supervisor of PhD candidate Elizabeth (Liz) Drury O'Neill, main supervisor of Master's student Noah Linder (Stockholm Resilience Centre, Stockholm University) and co-supervisor of PhD candidate Lina Isacs (Division of Environmental Strategies Research, Royal Institute of Technology, Stockholm).

Commissions

- » Scientific council member, Fores, Stockholm, since 2010.
- » Scientific advisor, EAT forum, Stockholm, since 2015.
- » Contributor to EAT-Lancet commission, since 2016.
- » Reserve member of PhD evaluation committee for PhD candidate Linus Hasselström (Division of Environmental Strategies Research, Royal Institute of Technology), Stockholm, November 2016.
- » Reviewer for *Nature Human Behaviour*, *Scandinavian Journal of Economics*, *Ecological Economics*, *Ecology and Society* and *Rethink*.

Other

- » Popular science communication: Ingen förändring kommer att ske utan samarbete (There will be no change without cooperation). Lindahl, T. *Klimatmagasinet Effekt*, Stockholm, 10 May 2017. Available online.
- » Popular science communication: Så minns vi Kenneth Arrow från mötena på Askö (This is how we remember Kenneth Arrow from the meetings at Askö). Crepin, A.-S., C. Folke and T. Lindahl. *Ekonomistas* (blog), Stockholm, 28 February 2017. Available online.



Daniel Ospina
PhD candidate, Researcher

Research focus

Coupled changes in rural livelihoods and landscapes in developing regions, amidst increasing global connectivity and urbanisation; in particular, understanding the effects of rural out-migration and remittance flows on land use, particularly the conditions under which it may lead to farmland abandonment and forest regrowth.

Publications during the period

- » Haider, L.J., J. Hentati-Sundberg, M. Giusti, J. Goodness, M. Hamann, V.A. Masterson, M. Meacham, A. Merrie, D. Ospina, C. Schill and H. Sinare. 2017. The undisciplinary journey: early-career perspectives in sustainability science. *Sustainability Science*. First online. doi:10.1007/s11625-017-0445-1.

Conferences, workshops and presentations

- » *Introduction to spatial agent-based modeling* (course), SES-YNC, Annapolis (MD), USA, December 2016. Participant.
- » *How to model human decision-making in social-ecological agent-based models* (course), Arizona State University, Tempe (AZ), USA, January 2017. Participant.

Teaching and training

- » Lecturer and teaching assistant, Master's level course *Systems theory and resilience thinking - Module 5: Regime shifts*, Stockholm Resilience Centre, Stockholm University, autumn 2016.

Other

- » Vice-chair of the PhD student council at Stockholm Resilience Centre, Stockholm University, since autumn 2016.
- » Research assistant for the Beijer Institute programme Global Dynamics and Resilience.



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 system archetypes and identifying regime shifts in data-poor or developing country contexts.

Publications during the period

- » Peterson, G. and J. Rocha. 2016. Arctic regime shifts and

resilience (Chapter 3). In: *Arctic Council (2016) Arctic Resilience Final Report*. Carson, M. and G. Peterson (eds). Stockholm Environmental Institute and Stockholm Resilience Centre.

- » Huitric, M., G. Peterson and J. Rocha. 2016. What factors build or erode resilience in the Arctic (Chapter 4). In: *Arctic Council (2016) Arctic Resilience Final Report*. Carson, M. and G. Peterson (eds). Stockholm Environmental Institute and Stockholm Resilience Centre.

Conferences, workshops and presentations

- » The Ecological Society of America meeting, Fort Lauderdale, USA, August 2016. Invited presenter: *Regime shifts in the Anthropocene*.
- » Resilience Alliance Young Scholars workshop, Atlanta, USA, September 2016. Participant.
- » Conference on Complex Systems 2016, Amsterdam, The Netherlands, September 2016. Presentations: *Behavioural experiments in social-ecological systems with thresholds* and *Cascading effects of critical transitions in social-ecological systems*.
- » Envisioning future workshop, South American Institute for Resilience and Sustainability Studies (SARAS), Maldonado, Uruguay, December 2016. Participant.
- » National Socio-Environmental Synthesis Center (SES-YNC), Annapolis, USA, May 2017. Invited talk: *Cascading effects of critical transitions in social-ecological systems*.
- » Beijer Young Scholars Workshop on Inequality and the Biosphere, the Royal Swedish Academy of Sciences and Ekskäret, Stockholm, May/June 2017. Participant.

Commissions

- » Contributing author, IPBES (International Panel for Biodiversity and Ecosystem Services), since 2017.
- » Research proposal evaluator for Fond National de la Recherche, Luxembourg.
- » Research proposal evaluator for Wageningen University, The Netherlands.
- » Reviewer for *Ecology and Society*, *Water, Sustainability Science*, *BioScience*, *Redes*, *Ambio* and *PLOS ONE*.



Caroline Schill
PhD candidate (PhD since May 2017), Researcher

Research focus

Human behaviour in social-ecological systems. In particular, how individual and collective behaviours respond to, and are shaped by, non-linear environmental change and inherent uncertainties in common-pool resource systems.

Publications during the period

- » Haider, L.J., J. Hentati-Sundberg, M. Giusti, J. Goodness, M. Hamann, V.A. Masterson, M. Meacham, A. Merrie, D. Ospina, C. Schill and H. Sinare. 2017. The undisciplinary journey: early-career perspectives in sustainability science.

Sustainability Science. First online. doi:10.1007/s11625-017-0445-1.

- » Lindahl, T., A-S. Crépin and C. Schill. 2016. Potential disasters can turn the tragedy into success. *Environmental and Resource Economics* 65:657-676.
- » Nyborg, K., J.M. Anderies, A. Dannenberg, T. Lindahl, C. Schill, M. Schlüter, W.N. Adger, K.J. Arrow, S. Barrett, S. Carpenter, F.S. Chapin III, A.-S. Crépin, G. Daily, P. Ehrlich, C. Folke, W. Jager, N. Kautsky, S.A. Levin, O.J. Madsen, S. Polasky, M. Scheffer, B. Walker, E.U. Weber, J. Wilen, A. Xepapadeas and A. de Zeeuw. 2016. Social norms as solutions. *Science* 354:42-43.
- » Schill, C. 2017. *Human Behaviour in Social-Ecological Systems: Insights from Economic Experiments and Agent-based Modelling*. Doctoral thesis in Sustainability Science. Stockholm Resilience Centre, Stockholm University.
- » Schill, C., N. Wijermans, M. Schlüter and T. Lindahl. 2016. Cooperation is not enough - exploring social-ecological micro-foundations for sustainable common-pool resource use. *PLOS ONE* 11(18):e0157796.

Conferences, workshops and presentations

- » Kappa seminar (PhD thesis review seminar), Stockholm Resilience Centre, Stockholm University, March 2017.
- » Defence of PhD thesis *Human Behaviour in Social-Ecological Systems: Insights from Economic Experiments and Agent-based Modelling* (opponent: Juan Camilo Cárdenas, Universidad de los Andes, Bogotá, Colombia), Stockholm University, May 2017.
- » Beijer Young Scholars Workshop on Inequality and the Biosphere, the Royal Swedish Academy of Sciences and Ekskärret, Stockholm, May/June 2017. Participant.

Teaching and training

- » Lecturer and examiner, Master’s level course *Governance and management of social-ecological systems: Drama of the commons*, Stockholm Resilience Centre, Stockholm University, spring 2017.



Agneta divides her time between the Beijer Institute and its partner, the Academy programme Global Economic Dynamics and the Biosphere Programme (GEDB). Her responsibilities include developing and editing the website and the annual report and administering the Beijer publication series, as well as organising workshops and other events. A member of Stockholm Resilience Centre’s (SRC) communications team, Agneta is involved in activities arranged jointly by SRC, the Beijer Institute and Albaeco, for example the Stockholm Seminars series. In addition, she was co-organiser and host for the *Beijer 25 Years* celebration in September 2016, co-organiser of the Beijer Young Scholars workshop 29 May–2 June 2017 and the coral reef project with Beckman School of Design (described in the Science in society section of this report).



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 metrics, LCA, eco-certification.

Publications during the year

- » 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. Williams. 2016. Contribution of fisheries and aquaculture to food security and poverty reduction: Assessing the current evidence. *World Development* 79:177-196.
- » Crona, B., T. Daw, W. Swartz, A. Norström, M. Nyström, M. Thyresson, C. Folke, J. Hentati-Sundberg, H. Österblom, L. Deutsch and M. Troell. 2016. Masked, diluted, drowned out: Global seafood trade weakens signals from marine ecosystems. *Fish and Fisheries* 17:1175-1182.
- » Gephart, J.A., L. Deutsch, M.L. Pace, M. Troell and D.A. Seekell. 2017. Shocks to fish production: Identification, trends, and consequences. *Global Environmental Change* 42:24-32.
- » Gephart, J. A., M. Troell, P.J.G. Henriksson, M.C.M. Beveridge, M. Verdegem, M. Metian, L.D. Mateos and L. Deutsch. The ‘seafood gap’ in the food-water nexus literature — issues surrounding freshwater use in seafood production chains. *Advances in Water Resources*. In press.
- » Jonell, M., B. Crona, K. Brown, P. Rönnbäck and M. Troell. 2016. Eco-labeled seafood: Determinants for (blue) green consumption. *Sustainability* 8(9):884.
- » Moksnes, P.-O., D. Mirera, R. Lokina, J. Ochiewo, H. Mahudi, N. Jiddawi, M. Hamad and M. Troell. 2016. Feasibility of extensive, small-scale mud crab (*Scylla serrata*) farming in East Africa. *Western Indian Journal of Marine Science* 14(1&2)(2015):23-38.
- » Österblom, H., B.I. Crona, C. Folke, M. Nyström and M. Troell. 2017. Marine ecosystem science on an intertwined planet. 20th Anniversary Paper. *Ecosystems* 20:54-61.
- » Troell, M., F. Ziegler and P. Henriksson. 2016. Is fish a fish - adding fish to the global food sustainability transformation. eLetter. *Science* 353(6305):1202-1204.
- » Troell, M., N. Kautsky, M. Beveridge, P. Henriksson, J. Primavera, P. Rönnbäck, C. Folke and M. Jonell. 2017. Aquaculture. In: *Reference Module in Life Sciences*. Elsevier, ISBN: 978-0-12-809633-8.

Reports

- » Crona, B. and M. Troell (eds) with support from M. Jonell and J.-B. Jouffray. 2017. *Trade, People and Ecosystems*. Background Brief, the Stockholm Dialogue.

- » Havenhand, J., A.-S. Crépin, H.L. Filipsson, S. Jagers, D. Langlet, S. Matti, S. Niiranen, M. Troell and L.G. Anderson. 2017. *Acidification of Swedish Seas in a Changing Environment: Causes, Consequences, and Responses – An Interdisciplinary Review of Current Knowledge, Knowledge Gaps, and Implementation Needs*. Report of the Environmental Committee of the Royal Swedish Academy of Sciences, Stockholm, Sweden. Available online.
- » Österblom, H. and J.-B. Jouffray (eds) with support from M. Troell and M. Oyinlola. 2016. *Aquaculture*. Background Brief 4, the Soneva Dialogue. Available online.
- » Österblom, H. and J.-B. Jouffray (eds) with support from A. Merrie and M. Troell. 2016. *Innovations and Market Dynamics*. Background Brief 7, the Soneva Dialogue. Available online.
- » Troell, M. and M. Jonell (eds) with support from P. Henriksson. 2017. *Seafood for Human and Planetary Health*. Background Brief, the Stockholm Dialogue.

Conferences, workshops and presentations

- » Workshop for the EAT-Lancet commission: ‘Our food in the Anthropocene’, London, September/October 2016. Participant.
- » Ocean acidification/Anthropogenic stressors workshop, Gothenburg University, Gothenburg, October 2016. Presentation: *Acidification and seafood production*.
- » Joint workshop with REACT on antibiotic resistance, Stockholm Resilience Centre, January 2017. Presentation: *AMRs in aquaculture*.
- » Workshop for the EAT-Lancet commission: ‘Our food in the Anthropocene’, London, February 2017. Participant.
- » Planning meeting: Connecting and Protecting Our Seas: Initiatives in the Baltic and the Mediterranean, Prince Albert II of Monaco Foundation/Swedish Embassy Paris, Monaco, April 2017. Participant.
- » The Stockholm dialogue: Advancing the Seafood Business for Ocean Stewardship (SeaBOS) Initiative. Keystone dialogues, the Royal Swedish Academy of Sciences, May 2017. Participant and presentation.
- » Life Cycle Assessments workshop (Seawin project), the Beijer Institute and Stockholm Resilience Centre, Askö, Sweden, June 2017. Co-organiser.
- » EAT Competence Forum: Fish Futures – sustainable seafood to support the SDGs, Clarion Sign Hotel, Stockholm, June 2017. Organiser and presentation: *Seafood’s role for improving human and planetary health*.
- » EAT Stockholm Food Forum, Stockholm, June 2017. Participant.
- » Workshop for the EAT-Lancet commission: ‘Our food in the Anthropocene’, Stockholm, June 2017. Participant.
- » Features of resilient global food systems workshop, Stockholm Resilience Centre and Stanford University, Vår Gård, Stockholm, June 2017. Participant and presentation.

Teaching and training

- » Lecturer, undergraduate course *Världens Eko*, Stockholm Resilience Centre, Stockholm University, November 2016.
- » Lecturer, Master’s course *Management of aquatic resources in the tropics*, Stockholm University, February 2017.
- » Supervisor of PhD candidate Malin Jonell (Department of Ecology, Environment and Plant Sciences, Stockholm

University, PhD Defence November 2016); co-supervisor of PhD candidate M. Oyinlola (Nereus PhD Fellowship, University of British Colombia, Vancouver, Canada); and member of supervisor committee of J. Timor (IFREMER, Plouzané, France).

- » Supervisor of postdoc Patrik Henriksson (Stockholm Resilience Centre, Stockholm University).

Commissions

- » Member of ICES 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 2016.
- » Evaluator of Marine Science for Management (MASMA) Program, WIOMSA, Mombasa, Kenya, October 2016.
- » Evaluator of SWEDBIO Worldfish Project, Worldfish, East Timor, November 2016.
- » Evaluator of Extended Research Proposal of PhD candidate Victoria Bignet (Stockholm Resilience Centre, Stockholm University), December 2016.
- » Chair of PhD defence of Helen Moor and Caroline Schill (Stockholm Resilience Centre, Stockholm University), November 2016 and May 2017.
- » Review editor for *Journal of Aquaculture Environment Interactions* (AEI) and *Frontiers in Marine Science*.
- » Journal Reviewer for *Aquaculture Research*, *Aquaculture*, *Nature*, *WIOJMS* and *Journal of Fisheries and Aquaculture*.

The Beijer Publication Series

Scientific papers by Beijer staff or Beijer fellows, published in refereed journals or in books that have undergone review, are 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 495, of which 38 were published on our website between July 2016 and June 2017. 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. 259 discussion papers have been produced since 1991.

E-Print Series

2017

- » **495.** Residential end-use electricity demand: Implications for real time pricing in Sweden. Vesterberg, M. and C.K.B Krishnamurthy (2016). *Energy Journal* 37(4):141-164.
- » **494.** Aquaculture. Troell, M., N. Kautsky, M. Beveridge, P. Henriksson, J. Primavera, P. Rönnbäck, C. Folke and M. Jonell (2017). In: *Reference Module in Life Sciences*. Elsevier, ISBN: 978-0-12-809633-8.
- » **493.** Indonesian aquaculture futures: An analysis of fish supply and demand in Indonesia to 2030 and role of aquaculture using the AsiaFish model. Tran, N., U.-P. Rodriguez,

- C.Y. Chan, M.J. Phillips, C.V. Mohan, P.J.G. Henriksson, S. Koeshendrajana, S. Suri and S. Hall (2017). *Marine Policy* 79:25-32.
- » **492.** Weaving knowledge systems in IPBES, CBD and beyond: Lessons learned for sustainability. Tengö, M., R. Hill, P. Malmer, C.M. Raymond, M. Spierenburg, F. Danielsen, T. Elmqvist and C. Folke (2017). *Current Opinion in Environmental Sustainability* 26-27:17-25.
 - » **491.** Arctic regime shifts and resilience (Chapter 3). Peterson, G. and J. Rocha (2016). *In: Arctic Council (2016) Arctic Resilience Final Report*. Carson, M. and G. Peterson (eds). Stockholm Environmental Institute and Stockholm Resilience Centre.
 - » **490.** Environmental impact of non-certified versus certified (ASC) intensive Pangasius aquaculture in Vietnam, a comparison based on a statistically supported LCA. Nhu, T.T., T. Schaubroeck, P.J.G. Henriksson, R. Bosma, P. Sorgeeloos and J. Dewulf (2016). *Environmental Pollution* 219:156-165.
 - » **489.** How spatial scale shapes the generation and management of multiple ecosystem services. Lindborg, R., L.J. Gordon, R. Malinga, J. Bengtsson, G. Peterson, R. Bommarco, L. Deutsch, Å. Gren, M. Rundlöf and H.G. Smith (2017). *Ecosphere* 8(4):e01741.
 - » **488.** Resilience offers escape from trapped thinking on poverty alleviation. Lade, S.J., L.J. Haider, G. Engström and M. Schlüter (2017). *Science Advances* 3(5):e1603043.
 - » **487.** Optimal management of groundwater under uncertainty: A unified approach. Krishnamurthy, C.K.B. (2017). *Environmental and Resource Economics* 67(2):351-377.
 - » **486.** What factors build or erode resilience in the Arctic (Chapter 4). Huitric, M., G. Peterson and J. Rocha (2016). *In: Arctic Council (2016) Arctic Resilience Final Report*. Carson, M. and G. Peterson (eds). Stockholm Environmental Institute and Stockholm Resilience Centre.
 - » **485.** Indonesian aquaculture futures – Evaluating environmental and socioeconomic potentials and limitations. Henriksson P.J.G., N. Tran, C.V. Mohan, C.Y. Chan, U.-P. Rodriguez, S. Suri, L.D. Mateos, N.B. Priyo Utomo, S. Hall and M.J. Phillips. (2017). *Journal of Cleaner Production* 162:1482-1490.
 - » **484.** Evaluation of different aquaculture feed ingredients in Indonesia Using Life Cycle Assessment. Henriksson, P. J.G., C.V. Mohan and M.J. Phillips (2017). *Indonesian Journal of Life Cycle Assessment and Sustainability* 1(2):13-21.
 - » **483.** Benchmarking the environmental performance of best management practice and genetic improvements in Egyptian aquaculture using life cycle assessment. Henriks-son, P.J.G., M. Dickson, A.N. Allah, D. Al-Kenawy and M. Phillips (2017). *Aquaculture* 468:53-59.
 - » **482.** Measures of difference and significance in the era of computer simulations, meta-analysis, and big data. Heijungs, R., P.J.G. Henriksson and J.B. Guinée (2016). *Entropy* 18(10):361.
 - » **481.** Pre-calculated LCI systems with uncertainties cannot be used in comparative LCA. Heijungs, R., P.J.G. Henriks-son and J.B. Guinée (2017). *International Journal of Life Cycle Assessment* 22(3):461.
 - » **480.** The undisciplined journey: Early-career perspectives in sustainability science. Haider, L.J., J. Hentati-Sundberg, M. Giusti, J. Goodness, M. Hamann, V.A. Masterson, M. Meacham, A. Merrie, D. Ospina, C. Schill and H. Sinare (2017). *Sustainability Science*. First online. doi:10.1007/s11625-017-0445-1.
 - » **479.** Capturing the value of green space in urban parks in a sustainable urban planning and design context: pros and cons of hedonic pricing. Engström, G. and Å. Gren (2017). *Ecology and Society* 22(2):21.
 - » **478.** The economics of tipping points. De Zeeuw, A.D. and C.Z. Li (2016). *Environmental and Resource Economics* 65:513-517.
 - » **477.** Resilience and development: Mobilizing for transformation. Bousquet, F., A. Botta, L. Alinovi, O. Barreteau, D. Bossio, K. Brown, P. Caron, M. D'Errico, F. DeClerck, H. Dessard, E. Enfors Kautsky, C. Fabricius, C. Folke, L. Fortmann, B. Hubert, D. Magda, R. Mathevet, R.B. Norgaard, A. Quinlan and C. Staver (2016). *Ecology and Society* 21(3):40.
 - » **476.** The shape of success in a turbulent world: Wave exposure filtering of coral reef herbivory. Bejarano, S., J.B. Jouffray, I. Chollett, R. Allen, G. Roff, A. Marshall, R. Ste-neck, S.C. Ferse and P.J. Mumby (2017). *Functional Ecology* 31(6):1312-1324.
 - » **475.** The risks of nuclear disaster and its impact on housing prices. Ando, M., M. Dahlberg and G. Engström (2017). *Economics Letter* 154:13-16.
 - » **474.** Resource misallocation in Chinese manufacturing enterprises: Evidence from firm-level data. Li, C.Z. and Wei, C. (2017). *Journal of Cleaner Production* 142, 837-845.
 - » **473.** Growth, water resilience , and sustainability: A DSGE model applied to South Africa. Li, C.Z. and R.B. Swain (2016). *Water Economics and Policy* 2(4):1-23.
 - » **472.** Planetary boundaries—governing emerging risks and opportunities. Galaz, V., A. De Zeeuw, H. Shiroyama and D. Tripley. (2016). *Solutions* 7(3):46-54.
 - » **471.** Structural and climatic change. Engström, G. (2016). *Structural Change and Economic Dynamics* 37:62-74. <http://dx.doi.org/10.1016/j.strueco.2015.11.007>
 - » **470.** Shocks to fish production: Identification, trends, and consequences. Gephart, J.A., L. Deutsch, M.L. Pace, M. Troell and D.A. Seekell. (2017). *Global Environmental Change* 42:24-32.
 - » **469.** Transboundary capital and pollution flows and the emergence of regional inequalities. Levin, S. and A. Xepapadeas. (2017). *Discrete and Continuous Dynamical Systems - Series B (DCDS-B)* 22(3):913-922.

2016

- » **468.** Is fish a fish - adding fish to the global food sustainability transformation. Troell, M., F. Ziegler and P. Henriks-son (2016). *Science* 353(6305):1202-1204.
- » **467.** Where and how to prioritize fishery reform? Österb-lom, H., J.-B. Jouffray and J. Spijkers (2016). *Proceedings of the National Academy of Sciences*, 113 (25):E3473-E3474.
- » **466.** Maintaining cooperation in social-ecological systems: Effective bottom-up management often requires sub-opti-mal resource use. Tilman, A.R., J.R. Watson and S. Levin (2016). *Theoretical Ecology*. 10(2):155-165.
- » **465.** Quantifying spatial resilience. Allen, C.R., D.G. An-geler, G.S. Cumming, C. Folke, D. Twidwell and D.R. Uden (2016). *Journal of Applied Ecology*: 53:625-635.
- » **464.** Resilience (Republished). Folke, C. (2016). *Ecology and Society* 21(4):44.

- » **463.** Social-ecological resilience and biosphere-based sustainability science. Folke, C., R. Biggs, A.V. Norström, B. Reyers and J. Rockström (2016). *Ecology and Society* 21(3):41.
- » **462.** Feasibility of extensive, small-scale mud crab (*Scylla serrata*) farming in East Africa. Moksnes, P.-O., D. Mirera, R. Lokina, J. Ochiewo, H. Mahudi, N. Jiddawi, M. Ham-ad and M. Troell (2015). *WIO Journal of Marine Science* 14(1 & 2): 23-38.
- » **461.** Cooperation is not enough—exploring social-eco-logical micro-foundations for sustainable common-pool resource use. Schill, C., N. Wijermans, M. Schlüter and T. Lindahl (2016). *PLoS ONE* 11(8): e0157796.
- » **460.** Guiding coral reef futures in the Anthropocene. Nor-ström, A., M. Nyström, J. Jouffray, C. Folke, N. Graham, F. Moberg, P. Olsson and G. Williams (2016). *Frontiers in Ecol-ogy and the Environment* 14(9):490-498.
- » **459.** Social norms as solutions. Nyborg, K., Anderies, J.M., Dannenberg, A., Lindahl, T., Schill, C., Schlüter, M., W.N. Adger, K.J. Arrow, S. Barrett, S. Carpenter, F.S. Chapin III, A.-S. Crépin, G. Daily, P. Ehrlich, C. Folke, W. Jager, N. Kautsky, S.A. Levin, O.J. Madsen, S. Polasky, M. Scheffer, B. Walker, E.U. Weber, J. Wilen, A. Xepapadeas and A. de Zeeuw (2016). *Science* 354(6308): 42-43.
- » **458.** Eco-labeled seafood: Determinants for (blue) green consumption. Jonell, M., B. Crona, K. Brown, P. Rönnbäck and M. Troell (2016). *Sustainability* 8(9), 884.
- » **457.** Use antimicrobials wisely. Jørgensen, P.S., W. Didier, S.P. Carroll, R.R. Dunn, S. Harbarth, R. Laxminarayan, S.A. Levin, A.D. So and M. Schlüter (2016). *Nature* 537: 159-161.

Discussion Papers

- » **259.** An ecological golden rule. Ram Fishman and Chandra Kiran Krishnamurthy. 2017.
- » **258.** An energy-centric theory of agglomeration. Juan Moreno-Cruz and M. Scott Taylor. 2016.

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ANNUAL REPORT 2016/2017



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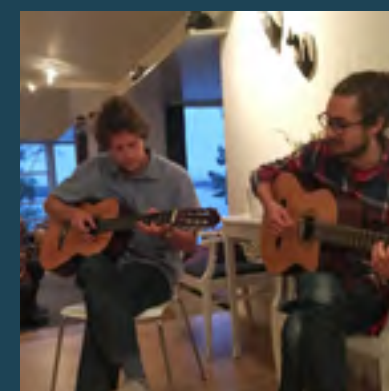
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1. Karl-Göran Mäler and Carl Folke at the 25th Anniversary celebrations.
2. Aisha Dasgupta and Scott Barrett at the Askö meeting.
3. Jean-Baptiste Jouffray and Karolin A. Johansson, Marshal of the Court for Crown Princess Victoria, at the Soneva Keystone dialogue.
4. The Beijer Institute Board.
5. Frau Dr Caroline Schill with her supervisors Anne-Sophie Crépin, Johan Colding, Carl Folke and Therese Lindahl.
6. Outdoor work session during the Beijer Young Scholars workshop.
7. Juan Carlos Rocha, Carl Folke and Caroline Schill at the Beijer Young Scholars workshop.
8. Tom Chaigneau and Jonas Hentati Sundberg at the Beijer Young Scholars workshop.
9. Christina Leijonhufvud, Gretchen Daily and Partha Dasgupta at the Askö meeting.

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.

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This Annual Report covers the period 1 July 2016 – 30 June 2017.

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