The Beijer Institute of Ecological Economics

Annual Report 2009/2010






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The major objectives of the Beijer Institute are to carry out research and stimulate cooperation between scientists, university departments, research centres and institutes to promote a deeper understanding of the interplay between ecological systems and social and economic development.

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Director's column

by *Carl Folke*, Director, the Beijer Institute

LIVING WITH CHANGE is part of the reality of any activity. Change is threatening to some, while others see it as an opportunity for new things. As a dynamic research institute, we are excited about managing the crucial balance of continuity and change. This year we have started new initiatives and restructured ongoing activities into research programmes, reviving the idea of programme directors from the early days of the Beijer Institute of Ecological Economics. The five research programmes focus on aquaculture and sustainable seafood production; behavioural economics and nature networks; complex systems; global dynamics and resilience; and urban social-ecological systems. We have received new grants for several of the activities of these programmes and organised very stimulating and productive workshops during the year. Many thanks to the programme directors and all others engaged in efforts of building new networks of collaboration, organising the activities, bringing in young researchers and raising critical funds.

The key focus of the Beijer Institute is to stimulate and perform collaborative research between economists and ecologists and related disciplines on fundamental and applied problems in relation to sustainability. We carry out teaching and training on those issues nationally and internationally, advising practice and policy, and communicating and disseminating insights and results. The Beijer Institute is a small body in terms of staff but with a large network of hundreds of respected scholars worldwide, including the regional networks in environmental economics.

Jeff Vincent and Aart de Zeeuw are doing a great job in nurturing the activities of the regional networks, through meetings, workshops, courses and the Mäler Scholarship, thanks to which we have hosted four researchers from Argentina, Benin and India this year. Our Chairman of the Board, Tasos Xepapadeas, continues to successfully edit the journal *Environment and Development Economics*. Although Aart has taken on the position of Scientific Director of the new Tilburg Sustainability Center in the Netherlands, and has stepped down as co-director of the Beijer, he is still very active in the Beijer Institute in his roles as director of the complex systems programme and as a new member of the Board of Directors. We are very happy about Aart's continued engagement in the Beijer Institute, which is of great significance. Anna Sundbaum, who worked with us for the last ten years, has moved on to practise Beijer findings in Stockholm County Council's environmental department. We will very much miss Anna, while warmly welcoming Agneta Sundin back to the Beijer Institute.

PHOTO: CECILIA NORDSTRAND

At the Board meeting last year we welcomed Anne-Sophie Crépin as Deputy Director – she is doing a fantastic and professional job in her new role. Gunnar Öquist has now left his post as Permanent Secretary of the Royal Academy, which he took on in 2003. Gunnar Öquist has been very engaged and instrumental in supporting Beijer strategies and activities. He has worked hard for further engagement of the Academy in global change research, reflected among other things in the new Swedish Secretariat for Environmental Earth System Sciences (SSEESS) hosted by the Academy and with Beijer involved. Staffan Normark, Professor in Medical Microbiology at the Karolinska Institute and the Swedish Institute for Infectious Disease Control, has been appointed to the post of Permanent Secretary from 1 July 2010 and we are very much looking forward to working with him.

Surprises happen as part of continuity and change. A pleasant one was the publication of a paper in *Nature* (A safe operating space for humanity) and one in *Science* (Looming global-scale failures and missing institutions) in the same month (September) last year, the first time in Beijer history! The *Science* paper was the result of an Askö meeting led by Brian Walker and the *Nature* paper an outcome of the collaboration with the Stockholm Resilience Centre. The annual Askö meeting in September focused on uncertainty, complex systems and decision-making. Steve Schneider participated in this Askö meeting, lively, insightful and engaged as always. His expertise was very much needed. It came as a sad surprise that Steve passed away on 19 July. His important contributions to the climate challenge have left deep imprints.

It is simply wonderful that Elinor Ostrom received the 2009 Prize in Economic Sciences in Memory of Alfred Nobel. Lin's engagement with Beijer has been profound throughout the years in research programmes, in the Board of Directors, in the Resilience Alliance, as a Beijer Fellow and now in the board of the Stockholm Resilience Centre. We had the great pleasure of hosting the celebration of Sir Partha Dasgupta and his achievements, following the World Bank ABCDE symposium in late May in Stockholm. Beijer fellows and Nobel laureates toasted Sir Partha and we all are most thankful for his contributions and support of the Beijer Institute. Many seminars have been organised and several visiting researchers have stayed with us this year. Dieter Grass from Vienna and Marty Anderies and family, from Arizona, stayed for the longest periods and contributed a lot through insights and inspiration.

There are intense collaborations with the Stockholm Resilience Centre, our joint institute with Stockholm Environment Institute and Stockholm University. Two reports for the Swedish Government were produced during the Swedish chairmanship of the European Union. We also organised a two-day seminar for government officials throughout Europe on the value of the marine environment and were engaged in The Economics of Ecosystems and Biodiversity (TEEB) effort. Beijer will play a significant role in the new global change Program on Ecosystem Change and Society (PECS), chaired by Steve Carpenter, with Beijer fellows and the Beijer director on the scientific committee. The International Council for Science has asked the Stockholm Resilience Centre to serve as the International Programme Office of PECS. PECS, a truly interdisciplinary scientific program and a follow-up of the Millennium Ecosystem Assessment, will try to determine how policies and practices affect the resilience of the portfolio of ecosystem services that support human well-being and allow for adaptation to a changing environment. PECS will provide scientific knowledge to the newly established Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES).

It is immensely rewarding to note that pioneering interdisciplinary research in ecological economics by the Beijer Institute is being disseminated through science and the science-policy interface worldwide and is making an impact. We are extremely privileged and grateful for the long-term investment of the Kjell and Märta Beijer Foundation in the Beijer Institute making this possible. I would personally like to thank Anders Wall and the members of the Beijer Foundation for their trust in our efforts and commitment to research for deeper understanding of the interplay between ecological systems and prosperous social and economic development.

Carl Folke
Stockholm, 22 August 2010

PHOTO: CECILIA NORDSTRAND

In October 2009, **Anne-Sophie Crépin** became the new Deputy Director of the Beijer Institute of Ecological Economics. While still working on her PhD, Anne-Sophie joined the Beijer Institute in 1998 under the leadership of Karl-Göran Mäler. As an economist her main interests lie in natural resource management and complex systems. Most of her work is based on small theoretical dynamic models that combine relevant economic factors with complex ecosystem dynamics. According to Anne-Sophie, her first year as Deputy Director has been exciting and stimulating but also challenging:

"As I see it, one of my main tasks is to promote the development of a critical mass of really good economists placed at the Beijer Institute to work on issues related to our research programmes", says Anne-Sophie, who also is a council member for the European Association of Environmental and Resource Economics "I have really enjoyed becoming much more involved in Beijer's research strategy planning this year and I look forward to a continued constructive collaboration with Carl and all the Beijer fellows on these and other issues",.

PHOTO: CECILIA NORDSTRAND

The staff and networks of the Beijer Institute have worked closely together with Professor **Gunnar Öquist** during his period as Permanent Secretary of the Royal Swedish Academy of Sciences. It has been most inspiring and encouraging following his vision and action in mobilising a range of expertise across the Academy as a whole and making it policy relevant. He has been instrumental in highlighting the global challenges facing humanity and is a strong supporter of the work of the Beijer Institute. Gunnar is now stepping down from his position as Permanent Secretary and we would like to thank him immensely for these productive years. We feel privileged to have had the opportunity and the great pleasure of collaborating with him.

PHOTO: CECILIA NORDSTRAND

Anna Sundbaum left the Beijer Institute at the end of April and has moved on to Stockholm County Council to work on environmental issues. Anna joined the Institute in October 2000 and spent almost 10 years with us! She worked mainly with information and communication, one of her main tasks being to edit our Annual Report, which evolved over the years from a black and white photo-copied version to a printed, nicely laid out colour report. In recent years she devoted a lot of time and energy to the Beijer website and to editing the forthcoming book on the Askö meetings. She was also responsible for budgetary and accounting issues. However, working at a small institute like the Beijer means having to turn one's hand to a great variety of tasks – organising meetings, workshops, seminars, staff events and renovation of the offices, helping guests and visitors, fixing things that are not working, ordering new supplies, cooking and serving the food at Askö – to mention but a few. Anna carried out all these tasks with honours. We will miss her – and we wish her the best of luck in the future!

Transdisciplinary science in the limelight

by *Agneta Sundin*, Communications Officer
and *Sturle Hauge Simonsen*, Stockholm Resilience Centre

"THE ROYAL SWEDISH Academy of Sciences has decided to award the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel for 2009 to Elinor Ostrom, Indiana University, Bloomington, USA, '*for her analysis of economic governance, especially the commons*'."

The joy was immense when the Beijer staff assembled in the Session Hall of the Royal Swedish Academy of Sciences for the announcement of the Prize in Economic Sciences heard those words from Gunnar Öquist, Permanent Secretary of the Academy.

Beijer fellow Elinor Ostrom is a long-time research associate of the Beijer Institute. She served on the Beijer Board between 1997 and 2002; she has attended several of the Askö meetings and was very active in the Beijer Institute's Property Rights Programme. She is currently serving on the board of the Stockholm Resilience Centre.

"Elinor Ostrom's work on collective action and common pool resource governance has been a great source of inspiration and has shaped our research on social-ecological systems and resilience thinking", says Beijer Director Carl Folke.

▼ Carl Folke, Karl-Göran Mäler, Economics Laureate Elinor Ostrom and Anders Wall, Chairman of the Kjell and Märta Beijer Foundation, at the Nobel Banquet.

PHOTO: SARA ANYIAR

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▶ Elinor Ostrom receiving her Prize from His Majesty King Carl XVI Gustaf of Sweden at the Stockholm Concert Hall, 10 December 2009.

Ostrom has with her studies of user-managed fish stocks, pastures, woods, lakes and groundwater basins shown that resource users frequently develop sophisticated mechanisms for decision-making and rule enforcement to handle conflicts of interest. She has found that self-governance and community-driven projects often work better than ineffective and ill-informed rules of governments. Trust is a key feature for successful governance. However, she cautions against the tendency to believe in a blue print solution for sustainable management of social-ecological systems.

"It's crucial to build enough diversity to cope with the diversity of the world and allow multi-tile systems with multiple scales so that you don't have a uniform, top-down panacea that is predicted to solve everything", explains Elinor Ostrom.

She emphasises that a major challenge for the research community is to bridge the divide between the social sciences and the ecological sciences, research at the core of the Beijer Institute's work.

"Elinor Ostrom has long recognised the importance of collaborations across many disciplines for improved stewardship of the commons and our life-supporting environment. Her work on governing the commons illustrates the significance of collective action and trust", says Carl Folke.

The main focus of Elinor Ostrom's current research is to get a deeper understanding of social-ecological systems.

"For instance we want to look at inshore fisheries, where we have seen some great successes but also big failures. We want to understand why," she says, adding that this work includes continued cooperation with researchers at the Beijer Institute and Stockholm Resilience Centre.

"Together we are trying to develop a better way of looking at variables on an ecological level that affect the ability of social systems to self-organise", concludes the 2009 Laureate of the Prize in Economic Sciences.

The new programmes and research structure of the Beijer Institute

In the early days of the Beijer Institute, research programmes formed the core of Beijer activities. The Institute leadership and its board have decided to revive this approach. As of 2010, the Beijer research activities will take place under five thematic areas and research programmes.

Aquaculture and Sustainable Seafood Production
LED BY MAX TROELL
AND CARL FOLKE

Behavioural Economics and Nature Network (BENN)
LED BY JASON SHOGREN
AND THERESE LINDAHL

Complex Systems
LED BY AART DE ZEEUW
AND CHUAN-ZHONG LI

Global Dynamics and Resilience
LED BY ANNE-SOPHIE CREPÍN,
STEVE POLASKY
AND BRIAN WALKER

Urban Social-Ecological Systems
LED BY JOHAN COLDING
AND ÅSA JANSSON

Aquaculture and Sustainable Seafood Production

Background

Beijer has long been involved in global sustainability analyses of capture fisheries and of aquaculture production. This work has resulted in key publications with an impact on fisheries and aquaculture policy throughout the world and is now continuing under a Beijer programme that is focusing particularly on the role of aquaculture in sustainable seafood production. The programme will address aquaculture in relation to coastal and marine governance and is closely linked to the Coastal and Marine research theme of the Stockholm Resilience Centre.

Fish stocks are under pressure in most parts of the world, illustrating fundamental failures in governance. While aquaculture has provided economic and nutritional benefits to millions, there is concern that unconstrained sectoral expansion and intensification of seafood farming, coupled with its ecological and social impacts, globalisation of markets and climate change, may erode the resilience of social-ecological systems.

A significant part of the aquaculture expansion will occur in coastal areas, where it will directly affect food systems already experiencing huge pres-

PHOTO: MAX TROELL

sure from human activities, as well as emerging climate change effects. Intensification of coastal and freshwater aquaculture will indirectly increase the dependence on marine ecosystems through the use of fish resources as feeds (and seed). There is a risk that the anticipated and much needed socio-economic benefits of aquaculture expansion will come at the expense of increased pressure on coastal ecosystems for goods and services, thus jeopardising the food security and livelihoods of coastal peoples. The challenge is to develop aquaculture in a fashion that strengthens social-ecological resilience instead of weakening it.

Without any doubt, small-scale fisheries, as well as small-scale aquaculture, provide important food resources and support diverse livelihoods for many poor people around the world. The global trade in seafood has steadily increased since the 1960s, and today fish is one of the fastest growing sectors in the global food trade, with at least half of fish exports in volume terms originating from developing countries. However, there are opposing views about the role played by the international fish trade in economic development and its benefits for the poor in developing countries. The main focus in these studies has been capture fisheries, but considering that aquaculture is regarded as the most viable option (or the only option) for meeting increasing future demands for seafood, and that its expansion in many cases is argued to significantly strengthen people's food security and resilience, there is a need to analyse the development of aquaculture from a broader ecological economics perspective.

Programme actions and ongoing work

This programme will address many of the challenges outlined above by analysing aquaculture developments and their interplay with fisheries and coastal and marine ecosystems, focusing on consequences and opportunities for sustainable and equitable use of global food resources and ecosystem services, and contributions to economic development and poverty alleviation in a changing world. Global analyses of the role of aquaculture in seafood production will be performed, complemented with case studies from e.g. Asia and the Western Indian Ocean Region.

▼ Feeding of fish at a fish farm in China.

PHOTO: MAX TROELL/AZOTE

EXAMPLES OF BEIJER INSTITUTE PROJECTS

Global resources and aquaculture

The choice of aquaculture species and farming methodologies has consequences for food provision and global resource efficiency. Fundamental research questions that need to be addressed are: Are we farming the 'right' sort of aquaculture species? What global patterns and trends exist? How does the production draw upon the global production base available? What are the consequences for global food security? What are the consequences for global energy transfer and protein production efficiency? How much fish is really consumed (i.e. including the masked seafood consumption through aquaculture species)? This work is partly taking the form of general reviews, analyses, and synthesis and case studies.

Project leaders: Max Troell and Malcolm Beveridge

Resilience and aquaculture development

Resilience thinking has only been marginally applied to aquaculture and seafood production. Concepts gathered under the 'resilience' banner are characterised by a focus on non-linear change, unpredictability, thresholds, adaptive management, transformation, institutional learning, vulnerability and adaptation to external drivers. The question is what insights for sustainable development emerge when analysing the role of aquaculture in seafood production through a 'resilience lens'. This work is carried out in collaboration with the WorldFish Center. A theoretical framework will be developed, which will then be tested in a number of different culture systems and contexts.

Project leaders: Max Troell and Carl Folke

Tools for increasing sustainability in aquaculture

Research questions to be addressed include: What tools/approaches/frameworks are available for measuring the sustainability of aquaculture? Do they sufficiently capture multiple-scale problems? This survey will take its starting point in recent work carried out by the FAO on an Ecosystems Approach to aquaculture and will also include more recent 'innovative' tools such as Ecological Footprint, Life Cycle Assessment (LCA), Fishprint, Global Aquaculture Performance Index, etc. This is an ongoing collaboration with FAO and Systems Ecology, Stockholm University.

Project leader: Max Troell

Environmental impacts and energy use in aquaculture – a Life Cycle Assessment approach

This study will focus on energy consumption in aquaculture production and the use of Life Cycle Assessments. Research questions to be addressed include: Are we choosing aquaculture systems/species that comply with necessary adaptations to global challenges with respect to environmental performance and energy scarcity? The work is underway and is being conducted in collaboration with groups that have already established themselves within LCA research in aquaculture (e.g. Dalhousie University and Leiden University).

Project leader: Max Troell

Integrated coastal aquaculture – its role in sustainable development

What is the current role of integrated coastal aquaculture and could these systems play a more significant role in the future? The work will build on previous work with the FAO and other international research groups that been collaborating with Beijer for many years (e.g. the University of New Brunswick, Canada).

Project leader: Max Troell

Aquaculture and ecosystem services

Much of the literature on aquaculture focuses on appropriation of services while failing to account for potential provision of other ecosystem services. What environmental services does aquaculture provide? What services can be provided and how can this knowledge be used in e.g. seascape planning? What are the trade-offs with other coastal and marine ecosystem services? Previous in-house work will form the basis for this analysis together with collaborating partners such as WorldFish, NACA and WIOMSA.

Project leader: Max Troell

Global aquaculture production and climate change

Large-scale effects from global climate change will affect aquaculture operations, which will further increase the vulnerability of farming systems and people. An analysis of recent spatial developments in coastal aquaculture and their correlation with cyclone events and sea level rise projections will form the basis for discussion about coping strategies for aquaculture. Aquaculture production data from various databases will be compiled and presented graphically. The results will be compared with data on climate factors from IPCC.

Project leader: Max Troell and Joshua Cinner

International fish trade and economic development

The role played by the international fish trade in economic development and its benefits for the poor in developing countries are unclear. The fish trade also has a significant impact on the productive capacity of ecosystems to produce marine ecosystem services, as global trade can mask the constraints of local ecosystems. This study will address the implications of aquaculture on ecosystem functions and also the role of aquaculture exports in poverty alleviation. This is a collaboration with WorldFish and the Univ. of Connecticut.

Project leaders: Max Troell and Lisa Deutsch

Aquaculture and subsides

Subsidisation of fisheries is a controversial issue but very little information exists about subsidies in aquaculture. This study aims to estimate economic subsidies to European aquaculture and identify structural differences in subsidies between fisheries and aquaculture. This ongoing work is a collaboration with the University of Santiago de Compostela.

Project leader: Max Troell

Behavioural Economics & Nature Network (BENN)

ENVIRONMENTAL AND RESOURCE economics has traditionally used rational choice theory to organise and evaluate alternative environmental policy options. According to rational choice theory, people purposely respond to policy instruments in their own self-interests and take all possible consequences into account. Over the past two decades, behavioural economics, defined as the application of psychology to economics, has emerged to challenge the traditional view by documenting how people make choices and state values that deviate from the conventional rationality model.

However, the behavioural connection to complex systems, e.g. in relation to natural resources, ecosystem services and the global challenges that humanity is facing, is not well developed.

Over the past two decades, the Beijer Institute has had great success in bringing together small groups of leading scientists who have made significant

PHOTO: ANDERS TEDEHOLM/AZOTE

EXAMPLES OF BEIJER INSTITUTE PROJECTS

Leadership and Common-Pool Resource Management

Although empirical evidence shows that leadership is crucial to successful management of common-pool resources, economic theory tends to focus on ownership or control over resources as the source of power. This project is looking at informal cooperation between individuals who are co-owners or co-users of common resources. It aims at providing a theoretical explanation for why there are leaders in such groups and how these leaders are appointed.

Project leader: Ingela Ternström

Strategic Interaction, Asymmetric Information and Coordination

The aim of this project is to analyse the interaction of asymmetric information and learning in coordination problems. More specifically, it will investigate how access to asymmetric information and learning affects the strategic interaction between the agents; the welfare consequences for individual actors; the overall welfare consequences that can be expected; and how policy instruments can be designed with the objective of overcoming the inefficiencies associated with coordination problems. To answer these questions we will use both theoretical predictions and experimental evidence.

Project leader: Therese Lindahl

Efficient Use of Local Natural Resources

The objective of this project is to improve our understanding of how different factors affect cooperation among the users of common-pool resources. The focus is on cooperation and on factors that control the actions of individuals. The project combines theoretical analysis and empirical analysis of data collected in farmer-managed irrigation systems in Nepal. It has resulted in several interesting insights, such as the great importance of leaders, the effect of wealth on cooperation and the way disturbances are dealt with in practice.

Project leader: Ingela Ternström

HIV/AIDS – The True Tragedy of the Commons?

The HIV/AIDS pandemic has dramatically decreased the size of the labour force, caused a loss of income from paid employment and increased medical bills and funeral costs in the most affected countries. For the rural population, the solutions so far have included shifting to less labour-intensive crops, an increased dependence on gifts and loans and an increased use of alternative sources of food and income, thereby increasing the pressure on local natural resources. This project is exploring the effects of HIV/AIDS on the management and use of local non-agricultural natural resources, such as forests and grazing land.

Project leader: Ingela Ternström

strides in integrating economics and ecology and related disciplines to address essential social-ecological challenges. We now want to bring more of the behavioural sciences into this productive atmosphere, including behavioural economics, psychology, anthropology, institutional design and decision-making, by launching a new Beijer research programme, *Behavioural Economics & Nature Network* (BENN).

The overall purpose of BENN is to serve as a clearing house for behavioural research around the globe in economics, ecology and other disciplines for improved stewardship of our life-supporting ecosystems. BENN will push for more work integrating behavioural sciences with life sciences and how understanding feedbacks between the two can generate better advice than either alone. BENN will work for both face-to face and online interactions between researchers.

The starting place for this new programme was an inaugural workshop held at the Royal Swedish Academy of Sciences on 24–25 May 2010. The aim of the workshop, which was organised by Jason Shogren, Therese Lindahl, Carl Folke and Christina Leijonhufvud, was to mobilise top scholars to share their insights and facilitate the debate over how best to integrate economics, ecology and behavioural sciences.

Specific objectives of the workshop were to:

- Bring together the top thinkers across several disciplines to share their insights into how a better understanding of human behaviour can make good environmental policy better and prevent bad policy from deteriorating further.
- Draft a succinct white paper highlighting these behavioural insights. In theory, the paper will address the behavioural opportunities that exist to help improve environmental policy for large-scale events such as climate change.
- Help identify the key research topics that should be included in the BENN research agenda and network.

The inspiring workshop was held in a positive and open-minded atmosphere. Many issues were raised

PHOTO: AGNETA SUNDIN

▲ Participants of the first BENN workshop in May 2010 with programme leaders Therese Lindahl and Jason Shogren to the far right.

for discussion and two main research clusters could be distinguished:

- How far has behavioural economics reached into environmental policy and environmental/ecological economics? What have we learned from behavioural economics and other behavioural sciences that will have important implications for current environmental policy?
- What are the major future challenges to better understanding of individual and social processes in the context of global environmental change? What are the main drivers/central dimensions that underlie behavioural trajectories within a complex social-ecological system?

A special BENN session was organised by Jason Shogren and Therese Lindahl at the 4th World Congress of Environmental and Resource Economists in Montreal, Canada in June 2010. It was an appreciated session that draw a lot of attention, the organizers had to find another room to accommodate the more than 100 people who wanted to attend.

The next steps for BENN and some upcoming events:

- Extending the network. The network is open to anyone wishing to join.
- Setting up an advisory group for BENN. This advisory group will help to guide the network and expand its scope.
- Launching a BENN website, which will be linked to the Beijer website and a BENN working paper series.
- Arranging an interdisciplinary conference with selected paper presentations in autumn 2011 to address behavioural challenges and trajectories in the context of global environmental change.

Complex Systems

ALTHOUGH HUMAN CONCERNS on complex systems have existed for thousands of years, formal scientific study of such systems is a fairly young branch of science. In contrast to other areas of science with simple system assumptions, this new branch of research explicitly recognises the complexity of multiple interacting components involving, among other things, threshold effects, fast and slow processes, non-convexities, non-linear feedbacks and stochastic influences.

The aim of this research programme is to develop economic theory and policy instruments for improving the management of social-ecological systems with the various complexities taken into account. The Beijer Institute is one of the pioneers in this research area, with a lot of specific expertise.

Over the past twelve months, the research programme that involves individual projects has been developed in several directions. The project *Arctic Tipping Points*, in which the Beijer Institute takes an active part, has received funding from the European Union's 7th Framework. The project intends to identify the elements of the Arctic marine ecosystem that are likely to show abrupt changes in

response to climate change and to establish the levels of the corresponding climate drivers that may induce regime shifts in those tipping elements.

For the ongoing project *Sharing Natural Resources with Complex Dynamics*, Anne-Sophie Crépin and Therese Lindahl have published their paper 'Grazing games: Sharing common property resources with complex dynamics' in the journal *Resource and Environmental Economics*, and have also conducted a set of new laboratory experiments on how individuals respond to the possibility of thresholds for natural resource management. The two other projects, *Inclusive Wealth and Accounting Prices* and *Valuing Resilience and Evaluating Sustainability*, are more interrelated. The idea is to evaluate dynamic welfare and sustainability in an inclusive wealth framework in which ecological resilience is treated as a kind of capital stock. An empirical paper applied to the case of Australia, co-authored by Brian Walker, Karl-Göran Mäler, Chuan-Zhong Li and others, has been published in *Resource and Environmental Economics*. In addition, a theory paper on resilience valuation with more extensions, including resilience management, developed by Professors Mäler and Li was presented at the World Congress of Environmental and Resource Economists in Montreal and is now forthcoming in Environment and Development Economics.

During part of the academic year, Aart de Zeeuw and Steve Polasky also drafted a resilience-related paper on 'Optimal management with potential regime shifts' and presented this paper at the Montreal World Congress.

In spring 2010, Beijer researchers and fellows engaged in the complex systems programme participated in the Beijer Institute and Stockholm Resilience Centre workshops on *Global Dynamics and Social-ecological Resilience in the Face of Multiple Shocks* and *Interactions Amongst the Planetary Boundaries*. We decided to form a research group modelling the economic effects of missing links and feedbacks in complex social-ecological systems. In the coming year, the group will develop small-scale integrated models to explore the various issues touched upon above, as well as their economic implications for improving resource management strategies. Among other things, optimal taxation of common pool resources in the presence of non-linearities, thresholds and multiple steady states will be studied. In addition, the inclusive wealth and resilience pricing model will be augmented to encompass information value and resilience management with applications to fishery studies involving stochastic influences and critical fish stocks.

EXAMPLES OF BEIJER INSTITUTE PROJECTS

Arctic Tipping Points

The project Arctic Tipping Points (ATP) is a large integrated project within the European Union's 7th framework. The project will identify the elements of the Arctic marine ecosystem likely to show abrupt changes in response to climate change, and will establish the levels of the corresponding climate drivers inducing regime shift in those tipping elements. The Beijer Institute is taking an active part in Work Package 6, *'Socio-economic opportunities and risks'*.

Project leader: Anne-Sophie Crépin

Inclusive Wealth and Accounting Prices (IWAP)

With this research, we are attempting to test whether it would be possible to estimate accounting prices for ecological systems. The study area is Stockholm County. The methods developed for estimating the accounting prices can later be applied to large-scale systems, in order to assess the sustainability of the joint economic and natural systems.

Project leader: Åsa Jansson

Valuing Resilience and Evaluating Sustainability

This project aims to develop theory and methods for pricing resilience in complex social-ecological systems. We also aim to incorporate resilience pricing models into the comprehensive sustainability-orientated dynamic welfare theory, with resilience as capital stock variables, along with the other physical, natural and human capital forms.

Project leader: Chuan-Zhong Li

Sharing Natural Resources with Complex Dynamics – Strategic Interaction Across Temporal and Spatial Scales with Policy Implications

How can institutions respond to the presence of a complex environment, involving discontinuities, thresholds and uncertainty?

Within such institutions, how do people interact strategically in the presence of complex dynamics and uncertainty?

How can we improve management of complex ecosystems and to what extent is there a need to revise current economic approaches to economic policy?

Project leader: Therese Lindahl

Global Dynamics and Resilience

THE 2008 ASKÖ MEETING resulted in a paper in the journal *Science* titled 'Looming global-scale failures and missing institutions'. This complemented a paper in *Nature* entitled 'A safe operating space for humanity'. The latter, initiated in the Stockholm Resilience Centre by Johan Rockström and Will Steffen, with several Beijer Institute researchers and fellows involved, dealt with known and possible planetary boundaries that humanity should not transgress. Together, these papers describe how the interactive effects between the trends in 'silo'-operating global institutions and global-scale changes in nature are driving the world towards several really undesirable thresholds. This is the reason for initiating this joint Beijer-SRC programme, which complements the Beijer Institute's focus with the global dimension.

The new programme has strong support but is difficult to structure due to a conflict between the need to consider all significant interactions (a *raison d'etre* for the programme), and the urge to focus on a limited number of tractable areas in which the Beijer Institute and the Stockholm Resilience Centre have expertise. A step towards overcoming this conflict has been taken by asking what is not being done, where the most serious gaps are, and how the expertise that the Beijer Institute can assemble

PHOTO: THE BEIJER INSTITUTE

▲ Participants of the Global Dynamics workshop in April 2010.

might make a contribution. The task is to appropriately frame the project in an interdisciplinary systems perspective without it becoming yet another international effort that offers another partial solution, thereby adding to the confusion and dangers of unrecognised links and feedbacks.

Current state of the programme

The programme tackles a twofold problem: i) The interactive effects of climate change, ocean acidification, declining fisheries, emerging diseases, antibiotic resistance and recurrent energy, food and water crises are likely to result in significant, perhaps irreversible, shifts in the planetary system's behaviour. ii) The world lacks institutions capable of addressing these interactive, cross-sectoral effects that connect the local with the global. Existing fragmented governance efforts, each dealing with parts of the problem, will most likely lead to dangerous threshold effects.

The overarching question is:

> *What are the critical unrecognised or ignored social-ecological links and feedbacks at the global scale, and what kinds of governance structures can be developed to avoid catastrophic shifts in the Earth system, so as to create long-term conditions for prosperous human development?*

The programme is co-led by Steve Polasky (economist) and Brian Walker (ecologist) and co-ordinated and managed by Anne-Sophie Crépin, Deputy Director of the Beijer Institute. The proposed structure is that of a 5–10 year programme with interlinked projects and links with key related projects elsewhere.

An initial workshop in April 2010, *Global Dynamics and Social-ecological Resilience in the Face of Multiple Shocks*, generated a focus on three core projects to start with:

1. Case studies as a basis for exploring important links and feedbacks. Three 'syndromes' were identified for further study : i) Expanding Cascade (local shock leads to a global crisis); ii) Double Whammy (at least two independent shocks combine); and iii) Long Fuse Big Bang (slow but relatively well known effects of today's actions imply a timing mismatch between costs and benefits).
2. Are the unrecognised feedbacks strong enough to shift global scenarios in important ways? Three activities were identified: i) Studying key known interactions that are typically excluded from integrated models; ii) thinking the unthinkable, focusing on environmental connections; and iii) social traps and erosion of trust, making global-scale collaboration even more difficult.
3. Modelling. What are key missing processes that should be introduced into existing models to better understand global system dynamics?

What's next?

A follow-up workshop will take place in September 2010 to further develop the programme of activities described above, building on the collaboration that has begun, leading to some initial publications and bringing in some new expertise to get additional insights. We are planning more workshops and hope to build a network of related projects around the world, to develop a small but actively collaborating group of complementary projects and research groups. We will also apply for new funds to support the new core research projects, as well as related projects already being conducted within programmes at the Beijer Institute and at other research institutions.

EXAMPLES OF BEIJER INSTITUTE PROJECTS

Adapting institutions, governance and complexity: Insights for social-ecological resilience

This book due to be published by Cambridge University Press, addresses the factors and features of society's abilities to adapt its institutions to governance of ecosystem management and explores institutional changes that are taking place as a response to increasing global environmental pressures at local, national, and international levels and the structural barriers and the opportunities for change through innovation and transformations, where they are occurring or not, and why.

Project leader: Carl Folke and Emily Boyd

Australian Research Council, Centre of Excellence for Coral Reef Studies

The Beijer Institute serves as a partner investigator in Programme 5 of the ARC Centre *'Resilience of linked social-ecological systems'*, see www.coralcoe.org.au. The objective of the programme is to provide new solutions to managing resilience and coping with change, uncertainty, risk and surprise in complex social-ecological systems. The overall aim is to improve the governance and management of natural systems and enhance their capacity to sustain human and natural capital.

Project leader: Carl Folke and Terry Hughes

Centre of Excellence, Resilience and Sustainability

This is a collaborative programme involving the Beijer Institute, the Stockholm Resilience Centre and the Stockholm Environment Institute (SEI) and funded by Formas – the Swedish Research Council for the Environment, Agricultural Sciences and Spatial Planning. The five-year research programme started in 2006 with new funding (25 million SEK in total). It focuses on complex systems, regime shifts and resilience, emphasising the need for new integrated and adaptive approaches to social and economic development, where the complex interconnectedness between humans and nature, at all scales, is considered and the existence of uncertainty accepted as the rule.

PLANETARY BOUNDARIES:

Exploring the safe operating space for humanity

New approaches are needed to help humanity deal with climate change and other global environmental threats that lie ahead in the 21st century. Drawing on decades of research on global environmental change, ecological economics, resilience and complex systems, 28 internationally renowned scientists proposed a 'safe planetary operating space' that humanity should not transgress in order to live safely.

They stress that human pressure on the Earth System has reached a scale where abrupt global environmental change can no longer be excluded. To continue to live and operate safely, humanity has to respect critical thresholds in the operation of the Earth System.

The group of scientists includes Johan Rockström and Will Steffen as lead authors with the Beijer Director Carl Folke; Beijer Fellows Stuart "Terry" Chapin, Marten Scheffer, Terry Hughes, Brian Walker as well as Kevin Noone, the new Director of Swedish Secretariat for Environmental Earth System Sciences (SSEESS) of the Academy. They have attempted to quantify the safe biophysical boundaries outside which, they believe, the Earth System cannot function in a stable state, in which human civilizations have thrived. The articles attracted a lot of media attention around the world, generating continued interest from the research community as well as the general public.

The nine planetary boundaries identified were climate change, stratospheric ozone depletion, land use change, freshwater use, biological diversity loss, ocean acidification, nitrogen and phosphorus inputs to the biosphere and oceans, aerosol loading and chemical pollution. Three of the boundaries (climate change, biological diversity and nitrogen input to the biosphere) may already have been transgressed and there is a risk that crossing one boundary may seriously challenge the ability to stay within the safe levels of the others.

ROCKSTRÖM, J., STEFFEN, W., NOONE, K., PERSSON, Å., CHAPIN, III, F.S., LAMBIN, E., LENTON, T.M., SCHEFFER, M., FOLKE, C., SCHELLNHUBER, H., NYKVIST, B., DE WIT, C.A., HUGHES, T., VAN DER LEEUW, S., RODHE, H., SÖRLIN, S., SNYDER, P.K., COSTANZA, R., SVEDIN, U., FALKENMARK, M., KARLBERG, L., CORELL, R.W., FABRY, V.J., HANSEN, J., WALKER, B.H., LIVERMAN, D., RICHARDSON, K., CRUTZEN, C., FOLEY. J. (2009). A SAFE OPERATING SPACE FOR HUMANITY. *NATURE* 461: 472-475 DOI 10.1038/461472A

Paper in *Science* calls for global cooperation

THE PLANETARY BOUNDARIES work described above emphasised that it is time for a new order of cooperative international institutions that are more capable of dealing with the interactive effects of global change.

Energy, food and water crises, climate disruption, declining fisheries, ocean acidification, emerging diseases and increasing antibiotic resistance: the list of serious, inter-related global-scale challenges spawned by the accelerating scale of human activity is long. Unfortunately, the solutions to these challenges are mostly scant and inadequate.

This formed the basis for discussions at the 16th Askö meeting in September 2008 arranged by the Beijer Institute (the Askö meetings are described on page 45). An outcome of the meeting was the paper in the journal *Science* entitled 'Looming global-scale failures and missing institutions', where an international group of authors argued that nations alone are unable to resolve the sorts of planet-wide challenges now arising.

The core of the problem is inducing cooperation in situations where individuals and nations will collectively gain if all cooperate, but each faces the temptation to free ride at the expense of the others.

The authors stress that the challenge of climate change is closely linked to the capacity of ecosystems world-wide to generate services and the well-being of the economy rests on this capacity. Such interdependencies have to be tackled through global cooperation.

WALKER, B.H., S. BARRETT, S. POLASKY, V. GALAZ, C. FOLKE, G. ENGSTRÖM, F. ACKERMAN, K. ARROW, S.R. CARPENTER, K. CHOPRA, G. DAILY, P. EHRLICH, T. HUGHES, N. KAUTSKY, S.A. LEVIN, K.-G. MÄLER, J. SHOGREN, J. VINCENT, T. XEPAPADEAS, AND A. DE ZEEUW. 2009. LOOMING GLOBAL-SCALE FAILURES AND MISSING INSTITUTIONS. *SCIENCE* 325:1345-1346.

▼ Lead author Brian Walker with co-authors Gretchen Daily and Steve Carpenter.

PHOTO: THE BEIJER INSTITUTE

Urban Social-Ecological Systems

PHOTO: STEVEN ZEFF/AZOTE

Background

The continuous increase in the number and size of urban regions and the ensuing transformation of landscapes is posing challenges to human welfare and to the provision of a livable, sustainable environment. Urban regions are hubs of services, knowledge, capital and innovation that offer solutions for humans and the environment, but they also create great demands for resources such as fresh water and generate large volumes of waste. Planning and developing infrastructure, basic amenities and a healthy urban environment is a testing task for governments and civil society. In this research theme we are looking at cities as integrated social-ecological systems, with the objective to 'analyse the capacity to provide access to and sustain ecosystem services in the urban landscape under uncertainty and change'. This view makes us unique and is undoubtedly necessary for achieving the mission.

This Beijer theme is part of the SRC theme '*Urban social-ecological systems and globalization*' and '*The Urban Network*', an interdisciplinary group of researchers spread over twelve cities on five continents. The Urban Network group has a number of common research areas including the '*Urban Atlas*' (www.urbanatlasportal.org), presenting each of the participating urban sites but also providing lessons learnt and methodologies useful for scaling up and replication. Other global network collaborations include TEEB, IPBES and URBIS.

Future activities

During autumn 2010 the Beijer Urban Theme will participate in responding to the EU FP7 call: *Sustainable and Resilient Green Cities*. We will also complete the book project '*Exploring Ecosystem Services in the Cities through the Lens of Resilience*'. Several distinguished researchers such as Professors Elinor Ostrom, Stephen Polasky and Fikret

Berkes have accepted an invitation to contribute chapters to this timely book, which will be edited by a group of researchers from the Urban Theme. The theme will organise a workshop on Urban Resilience in March 2011, in conjunction with the Resilience Conference in Phoenix, Arizona.

The Albano Patchwork Project will be presented at the Shanghai World Expo Global city summit in autumn 2010. The Shanghai World Expo is also the venue for the launch of the online platform Urban planet. The platform provides an innovative and attractive learning environment with interactive statistics, maps and best practices in the field of urban sustainability.

PHOTO: JERKER LOKRANTZ/AZOTE

EXAMPLES OF BEIJER INSTITUTE PROJECTS

The SUPER research group pictured during a workshop held in Istanbul in April 2009.

The SUPER project – Sustainable Urban Planning for Ecosystem Services and Resilience

The major objective of the SUPER project is to improve our knowledge of how to integrate ecosystem services into urban spatial planning processes. In collaboration with researchers from Wageningen University (the Netherlands), and Istanbul Technical University (Turkey), the SUPER project is seeking to identify critical aspects in current modes of spatial planning for sustaining ecosystem services. Drawing on research, methodologies and practical insights for dealing with ecosystem services in the three European cities of Istanbul, Arnhem-Nijmegen and Stockholm, researchers are exchanging knowledge and experiences in a number of research activities, including sustainable integrated design at Stockholm University, resilience building of biomass production in metropolitan landscapes, watershed management in the face of climate change, 'green urban commons' and current and historical governance of urban ecosystem services. The results obtained will be of practical use to urban planners, managers and policy-makers. The project is funded by FORMAS as part of the URBAN-NET project, with an additional three-year grant received for the period 2010–2012.

Project leader: Johan Colding

The URBAN-NET project is addressing issues of urban sustainability in Europe. Its overall aim is to increase the cooperation and coordination between European Member and Associated States through networking and collaboration on joint research activities. URBAN-NET is funded by the European Commission's Framework 6 Programme under the European Research Area Network (ERA-NET) initiative. For more information, see: http://www.urban-net.org/

Green Wedges as Urban Commons: Applying a Complex Social-Ecological System Approach to Sustainable Urban Planning

This project is exploring how a framework of common property (pool) resource management could improve metropolitan designs in their deliverance of ecosystem services. Based on case study-orientated research in the cities of Stockholm and Melbourne, the project is addressing three overall questions: 1) How can application of the concept of ecosystem services enable spatial planning and governance to better account for the reciprocal relationship between human and ecological systems in green wedges? 2) How can institutional capacity building related to common property resource management inform sustainable development of green wedges? 3) What overall lessons for sustainable urban development can be drawn from these insights?

Project leaders: Johan Colding and Cathy Wilkinson (SRC).

ILLUSTRATIONS (ABOVE AND BELOW): KIT ARKITEKTUR

▲ The sustainable vision for the Albano area encompass the latest urban ecology research and aims at promoting the creation of ecosystem services and institutions to enhance social, ecological and cultural values.

Collaborative planning of a sustainable urban campus

STOCKHOLM UNIVERSITY IS in dire need of more campus space and the Albano area, which is now a brown field area between Stockholm University, the Karolinska Institute and the Royal Institute of Technology (KTH), has been singled out as a strategically prime location, located within the world's first national urban park, the Royal National Urban Park. Through building a sustainable urban campus centre, researchers can help promote the principles of sustainable urban development. With that in mind, Beijer researchers Johan Colding and Stephan Barthel, together with researchers from Stockholm Resilience Centre and the Royal Institute of Technology, have joined forces with architects from KIT-arkitektur to develop a vision for a new Albano Sustainable Campus. Their proposal was presented at the conference '*Green Urbanism at Albano*' which was held in Stockholm in October 2009. It was arranged jointly by Akademiska hus (the land owner in the Albano area); the Beijer Institute and Stockholm Resilience Centre; and Stockholm University. The final vision was presented at Stockholm University on 22 June, 2010.

The vision, entitled '*Patchwork*', guidelines how local nature can support a better urban environment and how a science city can be built in a climate-smart way. If the vision is followed, the new campus should support ecosystem resilience in the national urban park and be sensitive to historical values as well as enhance transdisciplinary knowledge. Designs include the use of local conditions for energy production, greening of buildings with vegetation selected in relation to the historical landscape, and habitats and green corridors that support landscape ecological processes and biodiversity. This is likely to further establish Stockholm as an internationally attractive hub for research and serve as a model for sustainable urban development. After a year filled with meetings with politicians, city planners and architects, the researchers are now happy to note that there is broad consensus for the proposal. Currently, Stephan Barthel is part of the core project team of Stockholm city in the development of a detailed architectural plan for the area.

Resilience thinking and integrative research

by *Carl Folke*, Director, the Beijer Institute and
Scientific Director, the Stockholm Resilience Centre

THE STOCKHOLM RESILIENCE CENTRE is an international centre that advances interdisciplinary research for governance of social-ecological systems with a special emphasis on resilience – the ability to deal with change and continue to develop. The Centre is a joint initiative of the Beijer Institute and the Royal Swedish Academy of Sciences, the Stockholm Environment Institute and the host, Stockholm University. Beijer researchers, staff, fellows and collaborators are actively engaged in the activities of the Stockholm Resilience Centre (SRC), serving on the advisory board and as theme leaders, collaborating, writing papers, applications and taking part in training and communication strategies.

The Research Framework

Humanity is faced with the largest challenge ever, to redefine our relationship with the Biosphere, and translate this into operational governance and management to enable sustainable futures.

The research framework of the Stockholm Resilience Centre emphasises that ecosystems in all parts of the Earth are shaped by people and, at the same time that all people are fundamentally dependent on the Earth's ecosystems, the Biosphere and its generation of ecosystem services. Environmental issues have become issues of how to increase the likelihood for societal development pathways that can generate, sustain and improve human welfare and wellbeing in collaboration with the Biosphere.

SRC researchers are particularly interested in the interplay between periods of gradual change and periods of abrupt change – how to turn crises into new opportunities for sustainability and how this plays out across scales. Therefore, we emphasise three features of resilience thinking for analysing social-ecological systems in relation to sustainability:

- persistence – buffer capacity to withstand shocks in the face of change,
- adaptability – the capacity of people in a social-ecological system to manage resilience in order to deal with change, move on and continue to develop
- transformability – the capacity of people in a social-ecological system to create new development pathways when ecological, political, social or economic conditions make the existing system untenable

The start-up phase of the SRC was subject to external evaluation from Harvard, as reported in last year's Beijer Annual Report. During the year a new Action Plan for 2010–2013 has been developed and approved by the main funding organisation Mistra. Earlier, research collaboration was organized around nine transdisciplinary themes. As of 2010 SRC reshaped the themes into six overarching areas. The first three advance theory and methods actively interacting with the three latter cross-cutting themes.

- *Regime shifts and implications in social-ecological systems*
- *Global and cross-scale dynamics of social-ecological systems*
- *Multilevel adaptive governance, learning and transformations of social-ecological systems*
- *Water, food, ecosystem services in social-ecological landscapes*
- *Coastal and marine social-ecological systems*
- *Urban social-ecological systems*

The themes feed into each other through an ongoing dynamic process with active involvement of scholars from the natural and social sciences and

the humanities, within the centre, in Sweden and internationally. The Beijer Institute's competence in ecological economics is of great significance for the development and activities of the SRC.

Program on Ecosystem Change and Society

The International Council for Science has asked the Stockholm Resilience Centre to serve as the International Program Office of the new global change *Program on Ecosystem Change and Society* (PECS), chaired by Steve Carpenter, with Beijer Fellows and the Beijer director on the scientific committee. PECS, an interdisciplinary scientific program and a follow-up of the *Millennium Ecosystem Assessment*, will try to understand how policies and practices affect resilience of the ecosystem services that support human well-being and allow for adaptation to a changing environment. Answering this will require full integration of natural and social sciences. The program is jointly sponsored by ICSU and UNESCO. The hope is that PECS will provide a solid scientific knowledge base to the recently established *Intergovernmental Platform on Biodiversity and Ecosystem Services*, which will play a role similar to that of the IPCC in climate change.

Science, practice and policy

An important part of SRC activities is policy dialogues, capacity development, and communication. Two reports for the Swedish Government were produced during the year. The first report *Biodiversity, Ecosystem Services and Resilience: Governance for a Future with Global Changes* during the Swedish Presidency of the European Union, aimed at the high level meeting *Visions for Biodiversity Beyond 2010 – People, Ecosystem Services and the Climate Crisis* held September. The meeting gathered environment ministers and senior officials to prepare the revision of the Strategic Plan of the Convention on Biological Diversity. The second, with a focus on resilience and sustainability, was commissioned by the Swedish Government's Commission on Sustainable Development. A third event was a two-day seminar for government officials throughout Europe on the value of the marine environment, jointly organized with the Swedish Environmental Protection Agency during the EU Presidency. Significant parts of the forthcoming The Economics of Ecosystems and Biodiversity (TEEB) report were produced by SRC and Beijer researchers and fellows and there was close collaboration with Albaeco in all these processes and events.

The communication and outreach of the Beijer Institute is substantially magnified through the close collaboration with SRC and Albaeco. Research results, workshops and events are regularly highlighted at the SRC website. The achievements of the Stockholm Resilience Centre during 2009 are presented in the SRC Annual Report and further information is provided at www.stockholmresilience.org.

VISION AND MISSION

The vision of the Stockholm Resilience Centre is a world where social-ecological systems are understood, governed and managed, to enhance human well-being and the capacity to deal with complexity and change, for the sustainable co-evolution of human civilizations with the biosphere.

The mission of the Stockholm Resilience Centre is to advance research for governance and management of social-ecological systems to secure ecosystem services for human wellbeing and resilience for long-term sustainability. We apply and further develop the scientific advancements of this research with practice, policy and academic training.

Supporting Environmental Economics Networks

by *Agneta Sundin*, Communications Officer

ALL BUT ONE of the regional networks in Environmental Economics were initiated and developed in collaboration with the Beijer Institute. Researchers affiliated with the Beijer Institute support the networks with activities such as participating in workshops organised by the networks, evaluating research proposals, supervising research, and teaching short courses. The Beijer Institute has also introduced the Mäler Scholarship for promising young researchers from developing countries associated with the regional networks. During the last year the Beijer Institute hosted four Mäler Scholars:

- Albert Honlonkou, from Benin (RANESA), spent three months at the Beijer Institute during the autumn. Dr. Honlonkou worked on a forthcoming paper *On optimal contract for monitoring illegal exploitation of co-managed forests in Benin*.
- Pranab Mukhopadhyay and Rucha Ghate, from India (SANDEE), spent two months working closely with Ingela Ternström on forest governance issues. Drs Mukhopadhyay, Ghate and Ternström published a letter, *Sustainability, autonomy, and benefits from forest commons*, in the journal *Proceedings of the National Academy of Science (PNAS)*.
- Sebastián Villasante from Argentina (LACEEP) visited the Beijer Insitute for one and a half months in spring 2010 working on the paper *Resilience, adaptive capacity and co-management of artisanal fisheries in South Patagonia*. Dr. Villasante is returning to Sweden following his fieldwork in South Patagonia, Argentina, during the summer, to write a paper on the results obtained.

▼ Despite poor living conditions, this fishing community of South Patagonia, Argentina is participating in a co-management programme for a sustainable fishery that is making good progress.

PHOTO: GUSTAVO CARNERO

CEEPA and RANESA

CENTRE FOR ENVIRONMENTAL ECONOMICS AND POLICY IN AFRICA AND THE RESOURCE ACCOUNTING NETWORK FOR EASTERN AND SOUTHERN AFRICA

THE CENTRE FOR Environmental Economics and Policy in Africa (CEEPA) at the University of Pretoria, South Africa, continues to support various capacity strengthening activities in environmental economics and policy analysis in the region. Five new research grants have been awarded to researchers from Africa this year and two training of trainers workshops have been offered. The first of these covered training on biofuels and water resource management, while the second covered climate change and was given by Professor Thomas Sterner (Gothenburg University) and Professor Rashid Hassan (CEEPA).

Three PhD scholarships have been awarded this year and the first cohort of PhD awardees (two) completed their degree training and graduated in 2009/2010. Two visiting African scholar fellowships have been awarded in the past year and two post-doctoral fellowships were awarded for 2009.

CEEPA has pursued alternative, more effective mechanisms for attracting interest from international fellows and was successful in securing the appointment of Dr Greg Hertzeler of the University of Sydney as an extra-ordinary professor at the University of Pretoria. During his visit he taught CEEPA courses and supervised the research of PhD candidates, as well as working on joint research products with CEEPA staff and students.

A project supported by the Swedish International Development Cooperation Agency (Sida) and its Canadian counterpart (IDRC) continues to provide funding for research resources in the field of natural resource and environmental economics and policy in the region. These funds have been used to buy and distribute textbooks in order to provide the libraries of nineteen institutions in Africa with access to essential teaching and research materials. In addition, a journal series has begun to be distributed to these institutions.

CEEPA maintains a website that supports various research resources for its network of researchers and collaborating institutions in Africa and worldwide. The website hosts a library of various research publications and reports from CEEPA, including all workshop presentations, research tools and training materials. It also provides easy links to other key websites and sources.

During the past year, three of CEEPA's Sida and IDRC funded researchers have completed their research projects and written up the results. These reports have all have successfully made it through the peer review system and have been published as CEEPA discussion papers. Policy briefs for all the three discussion papers have subsequently been developed. Electronic copies of all publications are available at the CEEPA website at www.ceepa.co.za

RASHID HASSAN, PROGRAM DIRECTOR CEEPA/RANESA

EEPSEA

THE ECONOMY AND ENVIRONMENT PROGRAMME FOR SOUTH EAST ASIA

EEPSEA IS NOW in its 16th year of capacity building in the field of environmental and natural resource economics in Southeast Asia. During the period 2009–2010, EEPSEA approved twenty-two research projects under the regional competition and conducted four regional training courses and partnership activities. It also supported three in-country training activities in Cambodia, Laos and Thailand.

The highlight of the year was the *EEPSEA Impact Conference 2010* held in Hanoi, Vietnam on 26–27 February. The conference was a regional gather-

PHOTO: EEPSEA

▲ Beijer Fellow professor Jeff Vincent giving a plenary talk at the EEPSEA biannual workshop in Manila.

ing of Southeast Asia's eminent and upcoming researchers in the field of environmental economics. Past and current EEPSEA researchers and training alumni were present to share and discuss how their work with and through EEPSEA has influenced Southeast Asia's environment and natural resource management. The participants presented 40 'impact stories' which are featured in the forthcoming EEPSEA Impact Report. Bild: EEPSEA conference

A new book entitled '*The Economics of Environmental Management in Vietnam*' was launched. The book compiles important EEPSEA-supported research on environmental economics that has been carried out in Vietnam and which has influenced policy and education systems in the country. Bild: EEPSEA book

EEPSEA also held its customary biannual workshops. To mark the *32nd EEPSEA Biannual Workshop*, seventy Southeast Asian researchers, resource individuals and guests gathered in Hanoi, Vietnam on 16–19 November 2009. Talks were held on subjects such as climate change, payments for ecosystem services and behavioural economics.

The *33rd Biannual Workshop* was held in Manila, Philippines, on 25–27 May 2010, with sixty participants. Thomas Enters from the Centre for People and Forests (RECOFTC), Jeffrey Vincent from Duke University and the Beijer Institute, Rajib Shaw of Kyoto University, and Benoit Laplante, a long standing EEPSEA resource individual, delivered the plenary talks on community forestry, mangrove ecosystem services, disaster risk reduction, and climate change adaptation, respectively. Bild: EEPSEA Jeff Vincent (kan med fördel croppas)

HERMINIA FRANCISCO, PROGRAM DIRECTOR EEPSEA

LACEEP

LATIN AMERICAN AND CARIBBEAN ENVIRONMENTAL ECONOMICS PROGRAM

WITH THE CONTINUOUS support of the Canadian International Development Research Center (IDRC) and the research arm of the Swedish International Development Cooperation Agency (Sida), the Latin American and Caribbean Environmental Economics Program (LACEEP) has almost completed its fifth year of activities and is now a well-known point of reference for environmental researchers in the Latin American region.

The main objective of the programme is to create research capacity in environmental economics and related fields within Latin American and Caribbean research and policy-making institutions (universities, non-governmental organisations, government agencies, etc.).

LACEEP's ultimate goal is to improve the management of natural resources at all levels (government, non-governmental and private) and to contribute to better understanding of the causes and effects of environmental degradation.

The programme uses carefully selected and internationally recognised researchers and professors to strengthen the skills of existing researchers, teachers and policymakers in the region through a series of capacity building courses and in-depth supervision of research projects.

Ultimately we hope to create an active and dynamic community that supports capacity building of environmental economics researchers, with global standards of excellence; creating alliances regionally and internationally, contributing to state of the art and relevant policy dialogue from the perspective of Latin America and the Caribbean.

Within the past year, six of our grant holders completed their research projects:

Marcela Ibañez: Adoption of certified organic coffee: The case of Colombia.

Juliana Speranza: Assessing the economic impacts of climate change in Brazilian agriculture.

Marcelo Olivera: Economic effects of intense rainfall in the central states of the Pacific coast of Mexico: Global warming impacts on agriculture.

Jaqueline García-Yi: Heterogeneous motivations of household-level coca growing areas: The case of an indigenous community in Peru.

César Viteri: Valuation of attributes of Galapagos Islands tourism: A discrete choice experiment

Oscar Zapata: Understanding consumption and residential uses of water at the household level in Quito – Ecuador

Part of LACEEP's two annual workshops consists of a series of short courses on key topics in environmental economics. This year's courses were entitled: '*Behavioural and Experimental Economics with Environmental Applications*' and '*Key Topics in Environment and Development Economics*'.

A longer course in which participants received in-depth specialist training, entitled '*Environmental Economics with Emphasis on the Role of Businesses on the Environment and Climate Change Issues*', was also offered during the year.

JUAN ROBALINO, DIRECTOR, LACEEP

SANDEE

THE SOUTH ASIAN NETWORK FOR DEVELOPMENT AND ENVIRONMENTAL ECONOMICS

SANDEE'S CORE ACTIVITY is grant support for research on the economics of environmental problems in South Asia. In 2009, SANDEE organised two research and training workshops. It also awarded thirteen research grants in the areas of urban environmental management, environmental issues related to agriculture, and natural disasters and climate change.

Research

We are delighted that several peer-reviewed publications emerged from the SANDEE research stable (including a paper in the US *Proceedings of the National Academy of Sciences*) in addition to SANDEE's own working papers and policy briefs. Our second book manuscript '*Environmental Valuation in South Asia*' was accepted by Cambridge University Press and will be published in mid-2010.

New research in 2009

- Economics of rice crop residue burning in rice-wheat cropping systems of the Punjab, Pakistan (Ahmed, Pakistan).
- Climate change and the economic growth nexus: Evidence from South Asia (Akram, Pakistan).
- A study of tax and regulatory policies for the use of plastic bags in urban India (Gupta, India).
- The economic causes of crop residue burning in the rice-wheat system of the Indo-Gangetic plain in India (Gupta, India).
- Rice residue burning in the south-west region of Bangladesh (Haider, Bangladesh).
- Impact of climate change: A multi-sector regional analysis (Haque, Bangladesh).
- Is organic agriculture economically viable?
- Effect of climate change on water quality and diarrhoeal diseases (Patil, India).
- Recreation vs. pollution? A study of Hussain Sagar Lake and its surroundings in Hyderabad (Mishra, India).
- Exploring alternatives to open-field crop residue burning on the plains of Nepal (Pant, Nepal).

- Dynamics of household responses to natural disasters: Observations from Sundarbans after cyclone Aila (Ghosh, India).
- Economic impact of climate change on yield variability of major food crops in Tamil Nadu (Kumar, India).
- Factors influencing two conflicting groups – farmers and fishermen – to participate in integrated water resource management: The case of coastal areas of Bangladesh (Sultana, Bangladesh).

Training in environment and development economics and research methods is another important activity. Five training workshops were organised in 2009 and 164 researchers, policymakers and teachers were trained. Beijer fellow Jeff Vincent taught a course on *Estimating limited dependent variable models in valuation studies*, in Kathmandu, Nepal on 12–14 December 2009.

SANDEE also supports 'under-served areas' or smaller countries and less advanced areas in the region. The Environment Research Centre in the Maldives provided support to complete a valuation project related to marine resources. SANDEE also provided small grants for Master's theses in economics written by students at Tribhuvan University in Nepal.

Policy impacts

SANDEE-supported research has had two major policy impacts.

In Nepal, Mr Min Malla's SANDEE research documented the bad air quality in rural households and showed how small interventions in the kitchen (improved stoves and chimneys) could contribute to improved health outcomes. This led to Mr Malla and the organisation he works for, Practical Action Nepal, signing a Memorandum of Understanding with the Government of Nepal and developing draft National Guidelines on Indoor Air Quality.

Another interesting policy outcome emerged from work supported in the Maldives. Here, based on tourist surveys, researchers have been able to identify a particular island as being an area with extremely rich coral reefs. A harbour was being proposed for this island, which would have harmed the coral significantly. The researchers working on this project reviewed an environment impact analysis for the harbour and recommended that the plans be rejected. The government accepted the recommendation and a revised plan to build a jetty is now being implemented.

Last year was a significant year for SANDEE because of the change in the host institution. SANDEE moved from IUCN Nepal to ICIMOD Nepal in August 2009. The transition has been smooth and you can see we have a happy team at the Secretariat.

PRIYA SHYAMSUNDAR, PROGRAM DIRECTOR SANDEE

▼ SANDEE secretarial staff Anuradha Kafle, Priya Shyamsundar (Program Director) and Mani Nepal, with SANDEE Fellow Pranab Mukhopadhyay.

PHOTO: SANDEE

EDE

ENVIRONMENT AND DEVELOPMENT ECONOMICS

The Beijer Institute continues to support the journal Environment and Development Economics.

General

This twelve-month period saw a sizeable increase in submissions to the journal, a rise in the journal's impact factor, and an increase in the proportion of manuscripts submitted from the developing regions of the world.

In order to handle the increasing numbers of submissions in a timely manner, two new Associate Editors were added to the editorial team. Salvatore Di Falco from the London School of Economics, with expertise in applied environmental economics and econometrics, and Karen Pittel from ETH Switzerland, with expertise in growth and environment, joined Phoebe Koundouri (Greece), Mar-

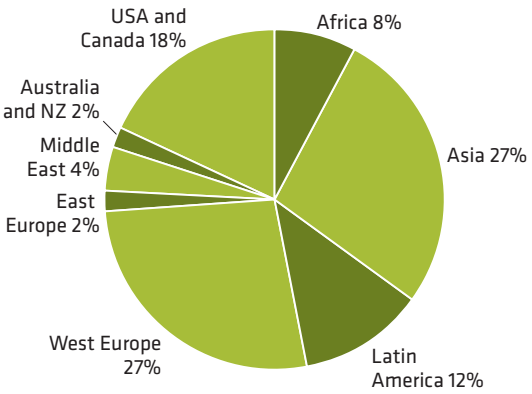
garet Chitiga Mabugu (South Africa), Bernardo Mueller (Brazil), Gerald Shively (USA), Eswaran Somanathan (India) and Jintao Xu (China). The Associate Editors continue to be the backbone of the journal, handling a growing number of manuscripts with the same high level of commitment to the capacity building role of the journal.

At the World Congress of Environmental and Resource Economists in Montreal, EDE organised a panel session entitled 'Environment and development: Are we moving forward? with Tasos Xepapadeas as moderator. Bernardo Mueller, Eric Mungatana, Eswaran Somanathan and Jintao Xu acted as panellists and introduced environmental issues from the Amazon, East and Southern Africa, India and China where progress has been achieved in the past ten years. The session was well attended and a lively discussion took place between the panellists and the audience.

Performance

The most recent (Thompson Reuters) impact factor information, which was released in June, shows a continued upward trend in the journal's citation factor.

The number of manuscripts submitted to *Environment and Development Economics* was significantly higher in 2009 than in 2008, with 2010 projected to show a slight increase over 2009.



Geographical distribution of submissions to *Environment and Development Economics* in the period 1 July 2009 – 30 June 2010.

Usage

Among the notable features with regard to usage of the journal is the fact that the total number of institutions with access to *EDE* rose from 3,774 to 6,443 in 2009. This huge increase is explained by the addition of the journal to further institutions in the AGORA and HINARI consortia. The top institutions by number of downloads provides proof of EDE's international readership, while the most-viewed article list shows a good spread of volume and issues.

Future targets

Over the next 12 months, the journal expects to publish three special issues: An issue on '*Critical Environmental and Development Issues in Latin America*', guest edited by Francisco Alpízar and Juan-Pablo Montero; an issue on '*Reducing Emissions from Deforestation and Forest Degradation* (REDD)', guest edited by Valentina Bosetti, Steven Rose and Carlo Carraro; and a *15th Anniversary Issue* to commemorate the journal's operations over the past 15 years.

The overall objective of the journal is to continue to promote high quality theoretical and empirical research in environment and development economics, to provide capacity building in developing countries related to these issues, and to focus – through special issues – on areas of current research and policy interest combining environmental and resource economics with development considerations, or on geographical regions of interest in terms of environmental and development issues. In this context, we are in the early stages of preparing a special issue on '*China in the 21st Century: Challenges in the Management of Natural Resources and the Environment*' with Jintao Xu as guest editor, and a special issue on '*Small Island Developing States*' with Sonja Teelucksingh, Paulo Nunes and Charles Perrings as guest editors. Also under consideration is a special issue related to Africa, while the possibility of involving SANDEE in a special issue on Asia will be explored.

ANASTASIOS XEPAPADEAS, EDITOR OF EDE AND CHAIRMAN OF THE BEIJER INSTITUTE'S BOARD OF DIRECTORS

SHORT COURSE:

Applying game theory and behavioral economics to the environment

THE DIRECTORS OF the regional environmental economics networks have become increasingly interested in joint activities as the networks have become better established. Such activities improve inter-network contacts and are more cost-effective than

PHOTO: GÉRARD GAUDET

▲ Beijer board member professor Scott Barrett was one of the lecturers at the course in Montréal.

PHOTO: GÉRARD GAUDET

▲ The 33 course participants came from 19 different countries in Africa, Asia and Latin America.

replicating the same activity multiple times. In addition, for activities that are intended for researchers with more advanced training, a single network might not have enough prospective participants to make the activity viable.

In 2009, former Beijer co-director Aart de Zeeuw and Beijer board member Jeffrey Vincent initiated discussions with the directors of the four leading regional networks – CEEPA, EEPSEA, LACEEP and SANDEE – about the possibility of organising a joint activity in conjunction with the 4th World Congress of Environmental and Resource Economists in Montréal in June, 2010. The group decided on a two-day course on game theory, behavioural economics and the environment. These are important fields of economics, but they have received little attention in previous network courses. Four distinguished scholars affiliated with Beijer activities – former board chair Sir Partha Dasgupta, board member Scott Barrett, fellow and head of the BENN programme Jason Shogren, and EDE associate editor E. Somanathan – have substantial expertise and were enthusiastic about lecturing within the course. Former Beijer director Karl-Göran Mäler, a pioneer in the application of game theory to transboundary pollution problems, gave a speech at the opening dinner.

The topic was well-chosen. The number of applications far exceeded expectations: more than 100 individuals applied. The network directors helped select 33 individuals for the course. They came from five countries in Africa, six in Latin America and the Caribbean, and seven in Asia. Participation from such a broad range of countries was made possible by the generous support of the Swedish International Development Cooperation Agency (Sida), the International Development Centre (IDRC), and the European Association of Environmental and Resource Economists (EAERE).

The course was very well-received. Lecturers commented to the organisers about the high quality of the participants, which is a sign of the networks' success in attracting and fostering the intellectual growth of talented individuals. Participants commented that the course was an eye-opener that exposed them to new concepts and methods that they can use in their research and teaching.

The course also contributed to the internationalisation of the World Congress, as most of the participants presented papers or posters at the Congress. It benefited from the strong support of Professor Gérard Gaudet, organiser of the 4th World Congress, and his staff at Université du Québec à Montréal, Canada. Administrative support was supported by Christina Leijonhufvud of the Beijer Institute. Discussions are underway about the possibility of a sequel during the 2012 meeting of the European Association of Environmental and Resource Economists.

JEFF VINCENT, BOARD MEMBER

A challenging year for a mathematician at Beijer

by *Anne-Sophie Crépin*, Deputy Director

IN THE PAST YEAR, we have had the great pleasure of having the Austrian mathematician Dieter Grass at the Beijer Institute.

Four years ago I presented a joint paper with Therese Lindahl relating to ecosystems with thresholds. We met some mathematical challenges with the complex mathematics involved in modelling these systems and we where suggested to get in touch with Dieter Grass, who was working on a toolbox to analyse optimal control systems with thresholds. Dieter and I had intensive e-mail exchanges on the topic and a couple of years later I had the opportunity to meet him in person. Dieter gave a fantastic presentation about the kinds of results he could obtain with his toolbox. At that time Aart de Zeeuw and I had just managed to secure funding for the Arctic Tipping Point project, a 7th framework EU programme, so we hired Dieter to work at Beijer within this project. The idea was to provide Dieter with a whole set of models with non convexities and let him use and improve the toolbox to study these systems in detail.

PHOTO: CECILIA NORDSTRAND

Dieter's year at Beijer didn't start very well. Barely two months after his arrival in August, he was hit by a car on his way to work. He ended up in hospital with memory loss from the accident and a nasty leg fracture that required surgery. Dieter is an amazing person. Thanks to his extraordinary physical condition, five days after the accident he was back on his feet climbing the many stairs of the Academy to go to work! By Christmas he could walk almost normally and had started to cycle on an exercise bike in his apartment for rehabilitation.

Even from the hospital, he worked on analysing our models on the toolbox. The work we have started this year together with Gustav Engström will now continue from abroad and has already led to several draft papers. We look forward to future meetings and to working together with Dieter.

TOOLBOX FOR ANALYSING COMPLEX DYNAMIC SYSTEMS

A major challenge relating to complex systems is to improve economic theory and policy to better deal with complex dynamics systems. We know fairly well how to deal with simple convex systems, but we still haven't managed to find general management rules for more complex systems. Instead we must study each specific system separately to find out how to deal with it. This is tedious as such systems often have multiple steady states, history dependency, so-called Skiba points (situations when going to two different steady states yields the same optimal welfare) and other kinds of strange dynamics.

We represent complex dynamic systems using mathematical models that boil down to dynamic systems of equations. A small degree of complexity is enough to prevent the existence of analytical solutions and hence we are seldom able to provide general recommendations and must instead test a whole array of different cases, varying parameter values and initial conditions.

The OCMAT toolbox that Dieter has developed together with colleagues from Vienna can perform such analyses quite quickly and produces amazingly good graphics to depict how the system develops for different initial conditions and parameter values, how the dynamics change with different steady states and what the Skiba manifolds look like. The OCMAT toolbox is available for MATLAB via http://orcos.tuwien.ac.at/research/ocmat_software/

Sabbatical leading to new intellectual journeys

by *J. Marty Anderies*, Arizona State University

PHOTO: AGNETA SUNDIN

▲ Line Gordon, Bert de Vries, Marty Anderies and Jeff Vincent at the Global Dynamics workshop in April 2010.

MY RESEARCH HAS been shaped over the years by the basic idea that social and ecological systems function as coupled units. Carl Folke coined the term "social-ecological systems" (SESs) that emphasizes this point. SES have another interesting feature: they often exhibit multiple stable configurations and rapid transitions between them. Finally SES are, by their very nature, complex systems and as such highly uncertain. Over the years the Beijer Institute and Stockholm Resilience Centre (SRC) have produced a significant body of work related to questions generated by these fundamental features of SESs. I was thus naturally attracted to the Beijer as a place to spend my sabbatical to further my own work in this area and generate new collaborations.

My stay at the Beijer was extremely productive. Not only was I able to push my own work forward given the excellent infrastructure provided by the Beijer and SRC, I became engaged in several interesting emerging intellectual streams through my participation in the *Planetary Boundaries* and *Inconvenient Feedbacks in Global Dynamics* workshops as well as the *Behavioral Economics and Nature Networks* workshop. The combination of the *Planetary Boundaries* and *Inconvenient Feedbacks in Global Dynamics* workshops induced me to explore the interaction of global boundaries using stylized mathematical models. It is my hope that I will be able to continue developing this work in collaboration with the Beijer and SRC beginning with the upcoming Inconvenient feedbacks in global dynamics workshop II in September, 2010.

Individual interactions produced fruitful ideas as well. Discussions with Max Troell at the Beijer Institute regarding the use the "ecosystem services" concept induced us to consider the transition from the language of "natural capital" of three to four decades ago to the language of "ecosystem services" of today. Likewise, several interactions with Carl Folke, produced a working paper that focuses on a careful clarification of the concepts of resilience, robustness, and sustainability. Finally, sitting in front of the computer with Jon Norberg was fruitful as always as we attempted to develop a simple bioeconomic model focused on understanding how social capital may operate in preventing overexploitation of a renewable resource and redistributing resource rents. Continued collaborations with Beijer and SRC scholars will hopefully bring these new intellectual journeys to fruitful destinations.

Selected events

The value of our marine environment

▼ Who says science is boring? Panel discussion with the Beijer Institute's Karl-Göran Mäler, Anne-Sophie Crépin and Steve Polasky and Sybille van den Hove, Autonomous University of Barcelona.

LAST SEPTEMBER THE SWEDISH Environmental Protection Agency held an international conference on the topic '*The Value of our Marine Environment*' under the auspices of the Swedish EU Presidency. The conference took place on a ship in Stockholm harbour. The Beijer Institute and the Stockholm Resilience Centre played an active part in setting the programme for this meeting, which aimed at finding ways to integrate the value of marine ecosystem services into decision-making in order to help manage them more sustainably. The conference was held as a series of plenary talks and panel discussions, in which several Beijer researchers and Beijer fellows presented relevant parts of their research and participated in debates and discussions in a relaxed atmosphere.

The main message of the conference was that human activities are shaping our marine environment, often in a negative way that threatens our major life-

PHOTO: THE SWEDISH ENVIRONMENTAL PROTECTION AGENCY

support systems. While several challenges were stressed, such as low awareness of nature's role and value, mismatches between ecosystems and policy boundaries and inability to deal with regime shifts, ways forward were also identified. These included incorporating humans and nature into mental models of the world adopting a systemic approach, ensuring broad participation and stakeholder participation in governance and management and developing strategies to make decisions even when knowledge is limited and risks may be large.

More information can be found on:
http://www.naturvardsverket.se/en/In-English/Menu/GlobalMenu/News/The-Value-of-our-Marine-Environment/

Resilience Alliance meeting in Canada

MEMBERS AND FRIENDS of the Resilience Alliance (RA) met between 27 September and 2 October 2009 at Gabriola Island in the Vancouver archipelago, a beautiful spot for constructive meetings and collaborations. Ilse and Buzz Holling were instrumental in organising the local meeting and the Beijer Institute, with support from the RA, helped coordinate the rest, with Christina Leijonhufvud as the core organiser and Per Olsson, Brian Walker and Carl Folke putting the content together. The meeting hosted plenary talks that explored global crises (financial, food, climate), resilience, social-ecological innovations and opportunity contexts (Elinor Ostrom, Frances Westley, Christo Fabricius) and prosilience – transformation challenges in social-ecological systems. Several working groups were formed, focusing on issues such as resilience and global change, resilience and biosphere reserves, workbooks and resilience assessments, indigenous societies and social-ecological resilience, tools for social innovation, earth system science research priorities from a resilience perspective, navigating the great transformation, and institutional analysis of social-ecological systems.

It was extremely rewarding to have the Resilience Alliance Young Scholars group (RAYS) at the meeting, with many enthusiastic and skilful participants. Social capital was strengthened and new members joined the Resilience Alliance.

There were also two pre-RA meetings, one with RAYS to discuss various resilience approaches and concepts and the other at the Middle Beach Lodge with First Nation people on the west coast of Vancouver Island.

Surprise Group Meeting

WHAT ARE SAFE LIMITS in complex dynamic systems with moving thresholds?

The combination of evolving and directional change and uncertainty makes thresholds in social-ecological systems particularly difficult to detect and manage. If thresholds are considered at all in governance and management, they are generally viewed as fixed points or linear causal chains. Replacement of this point of view with one of anticipating, mitigating or transforming undesirable system dynamics requires a revolution in training and the organisation of resources, power and decision making that is an innovation in itself.

The Surprise Group deals with such issues and Steve Carpenter, Marten Scheffer, Frances Westley, Oonsie Biggs and Carl Folke met this year in mid-April outside Stockholm to discuss elusive thresholds and their management. The team is evaluating case studies, analysing models of extreme nonlinear and stochastic events, and exploring new approaches for integrating knowledge, as well as approaches for education and training that help people combine knowledge from multiple diverse sources to ask new and different kinds of questions. Two manuscripts are in preparation.

Celebrating Sir Partha Dasgupta

ON JUNE 1ST the Beijer Institute hosted a dinner for Professor Sir Partha Dasgupta, much appreciated former Chairman of the Beijer Board and long time Beijer fellow. The dinner was held in connection with the World Bank ABCDE conference "Development Challenges in a Post-Crisis World" which was held in Stockholm May 31–June 2, 2010, hosted by the Swedish Ministry for Foreign Affairs. A great number of distinguished scholars wanted to pay tribute to Partha, who is retiring from Cambridge University. Robert Solow, Elinor Ostrom, Eric Maskin, James Mirrlees, Paul Ehrlich, Simon

PHOTO: GÉRARD GAUDET

▲ Sir Partha Dasgupta

Levin, and Joseph Stiglitz, among others were present at the Academy Klubbvilla and enjoyed a nice dinner with lots of speeches. A festschrift is also being prepared in Partha's honour, initiated by Karl-Göran Mäler, Eric Maskin and Scott Barrett.

The marine resilience group on the island of Åland

IN EARLY SUMMER, 5–11 June, a small group of researchers from different disciplines met for a week on northern Åland in the central Baltic Sea to discuss 'transboundary governance of marine social-ecological systems', including challenges for the Baltic Sea and the Coral Triangle Initiative in South-East Asia. The marine resilience group has existed since late 2002 and several high profile publications have been generated, focusing on social-ecological resilience in marine systems and the linkages between ecosystems and societal well-being. Several participants of the group have long experience of collaborating on the interface between societies, economies and the marine ecosystems that sustain them, where the unique characteristic is the emphasis on human interaction and dependence on marine ecosystems for livelihood and societal development.

The marine resilience group is part of a collaboration with the Australian Research Council (ARC) Centre of Excellence for Coral Reef Studies, where the Beijer Institute serves as a partner investigator in Program Five of the ARC Centre – Resilience of Linked Social-ecological Systems. The objective of the program is to provide new solutions to managing resilience and coping with change, uncertainty, risk and surprise in complex social-ecological systems. The overall aim is to improve the governance and management of marine ecosystems and enhance their capacity to sustain human and natural capital. The collaboration and workshops have generated new insights on the management and governance of coral reefs and coastal areas and have influenced policy. Publications over the years of collaboration include three papers in *Science*, two in *TREE*, and one each in *Nature*, *PNAS* and *Ambio*. Two further papers are currently being reviewed and two more are in progress.

The Åland workshop was initiated by an invitation from the Åland International Institute of Comparative Island Studies (AICIS). Many thanks to Agneta Karlsson of AICIS and Dag Broman for their support in helping to organise and host the productive workshop on the beautiful island of Åland.

▼ The marine resilience group at Åland in the Baltic Sea.

Appendix

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 should not be re-elected more than once, according to the standing instructions for the Beijer Institute approved by the Royal Swedish Academy of Sciences on 5 June 1991. The first Board of Directors for the new Institute was elected on 5 June 1991. The 19th annual board meeting was held at the Royal Swedish Academy of Sciences on 11 September 2009.

Board of Directors 2009–2010

CHAIRMAN

Anastasios Xepapadeas

Professor, University of Athens, Greece

EX-OFFICIO MEMBERS:

Carl Folke*

Director, the Beijer Institute, Sweden

Gunnar Öquist*

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

Anne-Sophie Crépin

Deputy Director, the Beijer Institute, Sweden

MEMBERS

Scott Barrett

Professor, Columbia University, USA

Stephen Carpenter*

Professor, University of Wisconsin, USA

Kanchan Chopra

Former Professor and Director, Institute of Economic Growth, Delhi, India

▼ The Beijer Board 2009
Back row: Scott Barrett, Steve Polasky, Aart de Zeeuw, Carl Folke. Front row: Gunnar Öquist, Gretchen Daily, Steve Carpenter, Marten Scheffer, Terry Hughes, Tasos Xepapadeas.

PHOTO: CECILIA NORDSTRAND

Gretchen Daily

Professor, Department of Biological Sciences, Stanford University, USA

Terry Hughes

Professor, James Cook University, Queensland, Australia

Stephen Polasky

Professor, University of Minnesota, USA

Marten Scheffer

Professor, Wageningen University, the Netherlands

Jeffrey Vincent

Professor, Duke University, USA

Aart de Zeeuw

Professor, Tilburg University, the Netherlands

Staff members

Carl Folke, Professor, Director

Anne-Sophie Crépin, PhD, Deputy Director

Stephan Barthel, PhD, Researcher

Johan Colding, PhD, Researcher

Gustav Engström, PhD candidate, Researcher

Dieter Grass, PhD, Researcher

Åsa Jansson, PhD, Researcher

Christina Leijonhufvud, BA, Administrator

Chuan-Zhong Li, Professor, Programme Director

Therese Lindahl, PhD, Researcher

Karl-Göran Mäler, Professor emeritus, former Director, Research Associate

Stephen Polasky, Professor, Programme Director

Jason Shogren, Professor, Programme Director

Anna Sundbaum, Communications officer

Agneta Sundin, Communications officer and financial controller (from May 2010)

Ingela Ternström, PhD, Researcher

Max Troell, Associate Professor, Researcher

Jeffrey Vincent, Professor, Project leader

Brian Walker, PhD, Programme Director

Aart de Zeeuw, Professor, Programme Director

* member of the Royal Swedish Academy of Sciences

Visiting scientists

J. Marty Anderies, Professor, Arizona State University, March–June 2010

Albert Honlonkou, PhD, Ceepa, University of Pretoria, South Africa and University of Abomey-Calavi, Benin, August–October 2009

Efthymia Kyriakopoulou, PhD candidate, Athens University, October 2009

Pranab Mukhopadhyay, PhD, Goa University, October–November 2009

Rucha Ghate, Director, SHODH: The Institute for Research and Development, Nagpur, October–November 2009

Sebastián Villasante, PhD, University Santiago de Compostela, May–June 2010

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 Institute.

Christina Leijonhufvud

Christina was responsible for the administration of the Board and Askö meetings in September 2009 and has helped organise several smaller workshops at the Beijer Institute and at the Royal Swedish Academy of Sciences. She co-organised the Resilience Alliance meeting and pre-meeting in Gabriola Island and Tofino, Canada, on 25 September–2 October 2009, as well as organising the two Bei-

jer workshops: '*Inconvenient Feedbacks in Global Dynamics*' on 12–14 April 2010, and '*Behavioural Economics and Nature Network* (BENN) on 12–15 May 2010.

Christina was also administrator for the course '*Applying Game Theory and Behavioural Economics to the Environment*' held in Montreal, Canada, on 27–28 June 2010 and is responsible for administration of the Maler Scholarships.

Agneta Sundin

Agneta Sundin replaced Anna Sundbaum as communications officer and financial controller in May 2010. Her responsibilities include developing and editing the website, administrating the Beijer Publication Series and editing the Annual Report. As financial controller she handles the budgetary and accounting issues for the Beijer Institute. As a member of the Communications group of the Stockholm Resilience Centre, Agneta is also involved in activities arranged jointly by the SRC, Beijer and Albaeco.

Funding

Core funding for the Beijer Institute is provided by the Kjell and Märta Beijer Foundation. Funding for the Institute's research activities between 1 July 2009 and 30 June 2010 was also provided by:

- The European Commission
- The Foundation for Strategic Environmental Research, MISTRA
- The Royal Swedish Academy of 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 environment and development and international training programmes.

PhD Course: The Economics of the Environment

During spring 2010, the Beijer Institute organised its biannual PhD level course for students at the Stockholm Doctoral Course Programme in Economics, Econometrics and Finance (SDPE). The course was attended by PhD students in Economics from the Stockholm School of Economics, Stockholm University, Uppsala University and the Swedish University of Agricultural Sciences.

The objective of the course was to give the students an introduction to environmental economics, as well as a deeper understanding of a few selected areas. The course covered basic theories and provided deeper knowledge about how the complexity of the socio-ecological environment alters these theories. The focus areas included resource economics, international environmental agreements, informal solutions to resource management problems and valuation, including green accounting.

The course was organised by Anne-Sophie Crépin, Therese Lindahl and Ingela Ternström, who were also lecturers at the course, together with Chuan-Zhong Li and Carl Folke.

PhD Course: Ecology and Economic Management

The course aims at giving students in Environmental Economics an understanding of the complexity and functions of interlinked socio-ecological systems, and the implication this has for governance.

The course is aimed at students participating in the SIDA financed PhD programme in Environmental Economics, Gothenburg University, and this years course was held between 25 January and 5 February, 2010. 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 capac-

ity 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.

Three Swedish PhD students in Environmental Economics, Gothenburg also participated in the course this year.

The PhD Course in Ecology and Economic management is held biannually.

The course in Ecology and Economic Management taught by the Beijer Institute was an excellent experience for me as a PhD student in Economics. The high quality and interdisciplinary lectures improved my understanding of the environment from an ecological economics perspective. The course provided me with examples and tools to develop theoretically and got me interested in ecosystems models that include human intervention.

Humans and ecosystems interact both spatially and temporally. Ecosystems are complex dynamic systems whose resilience may be strongly affected by economic development. Therefore, a good understanding of the fundamental ecological functions of the ecosystems would help policymakers and economists to design more appropriate policies for sustainable management of our natural resources. Relevant areas of application include planning urban landscapes, management of freshwater for irrigation systems and oceans for fisheries and aquaculture, as well as management of forest for wood, firewood and hydrological regulation. The course offered by the Beijer Institute combines ecological and economic concepts with interdisciplinary and scientific professionalism. I completely recommend this course, all the lectures were very valuable, and it stimulates new areas of research for those interested in environmental economics. Particularly, in the field of complex dynamics in ecosystems I think the experience of the Beijer Institute is unique. For me it was a great opportunity being at the Beijer Institute, submerged in an atmosphere of science.

JORGE ALEXANDER BONILLA, STUDENT ON THE PHD PROGRAMME IN ENVIRONMENTAL ECONOMICS, UNIVERSITY OF GOTHENBURG.

The Stockholm Seminar: Frontiers in Sustainability Science and Policy

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

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

During 2009/2010, the following seminars were held at the Royal Swedish Academy of Sciences:

2009

4 September: Prof. Maurice Godelier
In today's world, anthropology is more important than ever

22 September: Mr. Vasilis Dakos
Expecting the unexpected: Leading indicators of regime shifts

7 October: Prof. Kenneth Frank
The social embeddedness of natural resource extraction and use in small fishing communities

2010

28 January: Prof. Nancy Knowlton
Coral reefs: Present, past and future

25 February Dr Neville Crossman
Modernising Irrigation for Multiple Benefits: Restoring the Balance – Increasing Resilience

15 March: Prof. Frank Biermann
World politics in emergency mode

8 April: Prof. Robert Pomeroy
Managing overcapacity in small-scale marine fisheries

4 May: Assoc. Prof. J. Marty Anderies
Robbing Peter to pay Paul: Managing difficult trade-offs in uncertain resource management situations

7 May: Prof. Bedrich Moldan
Changing environment in Central Europe

17 May: Prof. Graeme Cumming
Dispersal, strategy, and resilience: Or, how to be a duck

19 May: Prof. Albert Jacquard
Economic growth vs uneconomic growth – shifting the economic system from a growth focus to a human-development focus

1 June: Prof. Jonathan Foley
The other inconvenient truth: A global crisis of land use and agriculture

9 June: Half-day seminar
At the intersection of climate and energy security – scenarios of fundamental global challenges

Brown Bag Lunch Seminars

The Brown Bag Lunch Seminars are a joint initiative between the Beijer Institute, Stockholm Resilience Centre, Stockholm Environment Institute, Albaeco and the Natural Resource Management group at the Department of Systems Ecology. The seminars aim to provide a platform for staff, students and visitors at the institutions that together form the Stockholm Resilience Centre, to share their work in an informal manner with ample time for discussion. They are held both at the Stockholm Resilience Centre and at the Beijer Institute. The Brown Bag Seminars have proved to be a success and often attract a large audience, with the seminar dates already fully booked for the autumn.

2009

9 September: EcoSanRes, SEI
Open discussion on linking sustainable sanitation to food security and ecosystem services research at SEI and SRC

16 September: Dr. Albert Honlonkou
The political economy of flood management in an African city

14 October: Prof. Kevin Noone
A big bowl of alphabet soup: International networks in global environmental change research

21 October: Dr. Dieter Grass
Numerical detection of regime shifts and thresholds in optimal control models

28 October: Dr. Jon Norberg
Conceptual thoughts on adaptive processes and innovation in relation to resilience

4 November: Dr. Therese Lindahl
Asymmetric information & learning in common pools

11 November: Dr. Regina Lindborg
Extinction debt: A challenge for biodiversity conservation

18 November: Dr. Rucha Gate & Dr. Pranab Mukhopadhyay
Understanding local forest use – results from field experiments and cross-country data

18 November: Dr. Mikael Román
Climate and development: Mitigation and adaptation as the result of other public policies

2010

2 February: Karl Hallding
Going clean – the economics of China's low carbon development

11 February: Prof. Carole Crumley
What's resilient about history? Introduction to the new IHOPE initiative at the Stockholm Resilience Centre

17 February: Dr. Thorsten Blenckner
Regime shifts in marine ecosystems: The Baltic Sea as a case

24 February: Dr. Louise Karlberg & Dr. Holger Hoff, *SEI*
Ecohydrological assessments of green and blue water: linking between scales

10 March: Dr. Åsa Jansson
Quantifying biodiversity for building resilience for food security in urban landscapes

24 March: Dr. Max Troell
Balancing aquaculture and fisheries – livelihood options from the farming of shrimp and mangrove crabs in Bangladesh and East Africa

7 April: Dr. Albert Norström
Steering feedbacks toward healthier marine ecosystems

16 April: Prof. Jenny Stewart
Transcending bureaucracy: The possibilities of systems theory

21 April: David von Below
The terrestrial carbon cycle in climate-economy models

5 May: Dr. Atakilte Beyene
Rural entrepreneurship in out-growers' scheme for Jatropha production: (a preliminary) case of a smallholder farming system, Ethiopia

19 May: Prof. Carl Folke
Global dynamics through the marine lens

24 May: Dr. Sarah Gergel
Historical dynamics and trade-offs among ecosystem services: Mapping ecological, cultural and economic values in coastal rainforests

27 May: Prof. Thomas Elmqvist, Eva Krutmeijer, Daniel Lundbäck, Dr. Fredrik Moberg
Urban sustainability at the Shanghai World Expo 2010

31 May: Prof. J. Marty Anderies
Studying the dynamics of social ecological systems: What is the "data" and how should we organize it

2 June: Prof. John A. Matthews
Climate bonds: Mobilising private finance to drive an energy industrial revolution

17 June: Prof. Stephen Lansing
Cultural landscapes, adaptive cycles and adaptive co-management: research opportunities in Indonesia

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 meet-

IN MEMORY OF STEVE SCHNEIDER

One of the participants in last year's Askö meeting, Stephen 'Steve' Schneider, has sadly passed away.

Steve Schneider, Stanford University, was a world leading climate scientist and served for example on the international research panel on global warming, IPCC, which shared the 2007 Nobel Peace Prize with former Vice President Al Gore. He studied climate change for decades and with great communication skills he worked tirelessly to attract the attention of politicians and the general public to the complex climate issue.

With his immense scientific skills and experience he was an appreciated participant at the Askö meetings he attended. Here at the Beijer Institute he will be remembered for his helpfulness and passion in trying to solve the global environmental challenges facing humanity.

▼ Participants of the 17th Askö meeting, September 2009.
Back row: Scott Barrett, Steve Polasky, Carl Folke, Simon Levin, Richard Howarth, Jason Shogren, Garry Petersen, Paul Erlich. Middle row: Steve Schneider, Terry Hughes, Marten Scheffer, Tasos Xepapadeas, Karl-Göran Mäler, Steve Carpenter, Anne-Sophie Crépin, Brian Walker, Ken Arrow, Nils Kautsky. Front row: Oonsie Biggs, Agneta Sundin, Christina Leijonhufvud, Gretchen Daily.

PHOTO: THE BEIJER INSTITUTE

ings 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 for the 17th Askö Meeting (12–14 September 2009) was '*Uncertainty*'. An article following the 2009 Askö meeting is in preparation. The theme for the 18th Askö meeting in September 2010 is '*Fat-tail generating mechanisms and their implications for planetary stewardship*'.

A list of publications from the Askö meetings can be found on www.beijer.kva.se

Staff members' publications and activities

Staff members' research activities are presented at events such as conferences, workshops and seminars. To stimulate interaction between the staff members both at the Beijer Institute and the Stockholm Resilience Centre, joint internal seminars take place regularly. Below is a selection of the staff members' publications and activities during 2009/2010.

Stephan Barthel

PhD, researcher

Research focus:

I have a PhD in natural resource management about actor groups in relation to management of biodiversity and ecosystem services in urban landscapes. I am especially interested in urban gardening and agriculture. Using a resilience lens, my research focus is on social-ecological features behind management practice. I address the following questions: Which linked social-ecological processes result in the generation of urban ecosystem services? What enables local management practices in urban landscapes? To what extent does on-the ground management affect ecosystem services? How are local management practices, which support ecosystem services, captured, retained and transmitted in self-organised actor groups? How can planning and governance incorporate ecosystem services, and secure a resilient flow of these?

Publications during the period:

Colding, J. & Folke, C. 2009. The role of golf courses in biodiversity conservation and ecosystem management. *Ecosystems* 12: 191–206.

Barthel, S., Folke, C. & Colding, J. 2010. Social-ecological memory in gardening: Retaining the capacity for management of ecosystem services. *Global Environmental Change* 20: 255–265.

Ernstson, H., Barthel, S., Colding, J., Grahn, S., Marcus, L., Ingman, M., Kärsken, C. & Torsvall, J. 2009. Patch Work – a social-ecological prototype for the Albano area, *Hagabladet*

Seminars and symposium presentations:

- Presentation SUPER project, SRC Urban theme workshop, Capetown, 2009.
  Albano sustainable campus:
  - Release of alternative suggestion for Albano Sustainable Campus, October 2009
  - SUPER workshop organiser and presenter with guests from Turkey and Holland, November 2009
  - Workshop and presentation about Albano with civil society actors, Stockholm, February 2010
- *Urban resilience of ancient Constantinople*, Brown Bag seminar, Stockholm Resilience Centre, February 2010.
- Presentation of urban resilience for urban planners, ESOF conference, Stockholm Resilience Centre.
- Presentation of Albano project for the Mayor of Stockholm, March 2010.
- Open lecture on the concept social-ecological memory, SUPER workshop, Holland, April 2010.
- Visions for historical research, presentation, AIMES conference, Scotland, May 2010.
- Social-ecological memory, organiser of workshop, the Royal Swedish Academy of Sciences, May 2010.
- Presentation of resilience planning to planners from Norrköpings stad, Sweden, June 2010.
- Presentation at press conference organised by Formas, Italy, June 2010.

Teaching and training:

- Course leader and lecturer for the 7.5 credit programme '*Hållbar samhällsutveckling (Sustainable societal development)*', Stockholm University 2009.

Commissions:

- Commissioned by the Stockholm University landlord, Akademiska hus, to create a vision for a sustainable new Albano campus.
- Member of the city planning group for Albano, organised by Stockholm City.

Other:

- Organiser of the international programme office for IHOPE at the Stockholm Resilience Centre

Chuan-Zhong Li

Professor, researcher

Research focus:

Dynamic welfare analysis, sustainability economics, and resilience studies

Publications during the period:

Incorporating resilience in the assessment of inclusive wealth: An example from South East Australia. *Environmental and Resource Economics* 45: *183–202 (with Walker B. et al., 2010)*

Measuring Welfare and Sustainable Development – Green National Accounting and Social Cost-Benefit Analyses. Ministry of Finance, Regeringskansliet, Stockholm 2010, 127 pages, in Swedish (with Löfgren, K.G.)

A note on the theory of investment: Hotelling's rule under process independence. Forthcoming in *Letters in Spatial and Resource Sciences*, DOI 10.1007/s12076-010-0035-7 (with Löfgren K.G.)

The theory of dynamic cost-benefit analysis: some recent advances. Forthcoming in *Handbook of Green National Accounting*. Edward Elgar Publishing Ltd.

Seminars and symposium presentations:

- European Association of Environmental and Resource Economists (EAERE) 17th Annual Conference, June, Amsterdam, the Netherlands (2009).
- Paper: *Valuing air quality and urban accessibility: A regional welfare analysis*. (with Isacsson, G.)
- Fourth World Congress of Environmental and Resource Economists, 28 June–2 July 2009, Montreal, Canada

Other:

- Professor of Economics at Uppsala University, Sweden

Johan Colding

PhD, researcher

Research focus:

Urban social-ecological systems

Publications during the period:

Colding, J. & Folke, C. 2009. The role of golf courses in biodiversity conservation and ecosystem management. *Ecosystems* 12: 191–206.

Barthel, S., Folke, C. & Colding, J. 2010. Social-ecological memory in gardening: Retaining the capacity for management of ecosystem services. *Global Environmental Change 20:* 255–265

Colding, J., Lundberg, J., Lundberg, S. & Andersson, E. 2009. Golf courses and wetland fauna. *Ecological Applications* 19: 1481–1491.

Colding, J. In press. Creating incentives for increased public engagement in ecosystem management through urban commons. Chapter 13 in Boyd, E. & Folke, C. (eds): *Adapting Institutions: Meeting the Challenge of Global Environmental Change*. Book proposal for Cambridge University Press.

Colding, J. in press. The role of ecosystem services in contemporary urban planning. In: Breuste, J., Elmqvist, T., Niemelä, J. & James, P. (eds), *Ecosystems, Ecosystem Services and Social Systems in Urban Landscapes*, Oxford Press.

Colding, J. 2009. Green wedges and urban commons. *Sustainability* 3, October 2009.

Colding, J. & Lundberg. 2009. *Golfbanan som våtmarksresurs: Manual för att främja biologisk mångfald i dammar och småvatten på golfbanan*. The Scandinavian Turfgrass and Environment Research Foundation.

Ernstson, H., Barthel, S., Colding, J., Grahn, S., Marcus, L., Ingman, M., Kärsken, C. & Torsvall, J. 2009. Patch Work – a social-ecological prototype for the Albano area, *Hagabladet*.

Wilkinson, C., Porter, L. & Colding, J. In press. Resilience science and metropolitan planning – the challenge of operationalising social-ecologi-

cal resilience beyond its metaphorical power. In press in *Critical Planning*.

Seminars and symposium presentations:

Invited Speaker. *Det urbana landskapets gröna delar: historia, värde, planering, skötsel och restaurering*. September 2009, International Association for Landscape Ecology (IALE), Royal Swedish Academy of Sciences, Stockholm, Sweden.

Patch Work – urban social-ecological design. Workshop contributor. October 2009. Stockholm Resilience Centre.

Invited Speaker, WHEN workshop, IHOPE, October 2009, Stockholm Resilience Centre.

Invited Speaker, Urban Net Conference, November 2009, The SUPER project. FORMAS, Stockholm, Sweden.

Other:

- Golf Courses May Protect Wetland Animals. Interview for Discovery News with Jessica Marshall. 3 Sept 2009.

Anne-Sophie Crépin

PhD, Deputy Director

Research focus:

Resource economics with focus on resources with complex dynamics due to diversity, species richness, the interplay of fast and slow variables, threshold effects, common property resources. Climate change and tipping points in the Arctic. Global dynamics and resilience.

Publications during the period:

Crépin, A-S. 2009. Miljö- och naturresurser. In *Tillämpad mikroekonomi*, Studentlitteratur. Second edition.

Crépin, A-S., Mäler, K-G. & Norberg, J. Coupled economic-ecological systems with slow and fast dynamics – modelling and analysis method. In revision for *Ecological Economics*

Crépin, A-S. & Jayet, P-A. Set-aside requirements versus production quotas in agro-environmental regulatory contracts, submitted.

Work in progress:

Crépin, A-S. & Grass, D. Dynamics of controlled ecosystems with tipping points

Crépin, A-S. Troell, M., Biggs, R., Polasky S., & de Zeeuw, A. Consequences of regime shifts for human welfare and implications for management

Polasky, Biggs, Crépin, Peterson et al., Askö paper on uncertainty

Crépin, A-S. et al., 2010 Inconvenient feedback in global dynamics. Background paper for the Workshop on Inconvenient Feedbacks in Global Dynamics

Engström, G., Grass D., and Crépin, A-S. Poverty traps, economic growth and climate change – what if life support systems become vulnerable?

Crépin, A-S., Levin, S., Xepapadeas A., et al., Social-ecological systems as complex adaptive systems: policy challenges.

Seminars and symposium presentations:

- Keynote speech at the 20th International Climate Policy Workshop, Stockholm University, April 2010
- Poverty traps, economic growth and climate change – what if life support systems become vulnerable?, 7th EU Framework project *Arctic Tipping Points*, yearly meeting, Centre for Environmental and Resource Economics in Umeå, Sweden
- Invited seminar at Centre for Nonlinear Dynamics in Economics and Finance, Amsterdam
- Invited speaker and participant in a panel discussion with Karl-Göran Mäler, Steve Polasky and Sybille van der Hove at the conference during the Swedish EU presidency organised by the Swedish Environmental Protection Agency '*The value of our marine environment*', Sweden

Teaching and training:

- Course organiser and lecturer (shared) for the PhD course '*The Economics of the Environment*' given in collaboration between the Department of Economics at Stockholm University and the Beijer Institute. Lecturer for the PhD course for economists '*Ecology and Environmental Management*' given at the Beijer Institute.
- Member of the examination committee of the licentiate thesis from the Swedish University of Agricultural Sciences Umeå: '*Environmental Compensation Using Resource Equivalency Analysis (REA) and Habitat Equivalency Anal-*

ysis (HEA): Is it Just for the Birds ? Determining Whether Societies are Better Off Following Resource-Based Compensation' by Scott G. Cole, Department of Forest Economics, Faculty of Forestry.

Commissions:

- Council member of Expertgruppen för miljöstudier, an environmental committee under the Swedish Department of Finance
- Council member of the European Association of Environmental and Resource Economists (*2008–2011)*
- Referee for the following journals: *Ecological Economics*, *Environment and Development Economics*, *Environmental and Resource Economics*, *Review in Fisheries Science*.

Other:

- Research team leader for '*Global and cross-level dynamics in social-ecological systems*' at Stockholm Resilience Centre (jointly with Kevin Noone, Steve Polasky, Will Steffen and Brian Walker)
- Programme director of the '*Global Dynamics and Resilience*' programme (jointly with Steve Polasky and Brian Walker)
- Research group leader and member of the Steering Committee within the 7th EU Framework project *Arctic Tipping Points*.
- Researcher: *Centre of Excellence*
- Deputy supervisor for Gustav Engström, PhD candidate at the Department of Economics and Stockholm Resilience Centre, Stockholm University (Lic. Nov. 2009) and Nasima Chowdhury, PhD candidate at the Department of Economics, Gothenburg University.
- Participant of the 17th Askö Meeting, '*Uncertainty*', September 2009, Askö, Sweden

Gustav Engström

PhD candidate, researcher

Research focus:

Economics of climate change, Baltic Sea, optimal control theory

Publications during the period:

Looming global-scale failures and missing institutions. *Science*, 11 September 2009 (co-authored with: Brian Walker, Victor Galaz, Carl Folke, Frank Ackerman, Ken Arrow, Scott Barrett, Stephen Carpenter, Kanchan Chopra, Gretchen Daily, Paul Ehrlich, Terry Hughes, Nils Kautsky, Simon Levin, Karl-Göran Mäler, Stephen Polasky, Jason Shogren, Jeff Vincent, Tasos Xepapadeas, and Aart de Zeeuw),

Seminars and symposium presentations:

- 2010 June – WCERE, World Congress of Environmental and Resource Economists (Montreal)
- 2010 June – 11th Workshop on Optimal Control, Dynamic Games and Nonlinear Dynamics, (Amsterdam)

Teaching:

- 2010 (Spring) *The Climate and the Economy*, Master's course, Stockholm University
- 2010 (Spring) *Ecology and Economic Management 2010*, PhD course given by the Beijer Institute

Carl Folke

Professor, Director

Research focus:

Integrated social-ecological systems, ecosystem services, dynamics and management, resilience, adaptive governance

Publications during the period:

Barthel, S., C. Folke & J. Colding. 2010. Social-ecological memory in urban gardens: Retaining the capacity for management of ecosystem services. *Global Environmental Change* 20: 255–265.

Barthel, S., J. Parker, C. Folke & J. Colding. Urban Gardens: Pockets of social-ecological memory. In: Tidball, K. and M. Krasny (eds.). *Greening in the Red Zone: Vulnerability, Resilience and Urban Community-Based Natural Resource Management*. Springer, Netherlands. In press.

Boyd, E. and C. Folke (eds.). 2010. *Adapting Institutions, Governance and Complexity: Insights for Social-Ecological Resilience*. Cambridge University Press. In press.

Chapin, III, F.S., S.R. Carpenter, G. P. Kofinas, C. Folke, N. Abel, W.C. Clark, P. Olsson, D.M.

Stafford Smith, B.H. Walker, O.R. Young, F. Berkes, R. Biggs, J.M. Grove, R.L. Naylor, E. Pinkerton, W. Steffen & F.J. Swanson. 2010. Ecosystem stewardship: Sustainability strategies for a rapidly changing planet. *Trends in Ecology and Evolution* 25: 241–249.

Crona, B., M. Nyström, C. Folke & N. Jiddawi. 2010. Middlemen, a critical social-ecological link in coastal communities of Kenya and Zanzibar. *Marine Policy* 34: 761–771.

Deutsch, L., M. Falkenmark, L.J. Gordon, J. Rockström & C. Folke. 2010. Water-mediated ecological consequences of intensive livestock production. In: Steinfeld, H., H.A. Mooney, F. Schneider & L.E. Neville (eds.) *Livestock in a Changing Landscape: Drivers, Consequences and Responses*. Island Press, D.C. pp. 97–110.

Falkenmark, M. & C. Folke. 2010. Ecohydrosolidarity: A new ethics for stewardship of value-adding rainfall. In: Brown, P.G and J.J. Schmidt (eds.) *Water Ethics: Foundational Readings for Students and Professionals*. Island Press, Washington D.C. pp. 247–264.

Fischer, J., G.D. Peterson, T.A. Gardner, L.J. Gordon, I. Fazey, T. Elmqvist, A. Felton, C. Folke & S. Dovers. Integrating resilience thinking and optimisation for conservation. *Trends in Ecology and Evolution* 24: 549–554.

Folke, C. 2010. How resilient are ecosystems to global environmental change? *Sustainability Science* 5: 151–154, doi.org/10.1007/s11625-010-0109-x

Folke, C. 2010. On resilience. SEED Global Reset 2010. SEEDMagazine.com pp. 40–41,43.

Folke, C. Learning and adapting: Central features of resilience. *Environmental Education Research*. In press.

Folke, C. The Askö challenge. In: Sundbaum, A., T. Söderqvist, C. Folke & K.-G. Mäler (eds.) *Bringing Ecologists and Economists Together: The Askö Meetings*. Springer Verlag, Heidelberg. In press.

Folke, C., S.R. Carpenter, B.H. Walker, M. Scheffer, F.S. Chapin III & J. Rockström. 2010. Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society*. In press.

Gunderson, L. & C. Folke. Riding a wave of creative destruction: reflections on ecology and society. *Ecology and Society*. In press.

Gunderson, L. & C. Folke. 2009. The Ecology and Society network. *Ecology and Society* 14(2): 44. [online] URL: http://www.ecologyandsociety.org/vol14/iss2/art44/

Lokrantz, J., M. Nyström, A.V. Norström, C. Folke & J. Cinner. 2010. Impacts of artisanal fishing on key functional groups and the potential vulnerability of coral reefs. *Environmental Conservation* doi:10.1017/S0376892910000147

Miller, F., H. Osbahr, E. Boyd, F. Thomalla, S. Bharwani, G. Ziervogel, B.H. Walker, J. Birkmann, S. van der Leeuw, J. Rockström, J. Hinkel, T.E. Downing, C. Folke & D.R. Nelson. Resilience and vulnerability: Complementary or conflicting concepts? *Ecology and Society*. In press.

Olsson, P., Ö. Bodin & C. Folke. 2010. Building transformative capacity in social-ecological systems: insights and challenges. In: Armitage, D. and R. Plummer (eds.) *Adaptive Capacity and Environmental Governance*. Springer Verlag, New York.

Österblom, H., A. Gårdmark, L. Bergström, B. Müller-Karulis, C. Folke, M. Lindegren, M. Casini, P. Olsson, R. Diekman, T. Blenckner, C. Humborg & C. Möllmann. 2010. Making the ecosystem approach operational – Can regime shifts in ecological and governance systems facilitate the transition? *Marine Policy* doi.org/10.1016/j.marpol.2010.05.007

Rockström, J. W. Steffen, K. Noone, Å. Persson, F.S. Chapin III, E.F. Lambin, T.M. Lenton, M. Scheffer, C. Folke, H.J. Schellnhuber, B. Nykvist, C.A. de Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P.K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R.W. Corell, V.J. Fabry, J. Hansen, B.H. Walker, D. Liverman, K. Richardson, P. Crutzen & J.A. Foley. 2009. A safe operating space for humanity. *Nature* 461: 472–475.

Rockström, J., C. Folke, F. Moberg et al. 2009. *Resilience and Sustainable Development* 2.0: A Report by the Stockholm Resilience Centre for the Swedish Government's Commission on Sustainable Development.

Rockström, J., W. Steffen, K. Noone, Å. Persson, F.S. Chapin, III, E.F. Lambin, T.M. Lenton, M. Scheffer, C. Folke, H.J. Schellnhuber, B. Nykvist, C.A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P.K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R.W. Corell, V.J. Fabry, J. Hansen, B.H. Walker, D. Liverman, K. Richardson, P. Crutzen & J.A. Foley. 2009. Planetary boundaries: exploring the safe operating space for humanity. *Ecology and Society* 14(2): 32. [online] URL: http://www.ecologyandsociety.org/vol14/iss2/art32/

Sundbaum, A., T. Söderqvist, C. Folke and K.-G. Mäler (eds.). *Bringing Ecologists and Economists Together: the Askö Meetings*. Springer Verlag, Heidelberg. In press.

Walker, B.H., S. Barrett, S. Polasky, V. Galaz, C. Folke, G. Engström, F. Ackerman, K. Arrow, S.R. Carpenter, K. Chopra, G.. Daily, P. Ehrlich, T. Hughes, N. Kautsky, S.A. Levin, K.-G. Mäler, J. Shogren, J. Vincent, T. Xepapadeas & A. de Zeeuw. 2009. Looming global-scale failures and missing institutions. *Science* 325: 1345–1346.

Selected seminars and symposium presentations

Organiser and speaker at:

- *The Value of Our Marine Environment*, with the Swedish Environmental Protection Agency. A conference for European policymakers during the Swedish EU Presidency, September, 2009
- The Resilience Alliance meeting, Gabriola Island, Canada, September 2009
- The Global Governance meeting, Stockholm, March 2010
- The Global Resilience and Planetary Boundaries workshops, Stockholm, April 2010
- The Surprise Group meeting, Stockholm, April 2010
- The BENN workshop, May 2010
- The Social Learning workshop, Stockholm, June 2010
- The Marine Resilience Group workshop, Åland, June 2010
- Various workshops and meetings locally.

Keynote speaker:

- Earth System Governance Symposium, Amsterdam, November–December 2010
- Expert meeting on conservation of biodiversity and ecosystems: *COP10 and beyond*, UNU, Tokyo, February 2010
- IR3S Symposium *Biodiversity and Sustainability: Rebuilding Society in Harmony with Nature*, Tokyo University, Tokyo, February 2010

Teaching and training:

- Lecturer at the research school on Earth System Governance, Amsterdam and at undergraduate and Master's level and PhD courses and research schools at Stockholm University.
- Supervisor (main and co-supervisor) of four PhD students in Natural Resource Management, Department of Systems Ecology, Stockholm University, with one of them (Albert Norström) defending his thesis during the year. Supervising one PhD student abroad (Germany).

Commissions

- Science Director, Stockholm Resilience Centre: Research for Governance of Social-Ecological Systems, Stockholm University
- Editor-in-Chief; *Ecology & Society* www.ecologyandsociety.org
- Advisory and editorial boards of 16 journals including: *Ambio*, *Ecological Economics*, *Ecological Economics Reviews*, *Ecosystems*, *Environment*, *Environmental Conservation*, *Environment and Development Economics*, *Frontiers in Ecology and the Environment*, *Global Environmental Change*, *Letters in Spatial and Resource Sciences*, *Sustainability Science*
- Founding member, Chair of the Executive Committee of the Resilience Alliance
- Member of the Royal Swedish Academy of Sciences since 2002
- Member of the Environmental Research Committee of the Royal Swedish Academy of Sciences since 2003
- Board member, Stockholm Environment Institute, since 2004

- Scientific Advisory Board, SARAS (South American Institute for Resilience and Sustainability Studies), Montevideo, Uruguay, since 2007
- Steering Committee, ESRC Centre for Climate Change Economics and Policy at London School of Economics and University of Leeds, UK, since 2008
- Partner investigator, The ARC Centre of Excellence for Coral Reef Studies, JCU, Australia, since 2005
- Scientific Committee, Programme on Ecosystem Change and Society (PECS), ICSU since 2009.
- Science Advisory Committee, IIASA since 2009
- Scientific Advisory Board, STEPS since 2010
- Scientific Committee, Volvo Environment Prize, since 2008
- Associate Faculty of the Earth System Governance Project, IHDP, since 2009
- Advisory Board to The International Network of Research on Coupled Human and Natural Systems (CHANS-Net) since 2009
- Advisor to the Minister and Ministry of the Environment, Sweden
- Steering Committee of Ekoklim and Beam, Stockholm University

Dieter Grass

PhD, researcher

Research focus:

Numerics of optimal control models, bifurcation theory.

Seminars and symposium presentations:

Regime Shifts in Dynamic Optimization Problems: A Coral Reef Model. Brown Bag Lunch Seminar, the Stockholm Resilience Centre, October 2009.

OCMat: A MATLAB toolbox for Bifurcation analysis in optimal control models: Arctic Tipping Points meeting, Copenhagen, March 2010.

Bifurcations of an Optimally Controlled Slow Fast Dynamics: Fishery in a Coral Reef System: 11th Workshop on Optimal Control, Dynamic Games and Nonlinear Dynamics, Amsterdam, May 2010

Working papers:

A two-sector model: Life at the subsistence level. G. Engström, D. Grass & A.-S. Crepin.

Poverty traps, economic growth and climate change – what if life support systems become vulnerable? G. Engström, D. Grass & A.-S. Crepin.

Numerical computation of the optimal vector field in a fishery model. D. Grass.

Optimal pricing of a conspicuous product during a recession that freezes capital markets. J.P. Caulkins, G. Feichtinger, D. Grass, R.F. Hartl, P.M. Kort & A. Seidl. In submission.

Åsa Jansson

PhD, researcher

Research focus:

Quantification and valuation of ecosystem services, urban sustainability and biodiversity

Publications during the period:

Jansson, Å. & Polasky, S. Quantifying biodiversity for building resilience for food security in urban areas: getting down to business. In press in *Ecology and Society*.

Folke, C., Jansson, Å. & Polasky, S. In prep. Ecosystem services perspectives: a history and future projections. Will be submitted to *Ecological Monographs*.

Mäler, K. G., Aniyar, S. & Jansson, Å. 2010. Accounting for regulating services. In: P. Kumar & M. Wood (eds) *Valuation of Regulating Services of Ecosystems, Methodology and Applications*. Hardback: 978-0-415-56987-3. Routledge.

Jansson, Å. Biodiversity and ecosystem services. In prep. In: Colding et al. *Managing Urban Ecosystem Services*. CUP.

Seminars and symposium presentations:

- Presentation: Sustainability Day, Svenskt näringslivsmiljöchefer. Cirkus. 2010. Keynote speaker.

Teaching and training:

- Lecture, Valuation of ecosystem services, October 2009, Sustainable Development program, Stockholm University

- Lecture, Valuation and EF, November 2009, Ecosystem management course, SRC.
- Lecture, Planetary boundaries, November 2009, for environmental co-ordinators. Lecture, Ecology and Economic management 2010. January 2010, Global ecosystems out of services – does it matter?

Other:

- Interview for the magazine *Miljöaktuellt*, Sustainability day 2010.
- Interview for the Environmental Protection Agency's magazine.

Therese Lindahl

PhD, researcher

Research focus:

Dr. Lindahl's research focus is broadly on environmental and resource economics, but more specifically on social dynamics in natural resource dilemmas. She is especially interested in improving the understanding of the interplay of knowledge, learning and norms. She also addresses the implications of complex ecosystem dynamics for individual decision-making and for management in natural resource dilemmas.

Publications:

Lindahl, T. & Söderqvist, T, 2010, Who wants to save the Baltic Sea when the success is uncertain? *Regional Environmental Change*, in press.

Lindahl, T. 2010. *Den omvända auktionen som styrmedel för att minska utsläpp från diffusa källor: en experimentell utvärdering*. Naturvårdsverket, rapport, in press.

Seminars and symposium presentations:

- Seminar, Stockholm Resilience Centre, autumn 2009.

Teaching and training:

- Organiser (together with Anne-Sophie Crépin and Ingela Ternström) of the PhD course *The Economics of the Environment*, The Stockholm Doctoral Course Programme in Economics, Econometrics and Finance (SDPE), Stockholm, spring 2010.
- Lecturer on the PhD course *The Economics of the Environment*, The Stockholm Doctoral Course Programme in Economics, Econometrics and Finance (SDPE), Stockholm, spring 2010.
- Lecturer on the PhD course *Ecology and Economic Management*, The Beijer Institute and Gothenburg University, spring 2010.
- Lecturer on the Master's course *Ecological Economics*, Stockholm University, spring 2010.
- Supervision of Master's students, ERG, Stockholm Resilience Centre, Stockholm University.

Commission:

- Member of the Scientific Advisory Council of FORES (Forum for Reforms, Entrepreneurship and Sustainability), Stockholm, Sweden.

Other:

- Organiser (together with Jason Shogren, Carl Folke and Christina Leijonhufvud) of the inaugural BENN (Behavioural Economics and Nature Network) workshop, Beijer Institute, spring 2010.
- Consultant for the Swedish Environmental Protection Agency, October 2009 – January 2010.
- Referee work: *Ambio*, *Ecology and Society*, *Journal of Environmental and Development Economics*, *Expertgruppen för miljöstudier*, *FORES*.

Karl-Göran Mäler

Professor emeritus, former director, researcher

Research focus:

Economics of Ecosystems

Publications during the period:

Mäler, K. G., Aniyar, S. & Jansson, Å. 2010. Accounting for regulating services. In: P. Kumar & M. Wood (eds) *Valuation of Regulating Services of Ecosystems, Methodology and Applications*. Hardback: 978-0-415-56987-3. Routledge

Walker, B.H., S. Barrett, S. Polasky, V. Galaz, C. Folke, G. Engström, F. Ackerman, K. Arrow, S.R. Carpenter, K. Chopra, G.. Daily, P. Ehrlich, T. Hughes, N. Kautsky, S.A. Levin, K.-G. Mäler, J. Shogren, J. Vincent, T. Xepapadeas & A. de Zeeuw. 2009. Looming global-scale failures and missing institutions. *Science* 325: 1345–1346.

Seminars and symposium presentations:

- Lecture: Koli Forum, Finland, October 2009
- Introduction: To lecture with Economics Laureate Elinor Ostrom, Stockholm , December 2009
- Lecture: *Accounting price for resilience in ecosystems,* University of Bologna, January 2010
- Conference: World Wealth, World Bank, Washington DC, February 2010
- Meeting: UK National Ecosystem Assessment, Cambridge, 2010
- Meeting: UK National Ecosystem Assessment, London, 2010
- Meeting: Scientific Advisory group,TEEB, Monaco, May 2010
- Lecture: *Capacity building in poor countries in environmental and resource economics*, Fourth World Congress of Environmental and Resource Economists, Montreal, July, 2010
- Plenary lecture: African Econometric Society, Cairo, July 2010

Teaching and training:

- Asian Institute of Technology, for SANDEE, Bangkok, spring 2010

Commissions:

- Swedish Economic Association
- American Economic Association
- European Economic Association
- European Association of Environmental and Resource Economists
- Member of the Committee on the Prize in Economic Sciences in Memory of Alfred Nobel 1981 –1994
- Elected Fellow of Association and Resource Economics
- Member of the Scientific Council of the Economics of Ecosystems and Biodiversity – TEEB
- Member of the Scientific Advisory group of UK National Ecosystem Assessment
- Member of the Scientific Council of Fores, a green liberal think-tank.
- Member of the Scientific Advisory group for the Swedish EPA research project Plus och Minus

Ingela Ternström

PhD, researcher

Research focus:

Dr. Ternström's research focuses on the way relatively small groups of people manage shared natural resources, especially in response to change and especially regarding the institutional structures that control their behaviour, such as:

- Institutional aspects of common-pool resource management.
- Understanding how informal groups respond to external disturbances, with special focus on the role of leadership in developing and maintaining institutions.
- The effect of HIV/AIDS on local natural resource management.

Publications during the period:

Ternström, I., P. Mukhopadhyay & R. Ghate, 2010. Sustainability, autonomy, and benefits from forest commons. *Proceedings of the National Academy of Science* 107, 14.

Seminars and symposium presentations:

- Understanding local forest use – results from field experiments and cross-country data. Rucha Ghate, Pranab Mukhopadhyay and Ingela Ternström. Presented at the Stockholm Resilience Centre and The Beijer Institute, November 2009.

Commissions:

- External reviewer for the *Journal of Institutional Economics*.
- External reviewer for SANDEE.

Teaching and training:

- Organiser (together with Therese Lindahl and Anne-Sophie Crépin) of the PhD course *The Economics of the Environment*, The Stockholm Doctoral Course Programme in Economics, Econometrics and Finance (SDPE), spring 2010.
- Lecturer on the PhD course *The Economics of the Environment*, The Stockholm Doctoral Course Programme in Economics, Econometrics and Finance (SDPE), spring 2010.

- Lecturer on the PhD course *Ecology and Economic Management 2010*, organised by Max Troell and part of the Sida-financed PhD programme in Environmental Economics at Gothenburg University.

Other:

- Collaboration with, and host for, Rucha Ghate and Pranab Mukhopadyay from SANDEE during their visit to the Beijer Institute as recipients of the Mäler Scholarship.

Max Troell

Associate Professor, researcher

Research focus:

Environmental impacts and sustainability of aquaculture, coastal ecosystems, ecosystem services, ecosystem functions, biodiversity, resilience, integrated aquaculture, mangroves.

Main interests: Investigating sustainability aspects of aquaculture development including; Identifying linkages between capture fisheries and aquaculture; identifying resource dependence and environmental and social externalities; identifying and estimating ecological basis for valuation with special focus on mangrove ecosystems; analysing and developing aquaculture techniques built on ecological engineering; studying biodiversity and resilience in temperate coastal habitats and the generation of ecosystem goods and services.

Publications:

Troell, M., A. Joyce, T. Chopin, A. Neori, A.H. Buschmann & J.G. Fang. 2009. Ecological engineering in aquaculture – potential for integrated multi-trophic aquaculture (IMTA) in marine offshore systems. *Aquaculture* 297: 1–9.

Troell, M. 2009. Integrated marine and brackish water aquaculture in tropical regions; research, implementation and prospects. In D. Soto (ed.). *Integrated mariculture: a global review*. FAO Fisheries and Aquaculture Technical Paper No. 529. Rome. FAO. pp. 47–131.

Ahmed, N. & M. Troell. 2010. Fishing for prawn larvae in Bangladesh– an important coastal livelihood with potential negative environmental impacts. *AMBIO* 39: 20–29.

Ahmed, N., M. Troell, E. H. Allison & J.F. Muir. 2010. Prawn postlarvae fishing in coastal Bangladesh: Challenges for sustainable livelihoods. *Marine Policy* 34: 218–227.

Henriksson, P., N. Pelletier, M. Troell & P. Tyedmers (in press). Life cycle assessment and its application to aquaculture production systems. *Encyclopaedia of Sustainability*.

Nyström, M., Norström, A.V., Bleckner, T., de la Torre Castro, M., Eklöf, J., Folke C., Steneck, R.S., Thyresson, M., Troell, M. & Österblom, H. (in review) Feedback processes in degraded marine ecosystems. (*Ecological Letters*)

Chopin, T., Troell, M., Reid G.K., Knowler, D., Robinson, S.M.C., Neori, A., Buschmann, A. & Pang, S.J. 2010. Integrated Multi-Trophic Aquaculture (IMTA) – a responsible practice providing diversified seafood products while rendering services to the ecosystem. In: Proceedings '*Advancing the Aquaculture Agenda: Policies to Ensure a Sustainable Aquaculture Sector*' with the support of the Government of France. OECD Conference Centre, Paris, 15–16 April 2010.

Kaushik S.J. & Troell M. 2010. Taking the fish-in fish-out ratio a step further. *Aquaculture Europe* 35: 15–17.

Seminars and symposium presentations:

- Member of the Scientific committee, Session chair, The Sixth WIOMSA Scientific Symposium, L'Université de la Réunion in Saint Denis, Réunion Island, 24 – 29 August 2009.
- Organiser IFS/WIOMSA Workshop '*Coastal aquaculture development in East Africa challenges and prospects*' Zanzibar, Tanzania, 30 November–3 December 2009.
- Invited Panel member, *Framtidens Vattenbruk – Samverkan för en hållbar utveckling i Sverige (Sustainable development of Swedish Aquaculture)*, 8–9 October 2009, Lysekil, Sweden
- Session chair, 6th WIOMSA Scientific Symposium, L'Université de la Réunion in Saint Denis, Réunion Island, 24–29 August 2009.

Teaching and Training:

- Teaching and supervising, 10 credit C-level graduate course (Tropical ecology; Management of aquatic resources in the tropics) Department of Systems Ecology, Stockholm University

- Course leader and lecturer, Ecology and Economic management, PhD certificate course. Joint effort with Department of Economics, University of Gothenburg. Responsibility, 2010.
- Lecturer on Systems ecology and natural resource management. Within the program '*Sustainable Development* (HSU)', Stockholm University, 2009.
- Stephan Barthel, 2009. PhD in Natural Resource Management. *Recalling Urban Nature – linking city people to ecosystem services*. (Reserve committee member)
- Elin Enfors, 2009. PhD in Natural Resource Management. *Traps and transformation – Exploring the potential of water system innovations in dryland sub-Saharan Africa*. (Reserve committee member)
- Supervision of PhD students and Master students at Department of Systems Ecology, Stockholm University:
- Lillieskölд-Sjöö, G. *Nutrient related effects on macroalgal properties and the role of macroalgae in coastal nutrient dynamics*. PhD. Stockholm University. Ongoing.
- Jonell, M. *Sustainability indicators and eco-labelling of seafood*. PhD. Stockholm University. Ongoing
- Henrikson, P. *Energy consumption in aquaculture*. Minor Field Study (MFS), Department of System Ecology, Stockholm University. 26 pp.
- Lisslö, K. *Global climate change and aquaculture development*. Department of System Ecology, Stockholm University. Ongoing
- Mozumder, S. *Sustainability tolls in aquaculture*. Department of System Ecology, Stockholm University. Ongoing
- Lundgren, V. *Fishprint – Tracing the True Fish Consumption*. Department of System Ecology, Stockholm University. Ongoing

Commissions:

- Member of the MASMA Programme Committee (Marine Science for Management). Programme within the Western Indian Ocean Marine Science Association (WIOMSA) (Funded by Sida/SAREC) (2007–).
- Member Editorial Board for journal *Reviews in Aquaculture*, Blackwell Publishing. (2007–)
- Scientific advisor for Swedish Board of Fisheries – Short-term contract for involvement in *Mangrove for the Future* (MFF, IUCN initiative financed by Sida and Norad). 1/2–7/3 2009, India.
- Technical advisor, '*Community based crab aquaculture in East Africa*', Marine Science for Management. (2009–2010).
- Reviewing editor, *Journal of Aquaculture Environment Interactions* (AEI) (http://www.int-res.com/journals/aei/). (2009–).
- *Framtidens Vattenbruk – Samverkan för en hållbar utveckling i Sverige (Sustainable development of Swedish Aquaculture)*, 8–9 October 2009, Lysekil, Sweden, Invited Panel member.
- Referee work during the report period: *Journal of Aquaculture, Journal of Applied Phychology, The Western Indian Ocean Journal of Marine Sciences, Journal of Resources, Conservation & Recycling, Journal* of World Aquaculture Society, Journal of Aquaculture Environment Interactions.
- Member of the evaluation committee for grant applications for IFS (International Foundation for Science).
- Theme leader '*Coastal and Marine Governance*', Stockholm Resilience Centre.
- Member of Organising Committee for IFS/Wiomsa collaboration on strengthening research collaboration between Swedish young scientists and East African scientists (2007–2009).
- Referee: *Foresight – Food and Farming Futures Project*: Driver Review: DR – 16 Aquaculture. UK Government. 2010.
- Evaluator of Lecturer position in '*Ecology towards sustainable development*' at Gotland University. 2010.

Publications

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303. *Impacts of Artisanal Fishing on Key Functional Groups and the Potential Vulnerability of Coral Reefs*. Lokrantz, J., M. Nyström, A.V. Norström, C. Folke and J. Cinner. Environmental Conservation

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301. *Middlemen, a Critical Social-Ecological Link in Coastal Communities of Kenya and Zanzibar*. Crona, B., M. Nyström, C. Folke and N. Jiddawi. Marine Policy 34: 761–771 (2010).

300. *Integrating resilience thinking and optimisation for conservation*. Fischer, J., G.D. Peterson, T.A. Gardner, L.J. Gordon, I. Fazey, T. Elmqvist, A. Felton, C. Folke, and S. Dovers. Trends in Ecology and Evolution 24: 549–554

299. *Water-Mediated Ecological Consequences of Intensive Livestock Production*. Deutsch, L., M. Falkenmark, L.J. Gordon, J. Rockström and C. Folke. In: Steinfeld, H., H.A. Mooney, F. Schneider, and L.E. Neville (eds.). Livestock in a Changing Landscape: Drivers, Consequences and Responses., Island Press, D.C. pp. 97–110.

298. *The Ecology and Society network*. Gunderson, L., and C. Folke. Ecology and Society 14(2): 44. (2009)

297. *Ecohydrosolidarity: A New Ethics for Stewardship of Value-Adding Rainfall*. Falkenmark, M. and C. Folke. In: Brown, P.G and J.J. Schmidt (eds.). Water Ethics: Foundational Readings for Students and Professionals. Island Press, Washington D.C. pp 247–264.

296. *Ecosystem Stewardship: Sustainability Strategies for a Rapidly Changing Planet*. Chapin, III, F.S., S.R. Carpenter, G. P. Kofinas, C. Folke, N. Abel, W.C. Clark, P. Olsson, D.M. Stafford Smith, B.H. Walker, O.R. Young, F. Berkes, R. Biggs, J.M. Grove, R.L. Naylor, E. Pinkerton, W. Steffen, F.J. Swanson. 2010. Trends in Ecology and Evolution 25: 241–249

295. *Sustainability, autonomy, and benefits from forest commons*. Ingela Ternström, Pranab Mukhopadhyay and Rucha Ghate Proceedings of the National Academy of Science, vol. 107 no. 14

294. *Social – ecological memory in urban gardens – Retaining the capacity for management of ecosystem services*. Barthel Stephan, Folke Carl, Colding Johan Global Environmental Change 20 (2010) 255–265

293. *Incorporating Resilience in the Assessment of Inclusive Wealth: An Example from South East Australia*. Brian Walker, Leonie Pearson, Michael Harris, Karl-Göran Maler, Chuan-Zhong Li, Reinette Biggs and Tim Baynes. Environ Resource Econ (2010) 45:183–202

2009

292. *Integrated marine and brackishwater aquaculture in tropical regions: research, implementation and prospects*. Max Troell. In D. Soto (ed.). Integrated mariculture: a global review. FAO Fisheries and Aquaculture Technical Paper. No. 529. Rome, FAO. pp. 47–131.

291. *Pattern formation, spatial externalities and regulation in coupled economic – ecological systems*. William Brock and Anastasios Xepapadeas. Journal of Environmental Economics and Management.

290. *Prawn postlarvae fishing in coastal Bangladesh: Challenges for sustainable livelihoods*. Nesar Ahmeda, Max Troell, Edward H. Allison, James F. Muir Marine Policy 34 (2010) 218–227

289. *Looming global-scale failures and missing institutions*. Brian Walker, Scott Barrett, Stephen Polasky, Victor Galaz, Carl Folke, Gustav Engström, Frank Ackerman, Ken Arrow, Stephen Carpenter, Kanchan Chopra, Gretchen Daily, Paul Ehrlich, Terry Hughes, Nils Kautsky, Simon Levin, Karl-Göran Mäler, Jason Shogren, Jeff Vincent, Tasos Xepapadeas, Aart de Zeeuw Science, vol 325: 1345–1346 (2009)

288. *Planetary Boundaries: Exploring the safe operating space for humanity*. Johan Rockström, Will Steffen, Kevin Noone, Åsa Persson, F. Stuart Chapin III, Eric F. Lambin, Timothy M. Lenton, Marten Scheffer, Carl Folke, Hans Joachim Schellnhuber, Björn Nykvist, Cynthia A. de Wit, Terry Hughes, Sander van der Leeuw, Henning Rodhe, Sverker Sörlin, Peter K.Snyder, Robert Costanza, Uno Svedin, Malin Falkenmark, Louise Karlberg, Robert W. Corell, Victoria J. Fabry, James Hansen, Brian Walker, Diana Liverman, Katherine Richardson, Paul Crutzen, Jonathan A. Foley Ecology and Society (2009)

287. *A safe operating space for humanity*. Johan Rockström, Will Steffen, Kevin Noone, Åsa Persson, F. Stuart Chapin, Eric F. Lambin, Timothy M. Lenton, Marten Scheffer, Carl Folke, Hans Joachim Schellnhuber, Björn Nykvist, Cynthia A. de Wit, Terry Hughes, Sander van der Leeuw, Henning Rodhe, Sverker Sörlin, Peter K.Snyder, Robert Costanza, Uno Svedin, Malin Falkenmark, Louise Karlberg, Robert W. Corell, Victoria J. Fabry, James Hansen, Brian Walker, Diana Liverman, Katherine Richardson, Paul Crutzen, Jonathan A. Foley Nature, Vol 461: 472–475 (2009)

286. *Golf courses and wetland fauna*. Johan Colding, Jakob Lundberg, Stefan Lundberg and Erik Andersson. Ecological Applications, 19(6):1481–1491 (2009)

285. *Model Uncertainty, Ambiguity and the Precautionary Principle: Implications for Biodiversity Management*. Giannis Vardas and Anastasios Xepapadeas. Environ Resource Econ, published online 13 August 2009.

284. *Managing the Biosphere*. Stephen R. Carpenter. pp. 679–682 in Levin, S.A., S.R. Carpenter, C.J. Godfray, A.P. Kinzig, M. Loreau, J.P. Losos, B. Walker and D.S. Wilcove (eds.). Princeton Guide to Ecology. Princeton University Press, Princeton, N.J.

283. *Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment*. Stephen R. Carpenter, Harold A. Mooney, John Agard, Doris Capistrano, Ruth S. DeFries, Sandra Díaz, Thomas Dietz, Anantha K. Duraiappah, Alfred Oteng-Yeboah, Henrique Miguel Pereira, Charles Perrings,Walter V. Reid, Jose´ Sarukhan, Robert J. Scholes, and Anne Whyte. Proceedings of the National Academy of Sciences 106: 1305–1312 (2009)

282. *Resilience: Accounting for the Noncomputable*. Stephen R. Carpenter, Carl Folke, Marten Scheffer and Frances Westley. Ecology and Society 14 (1): 13 (2009)

281. *Turning back from the brink: Detecting an impending regime shift in time to avert it*. Reinette Biggs, Stephen R. Carpenter, and William A. Brock. Proceedings of the National Academy of Sciences 106(3): 826–831 (2009)

280. *Spurious Certainty: How Ignoring Measurement Error and Environmental Heterogeneity May Contribute to Environmental Controversies*. Reinette Biggs, Stephen R. Carpenter, and William A. Brock. BioScience 59: 65–76 (2009)

279. *Adaptive Capacity and Traps*. Stephen R. Carpenter and William A. Brock. Ecology and Society 13(2): 40 (2008)

278. *A General Framework for Analyzing Sustainability of Social-Ecological Systems*. Elinor Ostrom. Science 325: 419–422 (2009)

Discussion Papers

221. *Robust Control and Hot Spots in Dynamic Spatially Interconnected Systems*. William Brock and Anastasios Xepapadeas

220. *Optimal Management with Potential Regime Shifts*. Stephen Polasky, Aart de Zeeuw, Florian Wagener

219. *Assessing Sustainable Development in a DICE World*. Gustav Engström. 2009.

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