

Stockholm Resilience Centre

Annual report 2019



Stockholm Resilience Centre
Sustainability Science for Biosphere Stewardship



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Stockholm Resilience Centre Annual Report 2019

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

Chair's preface

Exciting, inspiring and rewarding – those words nicely capture my first year as chair of the board of the Stockholm Resilience Centre (SRC)

WITH THE FIRST 12 YEARS of funding and development coming to an end in 2018, it has been a privilege to follow what can only be described as a smooth and impressive transition into a new and exciting phase of the centre. Amid several uncertainties, the new leadership has navigated the centre into a new dynamic space applying a true resilience spirit. With Line Gordon as director we have become an impressive team; brave and professional, complementing each other in a way that benefits the centre as a whole.

The new organisation also includes a new “semi-internal” board consisting of centre staff and representatives from Stockholm University and the Royal Swedish Academy of Sciences. An International Scientific Advisory Council was established in 2019, made up of leading researchers in sustainability. This council complements our International Advisory Board on policy and business, which remains strong and engaged. There are good relations and support from Stockholm University’s leadership and the collaborations with the Beijer Institute as well as the Global Economic Dynamics and the Biosphere Programme of the Royal Swedish Academy of Sciences continue to flourish. What has been remarkable during 2019 is to witness the internal mobilisation and the collective spirit of “one for all, all for one”. That everybody is pulling in the same direction makes the centre unique. It has been instrumental for our complex yet successful transition in both leadership and funding. For instance, the grants and funding received during 2019 were a record high. This is particularly impressive considering that our core Mistra funding ended in 2018. What is striking is the explosion of new scientific insights coupled with a continuous increase in the number of articles, many of them appearing in top journals. The professionalism that characterises our transdisciplinary experiments, collaborations, training programmes and outreach work remains inspiring!

As the founder and scientific director of the SRC, it is deeply rewarding to experience all of this and to have the privilege to be part of a research centre with such an imprint and reputation internationally. The legacy of Buzz Holling, the

father of resilience thinking, who passed away in 2019, has not only been carefully cultivated but amplified into new strands of research and applications that influence and inspire people worldwide.

*Professor Carl Folke
chair of the board and science director
of the Stockholm Resilience Centre*



Carl Folke
Chair of the board

Our funders

The support from our funders is a determining factor for our success. In addition to our support from Stockholm University we would like to express our gratitude to the following funders:



The Swedish Research Council for Environment,
Agricultural Sciences and Spatial Planning



*Marianne and Marcus
Wallenberg Foundation*



In addition to Futura Foundation, Natural Environment Research Council, Ellen MacArthur Foundation/H&M, Johansson Family Foundation, Zennström Philantropies, Arctic Research Foundation and others.

Directors' view

Our work rests on a strong scientific foundation working to understand the complex dynamics of people and planet in the Anthropocene

THE COLLECTIVELY clear synthesis from the scientific community about the state of our planet continued throughout 2019, with IPCC's two reports on *Climate Change and Land*, and the *Ocean and Cryosphere*, and the *United in Science* report from the World Meteorological Organization among the many outputs sharing an image of a planet in a dire state. The global synthesis work by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), which several SRC researchers are engaged in, warned – among other things – that 12% of all known species are at risk of extinction. Combined, all these reports illustrate the interconnectedness of human societies with the biosphere and the climate system. They also demonstrate the growing gap between climate targets or Sustainable Development Goals, and the actual reality of emissions and impact on the biosphere.

But amid the gloom, the reports also highlight hope and opportunity: it is still possible, at least biophysically, for the global population to live good lives on our planet, provided large changes in our societies take place. As an example, the EAT-Lancet Commission, with its secretariat based at the SRC, shows how it is possible to produce healthy food for 10 billion people within the planetary boundaries by 2050. To do so would require cutting global food loss and waste by 50%, large changes to people's diets and substantial improvements in agriculture to produce more food with less impact.

The SRC rests on a strong scientific foundation working to understand the complex dynamics of people and planet in the Anthropocene. The centre strives to identify potential leverage points towards sustainable futures, and to engage in a variety of collaborations across sectors and disciplines. Our researchers have never before produced so many peer-reviewed papers – and in high-impact journals – as in 2019. A global sustainability transition has to be built on evidence-based and evidence-informed understanding. But the need for science-based change also comes at a time when we see increasing mistrust in science and misrepresentation of facts in public discussions. Information is not enough for change, and as this annual report shows, we have intensified our work in the knowledge-action interface. This way we increase the likelihood of our science and knowledge being available to support the transition to more just and sustainable societies. Examples of this work include our Sida-funded programmes SwedBio, Global Resilience Partnership and GRAID, and our various training programmes that engage different stakeholders like top executives in Sweden-based companies and entrepreneurs and innovators across the Baltic countries and in Africa. If there is one take-away from these programmes, it is that biosphere stewardship is emerging as new constellations of actors come together, all stepping up to tackle the planetary emergency.



Line Gordon
Director



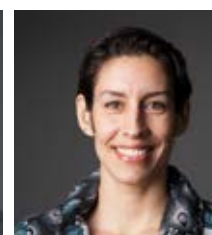
Victor Galaz
Deputy director



Carl Folke
Science director



Henrik Österblom
Science director



Beatrice Crona
Deputy science
director



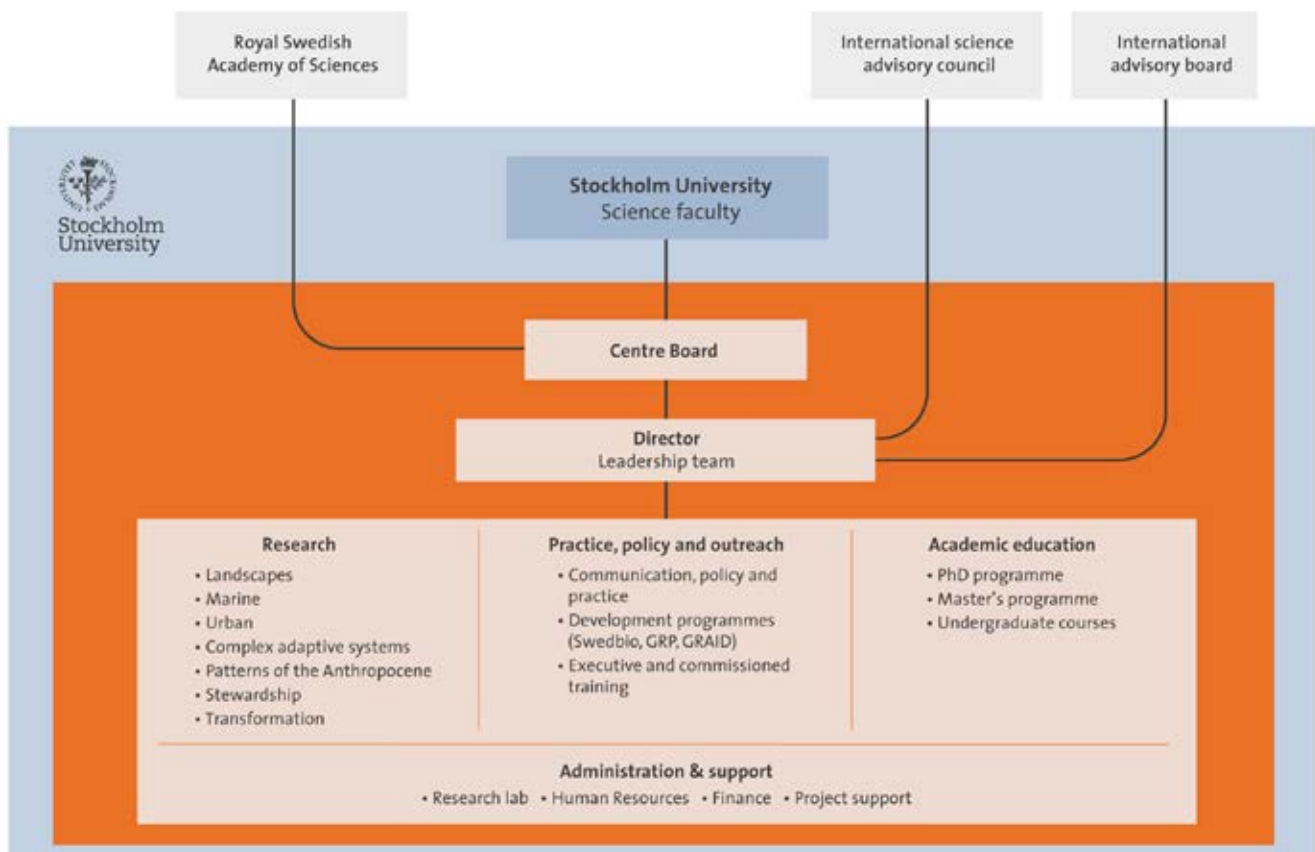
Lisen Schultz
Deputy director of
transdisciplinarity

To deliver on both high-quality science and knowledge-action interfaces, the SRC has built a complex and dynamic organisation. To make it work and ensure creativity, quality and collective action, we invest heavily in our work culture. In 2019, we adopted a set of work-culture aspirations. They focus on how we relate to each other and operate to stimulate a healthy and sound work environment, while supporting the development of internationally leading science, education and knowledge-action interfaces for sustainability. They include aspirations such as ensuring integrity, promoting learning and experimentation, and fostering diversity and care.

As a society, we might remember 2019 as the year when schoolchildren all over the world urged world leaders to

listen to science and act accordingly. As we enter 2020, the “super year” for the planet, we do so with the commitment to make our work help improve the future for our children. Combined with science, our work-culture aspirations can also be a trigger for important discussions about empathy and care beyond our own organisation, and involving many of the actors with whom we engage. Let 2020 be a year where such empathy becomes visible in action, based on science that provides a deep understanding of how humans, the biosphere and the climate system interact.

Line Gordon,
director



Introducing the International Science Advisory Council

The new council consists of internationally leading researchers providing strategic advice and guidance on the scientific development and direction of the centre



The composition and membership of the council is formally decided by the SRC board. Members of the new council met for the first time, 15 September in Stockholm. From top left: Stephen Carpenter, University of Wisconsin-Madison; Frances Westley, University of Waterloo; Jonas Ebbesson, Stockholm University; Stephen Polasky, University of Minnesota; Simon Levin, Princeton University; Marten Scheffer, Wageningen University. Bottom left: Deliang Chen, University of Gothenburg; Elena Bennett, McGill University; Elizabeth Selig, Stanford University; Rashid Sumaila, University of British Columbia; Eric Lambin, Université Catholique de Louvain, Stanford University; Elke Weber, Princeton University. Not present: Frank Geels, University of Manchester; Danica Kragic, Royal Institute of Technology, Sweden; Karen Seto, Yale University; Jane Lubchenco, Oregon University; Pavan Sukhdev, WWF International; Jessica Fanzo, Johns Hopkins University.

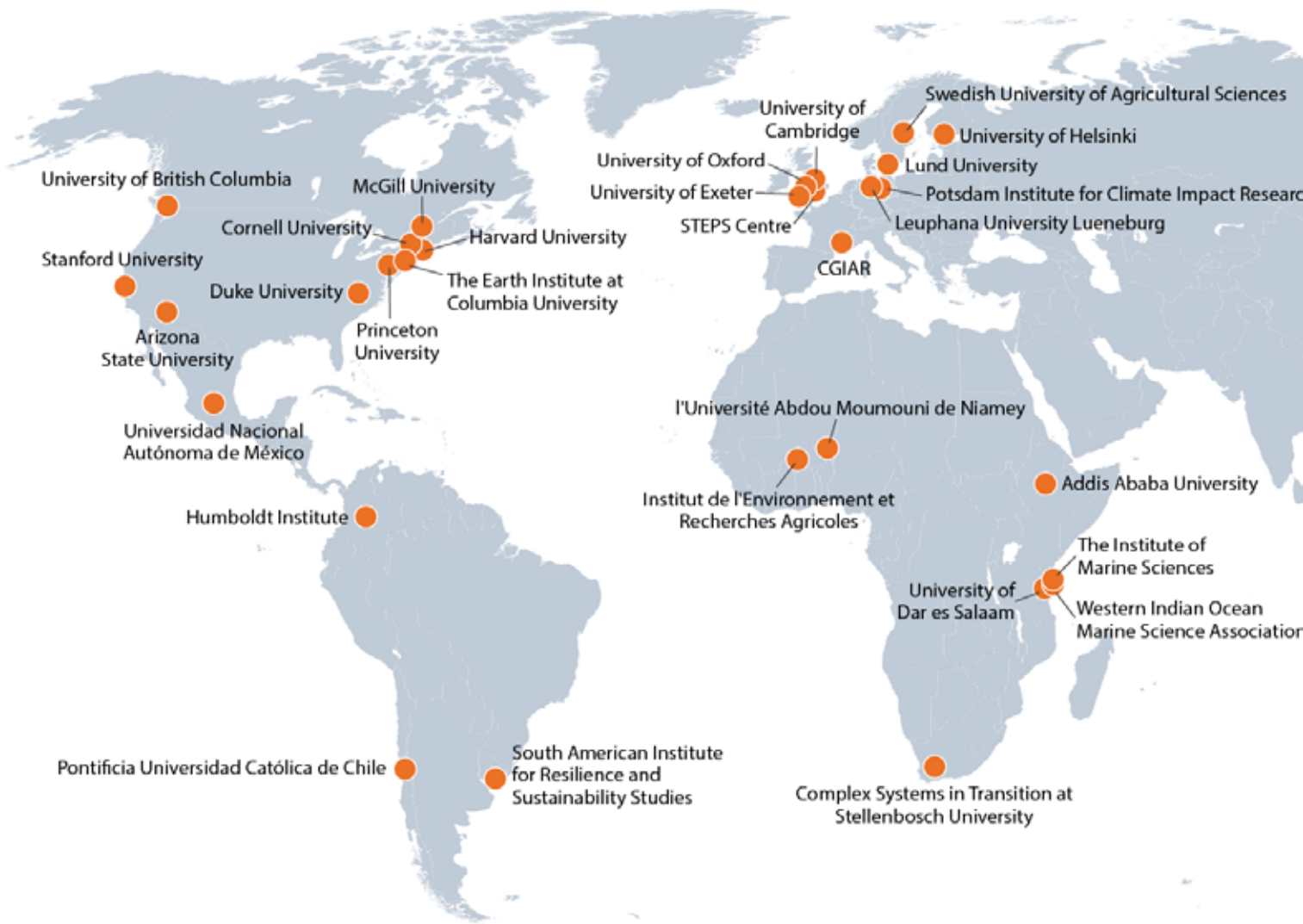
International Advisory Board



Originally established in 2013, the International Advisory Board (IAB) provides strategic advice to the centre in its efforts to have global impact within science, business, policy and practice. Between 26–27 August the board met again, at Rosenön outside Stockholm, courtesy of member Niklas Zennström. Present at the 2019 IAB meeting (from top left): Henrik Pompeius (senior advisor, Stockholm University), Jan Eliasson (former deputy secretary-general, UN), Niklas Zennström (chair, Atómico & Zennström Philanthropies), Alexander af Jochnick (chair, Oriflame), Sara Öhrvall (chief digital, customer experience and communications officer, SEB), Carl Folke (chair, Stockholm Resilience Centre board), Hans Enocson (former CEO, GE Nordic), Astrid Auraldsson Sjögren (coordinator to the director, Stockholm Resilience Centre), Lisén Schultz (deputy director of transdisciplinarity, Stockholm Resilience Centre), Gunhild Stordalen (chair, Stordalen Foundation), Johan Rockström (director, Potsdam Institute for Climate Impact Research), Beatrice Crona (deputy science director, Stockholm Resilience Centre), Jerker Johansson (Johansson Family foundation), Henrik Österblom (science director, Stockholm Resilience Centre), Line Gordon (director, Stockholm Resilience Centre), Victor Galaz (deputy director, Stockholm Resilience Centre). Not present: Jim Balsillie (co-founder, BlackBerry), Carl Bildt (former prime minister and foreign minister of Sweden), Johan Eliasch (chair and CEO, HEAD), Ólafur Ragnar Grímsson (former president of Iceland), Kevin Rudd (former prime minister and foreign minister of Australia), Jacob Wallenberg (chair, Investor AB).

Some of our partners worldwide

Selected scientific partners





Selected Global networks and organisations

- Earth System Governance Project
- EAT Initiative
- Future Earth
- Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)
- Lancet commission on health and climate change
- Local Governments for Sustainability, ICLEI
- Resilience Alliance
- Stockholm International Water Institute (SIWI), Sweden
- The World in 2050: Pathways towards a sustainable future
- UN and UN Agencies in relation to the 2030 Agenda
- UN Sustainable Development Solutions Network (SDSN)
- World Business Council for Sustainable Development, WBCSD
- World Economic Forum

Behind every great leader, there is an Astrid

Meet the superwoman who keeps crazy ideas in check and management on top of things

ASK ASTRID AURALDSSON SJÖGREEN what it takes to do her job, and she says the Swedish pop song “It takes a fool to remain sane” comes to mind. She may be onto something. Astrid is the coordinator to the centre director and, according to Johan Rockström, the centre’s former director, she is “SRC’s superwoman”. This is because she keeps all crazy ideas, challenging relations, funding networks, high-level interactions and daily practicalities under control. “Astrid has this extraordinary ability of being socially super-capable and being super-executive at the same time,” Rockström says. Consider this example: in 2015 Rockström was awarded the International Cosmos Prize in Japan and the Deutsche Umweltpreis in Germany. The award ceremonies took place one day after another, 10,000 km apart and in different time zones. So quite the logistical challenge. As if that was not enough, a serious bike accident forced Rockström into hospital a week before leaving for Japan. It did not look good in terms of time and he himself certainly did not look good (his jaw was badly hit and it

was difficult understanding him when he talked). In the end, bruises and injuries were sufficiently healed for him to go and accept the awards. “It all went well but we had hardly finished the dessert in Japan before having to catch the flight for Germany in time for the next award ceremony,” Astrid explains.

She started her role as coordinator to the director in 2012, but things could have turned out differently. If it wasn't for Teresa Ogenstad, Johan’s former secretary, she would not have the job in the first place. Her application for the job was originally turned down but Ogenstad recognised her name among the applicants and made sure she was called in for an interview. Astrid is not one for changing workplaces too often, either. If things work out, she stays. “It’s a privilege to work in an academic institution like the SRC,” she says. “I see my daily work as a tiny contribution to a more sustainable planet.”

Before coming to the SRC she worked for several years at the Royal Swedish Academy of Sciences in various capacities. She travelled to places like Tanzania, Borneo, India, Chile and Nepal, organising workshops sponsored by the MacArthur Foundation and later Sida. Wherever she went Astrid would charm everyone and get the work done fast. She is, in the words of a former colleague, a “no-nonsense, straightforward but very considerate person”. That description works perfectly to this day. Current colleagues characterise her as a good listener who is able to put herself in other people’s shoes, offering both empathetic and sound support. New centre director Line Gordon confirms this, “Astrid is a warm, wise and considerate person who with a firm hand helps me prioritise among the many requests we get from various places”.

Johan Rockström sums up, “Consistent feedback from board members, distinguished Nobel Laureates, business leaders and politicians all over the world, was their admiration for Astrid. ‘How can you have such a fantastic coordinator? Astrid is phenomenal!’ they said. This always made me very proud, a feeling I was privileged to experience many times”. That kind of a reference, a fool would never get.



Astrid with C. S. “Buzz” Holling, the founding father of social-ecological resilience, from 1994.





Our research framework

Our curiosity-founded research is driven by an interest in identifying challenges as well as opportunities for change

HUMAN SOCIETIES are reliant on a healthy and resilient biosphere providing suitable living conditions. At the same time, human actions are a major force in shaping the dynamics of the biosphere and the broader earth system. Social conditions, health, culture, democracy, power, justice, equality, matters of security and ultimately survival are interwoven with the earth system and its thin biosphere in a complex interplay of local, regional and worldwide dependencies. It is an intertwined system of people and planet.

Our core focus is to advance research in the frontier of biosphere-based sustainability science, applying a social-ecological approach and resilience thinking. The approach that the SRC takes – that humans are part of the biosphere – informs and guides our research, enabling cohesion, unity of purpose and the distillation and synthesis of diverse theories, methods and data. Inductive and deductive work, practice and theory continuously interact.

SRC's organisational design is to frame creativity through the biosphere-based approach, guiding and defining a problem space in which creativity and innovation are encouraged to flourish. It involves developing and implementing research strategies, organisational structures and team-building processes that enable, support and stimulate creativity and cutting-edge research, ranging from disciplinary to interdisciplinary to transdisciplinary. Significant time is devoted to encouraging interaction and to stimulating sharing of ideas at the frontier of sustainability science and resilience thinking.

Our research aims at capturing significant patterns and processes of the Anthropocene, using complex adaptive systems and resilience thinking as core perspectives, developing theory and methods, and experimenting and exploring transdisciplinarity for biosphere stewardship and transformations towards sustainability. The research topics



PHOTO: C. HELANDER/AZOTE

are diverse but tend to be anchored in systems approaches and around food systems, the ocean, urbanisation and development challenges.

Research for change

Our curiosity-founded research is driven by an interest to identify challenges as well as opportunities for change. This is at the heart of the planetary boundaries framework, which in 2019 celebrated its 10th anniversary. With over 3,600 citations to date, the original *Nature* article has sparked excitement across science, policy and business. Downscaling or translating the boundaries has been undertaken by several countries and regions – including the EU, China and Germany – while several companies are looking at ways to adapt the framework to their businesses.

Research by the SRC was essential in another more recent international effort: the EAT-Lancet Commission on Food, Planet and Health. It demonstrates how diet and food production can radically change to improve health and avoid damage to the planet. Inevitably, the report generated both excitement and controversy (particularly for its call to drastically reduce meat consumption) and became one of the most discussed science articles of the year, according to Altmetric, a data science company.

The UN Sustainable Development Goals, agreed by world leaders in 2015, are increasingly influencing policies and

corporate strategies. In the midst of calls to listen to science, our research is asked for. When *Nature*, one of the world's most important scientific journals, celebrated its 150th anniversary, it invited centre researchers to contribute with their perspectives on how humans – through farming, forestry and fisheries – are changing the anatomy of our biosphere.

Our findings on resilience during the last decade illustrate how crises lead to new opportunities, the mobilisation of diverse actors and stimulate bold vision. 2019 may enter history as the year when environmental crises became a mainstream topic. Reports by the Intergovernmental Panel on Climate Change (IPCC) and Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) on the dire state of our planet spurred growing calls for political and corporate leaders to listen to science. Our executive education on resilience thinking and multiple collaborative dialogues at different scales continue to connect CEOs and board members of large companies, as well as innovative entrepreneurs from small and medium business enterprises, with sustainability scientists and experts.

The centre is thriving under its new leadership and is staying busy with its multiple forms of collaborative engagements. We are particularly excited about our new international scientific advisory council, established to provide advice on our scientific direction of the coming decade. There is much more work to do.

Pioneering the science of surprise

Crawford Stanley “Buzz” Holling, the father of resilience research, passed away on 16 August 2019, aged 88



PIONEERS BREAK NEW GROUND and leave an empty space when they move on. Crawford Stanley Holling is considered the father of resilience research and a pivotal figure in the development of the Beijer Institute, the Resilience Alliance and the Stockholm Resilience Centre. Crawford, or “Buzz” – a nickname given to him by his sister because she believed it suited his character better (he agreed) – called his resilience work the “science of surprise”. He highlighted the importance of considering surprise, system reorganisation and learning when trying to understand social-ecological dynamics. He also emphasised that understanding – not knowledge in a narrow sense – is navigating the dynamic, connected and evolving challenges of our rich and beautiful but unequal world.

Buzz Holling was born in 1930 and grew up in the forests of Northern Ontario where he developed a deep interest in the living world. An early interest in forest insects led him

to study them, first at the University of Toronto and then the University of British Columbia. During his PhD (1957) he developed the first mathematical theory of predation. These concepts are now widely used to analyse predator-prey interactions. In the 1960s and 1970s, Holling extended his work using systems to understand diverse types of interactions among people and nature. He began to collaborate with experts outside of universities and research labs to understand land development, forest management and pest management. It was from these experiences that Holling first began to formulate his ideas about resilience. This work continued in Vienna where Holling first visited and later became director of the International Institute of Applied Systems Analysis (IIASA).

In the 1990s, Holling moved from the University of British Columbia to the University of Florida in the United States. This marked the beginning of a long-term



collaboration with Stockholm-based researchers, initially through the Beijer Institute of Ecological Economics at the Royal Swedish Academy of Sciences, and then with researchers at Stockholm University. These collaborations led Holling to initiate the Resilience Alliance in 1999. It was established as an international partnership of interdisciplinary researchers focused on understanding transformations in human and natural systems. The researchers published a number of influential papers and books in the 2000s, which helped resilience and social-ecological systems move from being relatively unknown ideas to central concepts in sustainability science. Holling trained many scientists who went on to make major impacts in behavioural ecology, forest management, fisheries, ecology and sustainability science. He was passionate about developing cross-disciplinary, international networks among younger scientists. He encouraged young scientists to explore

bold ideas that connected different bodies of knowledge both within and outside of the academy, and he enthusiastically connected them to people and resources that enabled these explorations. Buzz Holling received many honours for his contributions to science and society. He received the Mercer Award and the Eminent Ecologist Award from the Ecological Society of America. He was a fellow of the Royal Society of Canada, as well as a foreign fellow of the Royal Swedish Academy of Sciences. He received the Austrian Cross of Honour for Science and Art, and he became an Officer of the Order of Canada “for his pioneering contributions to the field of ecology, notably for his work on ecosystem dynamics, resilience theory and ecological economics”. He will be greatly missed.

Publications and special issues

In 2019, we produced more than 190 scientific articles published in over 100 different scientific journals. Citations of our publications also continue to increase

CARRYING OUT high-quality research is the foundation of the SRC, reflected in the ability to publish in leading and high-impact factor journals. In 2019, we had around 20 articles published in *The Lancet*, *Nature* and Nature-related journals, *Proceedings of the National Academy of Sciences, USA (PNAS)*, *Science*, and *Science Advances*.

All in all, more than 190 scientific articles were published in 2019. The articles were published in over 100 different scientific journals. More than 50% of the articles appeared in journals with an impact factor of four or higher. A large part were published in journals with a strong interdisciplinary focus and SRC researchers published five or more articles in each of *Ecology and Society*, *Environmental Research Letters*, *Global Sustainability*, *Nature Sustainability*, *Current Opinion in Environmental Sustainability*, *Marine Policy*, *Ecological Economics* and *Sustainability Science*.

SRC articles of 2019 appeared in more than 30 journals that were new to the SRC publication list, namely: *Accounting, Auditing & Accountability Journal*; *Agrekon*; *Annual Review of Ecology, Evolution and Systematics*; *Australian Geographer*; *Bird Study*; *Cell*; *Climate Policy*; *Collective Dynamics*; *Earth System Governance*; *Ecosystems*

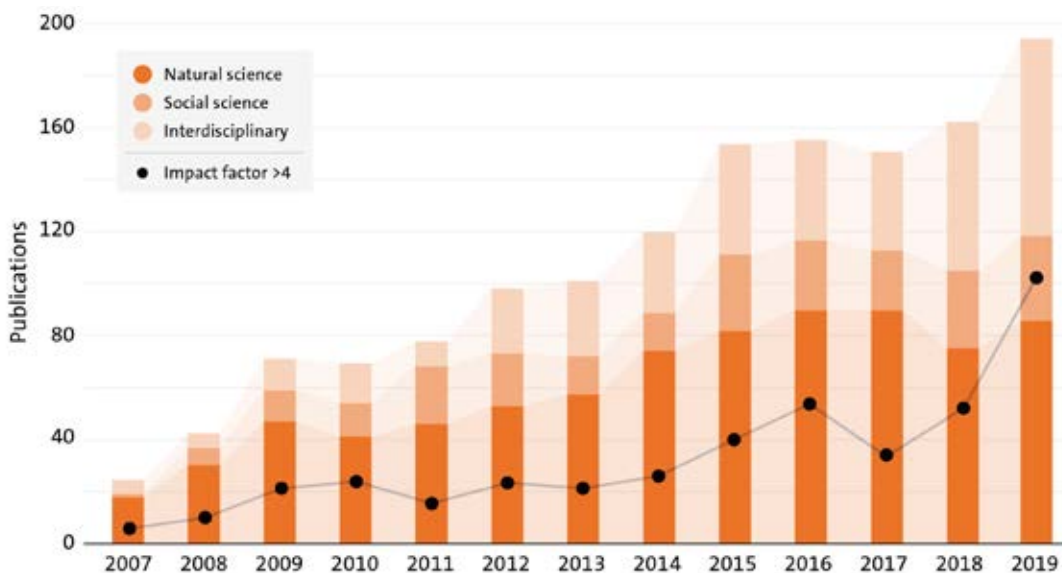
and *People*; *Environmental Toxicology and Chemistry*; *Fisheries Research*; *Forest Policy and Economics*; *Fteval Journal for Research and Technology Policy Evaluation*; *Geoinformatica*; *Global Health Action*; *Interest Groups & Advocacy*; *International Journal of Agricultural Sustainability*; *Journal of Environmental Studies and Sciences*; *Journal of Mathematical Sciences*; *Light: Science & Applications*; *MethodsX*; *Nature Biotechnology*; *One Earth*; *People and Nature*; *Philosophy Kitchen*; *Progress in Planning*; *Science Bulletin*; *Smart Cities*; *Southeast Asian Studies*; *Systems*; *Transboundary and Emerging Diseases*; *Urban Morphology*; *Water Security*; *Water Birds*.

Centre researchers have also been engaged with editing special issues of journals:

Mancilla García, M., J. Hileman, and Ö. Bodin (eds.). 2019. Collaboration and conflicts in complex water governance systems across a development gradient. *Ecology and Society* 24(3), 8 articles.

Masterson, V.A., J.P. Enqvist, R.C. Stedman, and M. Tengö (eds.). 2019. Sense of Place in Social–Ecological Systems: From Theory to Empirical Exploration. *Sustainability Science* 14(3), 9 articles.

Centre publications by discipline & impact factor



Pauleit, S., E. Andersson, B. Anton, A. Buijs, D. Haase, R. Hansen, I. Kowarik, J. Niemelä, A. Stahl Olafsson, and S. Van der Jagt (eds.). 2019. Urban green infrastructure – connecting people and nature for sustainable cities. *Urban Forestry and Urban Greening* 40, 34 articles.

Shackleton, S., P. Hebinck, C.I. Speranza, V. Masterson, D. Spear, and T. Tengö (eds.). 2019. Livelihood and Landscape Change in Africa: Future Trajectories for Improved Well-Being under a Changing Climate, *Land* 8(8), 12 articles. Wabnitz, C.C.C., and R. Blasiak (eds.). 2019. Funding for ocean conservation and sustainable fisheries. *Marine Policy* 107, 11 articles.

One book has been published:

Galaz, V. (ed.) 2019. *Global Challenges, Governance, and Complexity: Applications and Frontiers*. Edward Elgar, Cheltenham, UK.

Centre researchers Carl Folke, Victor Galaz, Beatrice Crona, Line Gordon, Lisen Schultz and Henrik Österblom contributed to the book *Green Growth That Works: Natural Capital Policy and Finance Mechanisms From Around the World*. It is the first practical guide to offer proven techniques for planning and achieving nature-based solutions and is edited by leading experts from the Natural Capital Project, where the SRC is a partner.

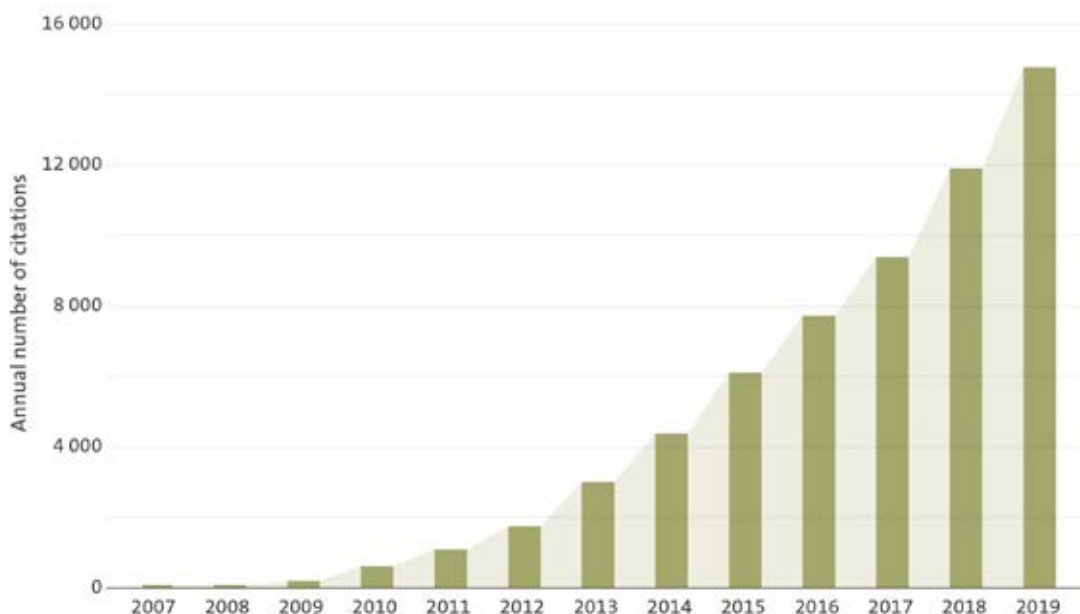
In addition, at least 25 journal articles with official publication dates in 2020 appeared online in 2019. There were also several book chapters as well as science, policy, practice, communication and outreach publications and reports published during 2019. This includes the EAT-Lancet report launched in January. “The World in 2050” report was launched in July and the Global Resilience Partnership report

in September. There have also been reports produced for the UN Global Compact Ocean Action Platform in addition to governmental agencies in Sweden and Europe. Centre researchers contributed to the Global Assessment of IPBES and two reports from IPBES’s ongoing task force on models and scenarios. A set of background briefs were also developed for the Keystone Dialogue and SeaBOS meeting in Thailand, September 2019.

Citations of SRC publications continued to increase, exceeding 14,000 in 2019 alone and beyond 60,000 in total in the Web of Science. Four of the 2019 articles were acknowledged as “highly cited papers” by Essential Science Indicators. Highly cited papers are those that received enough citations to place them in the top 1% of their academic field. One paper, in *The Lancet*, was recognised as a “hot paper”. Hot papers are those that received enough citations in the last two years to place them in the top 0.1% of papers in their academic field.

Centre researchers contributed to Nature’s exclusive 150th anniversary collection with a paper on how farming, forestry and fisheries are changing the anatomy of the biosphere. The paper, entitled *Anatomy and resilience of the global production ecosystem* was part of Nature’s selection of articles that “reflect the past, present and future of Nature”.

Annual number of citations



Selected scientific publications



PHOTO: N. RYRHOLM/AZOTE

An altered planetary anatomy

Humans have transformed much of the planet to produce more and more food, fibre and fuel. Now we need to radically transform this global production ecosystem. Centre researchers offer perspectives in Nature's exclusive 150th-anniversary collection
Nyström, M., J-B. Jouffray, A. V. Norström, B. Crona, P. S. Jørgensen, S. R. Carpenter, Ö. Bodin, V. Galaz, C. Folke. 2019. Anatomy and resilience of the global production ecosystem. Nature 575(7781): 98–108.



PHOTO: N. RYRHOLM/AZOTE

Not so smart after all...?

A popular concept for building sustainable cities stands on fragile scientific grounds
Gren, A., J. Colding, M. Berghauer-Pont, L. Marcus. 2019. How smart is smart growth? Examining the environmental validation behind city compaction. Ambio 48(6): 580–589.

PHOTO: GEORGIAN BAY BIOSPHERE RESERVE/FACBOOK



From conflicts to solutions

Conflict in environmental governance is common, what mechanisms exist to get people to collaborate?
Baird, J., L. Schultz, R. Plummer, D. Armitage, Ö. Bodin.

2019. *Emergence of collaborative environmental governance: what are the causal mechanisms?* *Environmental Management* 63(1): 16–31.

PHOTO: O. HENRIKSSON/AZOTE



Ecosystem services for men, ecosystem services for women

There can be stark differences in how men and women use and experience ecosystem services. This has significant impact on their well-being
Fortnam, M., K. Brown, T. Chaigneau, B. Crona, T.M. Daw, D. Goncalves, C. Hicks, M. Revmatas, C. Sandbrook, B. Schulte-Herbruggen. 2019. *The Gendered Nature of Ecosystem Services.* *Ecological Economics* 159: 312–325.

PHOTO: K. HELMIG/AZOTE



More complex than the sum of its parts

New framework for analysing emergent properties and dynamics in social-ecological systems tested on seven case studies
Schlüter, M., L. J. Haider, S. J. Lade, E. Lindkvist, R. Martin, K. Orach, N. Wijermans, C. Folke. 2019. *Capturing emergent phenomena in social-ecological systems: an analytical framework.* *Ecology and Society* 24(3): 11.



PHOTO: B. CHRISTENSEN/AZOTE

Revisiting coral reef ecology

Coral reefs face a new reality dominated by human impact and it is time for traditional coral reef ecological paradigms to follow suit
 Williams, G. J., N. A. J. Graham, J-B. Jouffray, A. V. Norström,

M. Nyström, J. M. Gove, A. Heenan, L. M. Wedding. 2019. *Coral reef ecology in the Anthropocene. Functional Ecology* 33(6): 1014–1022. *Management* 63(1): 16–31.



PHOTO: PEXELS

Money for farming or forests?

Money sent home by migrants can prevent undesired farmland abandonment, as well as the promise of extensive forest regrowth
 Ospina, D., G. D. Peterson, A-S. Crépin. 2019. *Migrant remittances can reduce the potential of local forest transitions: a social-ecological regime shift analysis. Environmental Research Letters* 14(2): 24017.



ILLUSTRATION: J. LOKRANTZ/AZOTE BASED ON STEFFEN ET AL. 2015

It's all about the safe operating space

Ten years after the original publication of the planetary boundaries concept, researchers make an in-depth analysis of academic research and discussion generated by the concept
 Downing, A. S., A. Bhoumik, D. Collste, S. E. Cornell, J. Donges, I. Fetzer, T. Häyhä, J. Hinton, S. Lade, W. M. Mooij. 2019. *Matching scope, purpose and uses of planetary boundaries science. Environmental Research Letters* 14(7): 73005.



PHOTO: PSHERE

The time is now

Only immediate transformation of global business-as-usual economies and operations will sustain nature as we know it – and us – into the future

Díaz, S., J. Settele, E. S. Brondizio, H. T. Ngo, J. Agard, A. Arneeth, P. Balvanera, K. A. Brauman, S. H. M. Butchart, K. M. A. Chan, L. A. Garibaldi, K. Ichii, J. G. Liu, S. M.

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PHOTO: PSHERE



PHOTO: PSHERE

The complexity of human behaviour

Despite its importance to future sustainability, approaches to understanding human behaviour remain too simple

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Schlüter. 2019. A more dynamic understanding of human behaviour for the Anthropocene. Nature Sustainability 2(12): 1075–1082.

PHOTO: PIXABAY



What time tells us

An in-depth review of existing approaches of time series networks, covering their methodological foundations, interpretation and practical considerations with an emphasis on recent developments

Zou, Y., R. V. Donner, N. Marwan, J. F. Donges, J. Kurths. 2019. *Complex network approaches to nonlinear time series analysis. Physics Reports* 787: 1-97.

PHOTO: N. DESAGHEN/AZOTTE



Know your place

Experience dictates influence among fishers, with older fishers and information brokers having distinct roles in shaping catch patterns for large- and small-sized fish species

Alexander, S. M., P. P. M. Staniczenko, Ö. Bodin. *Social ties explain catch portfolios of small-scale fishers in the Caribbean. Fish and Fisheries* doi:10.1111/faf.12421.

PHOTO: HISTORICAL RECORD FROM TAJIK FORESTRY AGENCY, PHOTO COURTESY FROM K. KHOSIMBEKOV



Striving for sustainable forestry: history matters

Applying Elinor Ostrom's principles on common pool resources management demonstrates how forest management in the Pamir Mountains may not be so tragic after all. But Soviet-era legacy lingers, new research shows

Haider, L. J., B. Neusel, G. D. Peterson, M. Schlüter. 2019. *Past management affects success of current joint forestry management institutions in Tajikistan. Environment, Development and Sustainability* 21, 2183–2224.



PHOTO: POSELS

Invisible resilience in the Anthropocene

Uncovering society's hidden footprint on the water cycle and its implications for future water security

Keys, P. W., M. Porkka, L. Wang-Erlandsson, I. Fetzer, T.

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PHOTO: NEEDPIX



Help from an unexpected source

Accounting can be much more than just crunching numbers. Imagine it saving our environment

Bebbington, J., H. Österblom, B. Crona, J-B. Jouffray, C. Larrinaga, S. Russell, B. Scholtens. 2019. *Accounting and accountability in the Anthropocene*. *Accounting, Auditing & Accountability Journal* 33(1): 152–177.



PHOTO: NASA

Time for an emergency response

Nine climate tipping points now are now “active”, which means the situation is urgent and we need an emergency response, warn scientists

Lenton, T. M., J. Rockström, O. Gaffney, S. Rahmstorf, K. Richardson, W. Steffen, H. J. Schellnhuber. 2019. *Climate tipping points – too risky to bet against*. *Nature* 575(7784): 592–595.

A digital backlash on the planetary health diet

How a pro-meat social media campaign attacking research related to healthy diets may have influenced social media audiences

Garcia, D., V. Galaz, S. Daume. 2019. *EATLancet vs yes2meat: the digital backlash to the planetary health diet*. *The Lancet* 394(10215): 2153–2154.

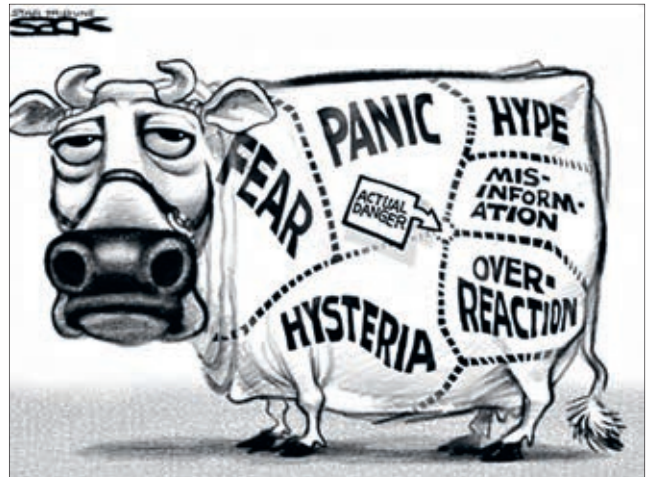


PHOTO: TWITTER SCREENSHOT

PHOTO: US ARMY CORPS OF ENGINEERS, SAVANNAH DISTRICT



No community or ecosystem is an island

Why thinking globally and acting locally can actually undermine sustainability at larger scales – and how to make sure that it doesn't
Ringsmuth, A. K., S. J. Lade, M. Schlüter. 2019. Cross-scale cooperation enables sustainable use of a common-pool resource. Proceedings of the Royal Society B: Biological Sciences 286: 1913.



PHOTO: N. ALTY/WIKIMEDIA

Solutions that provide synergies

Environmental policy instruments must be used to deal with global environmental problems

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

PHOTO: P. MALMER



Being biocultural

Why biocultural diversity can contribute to both local and global sustainability

Merçon, J., S. Vetter, M. Tengö, M. Cocks, P. Balvanera, J. A. Rosell, B. Ayala-Orozco. 2019. From local landscapes to international policy: contributions of the biocultural paradigm to global sustainability. Global Sustainability 2: e7.



PHOTO: B. CHRISTENSSON/AZOTE

What they talk about when they talk about social-ecological systems

As the social ecological system framework celebrates 20 years, researchers analyse its use in scientific publications. Despite increased popularity, a unifying definition is still missing
Colding, J., S. Barthel. 2019. Exploring the social-ecological systems discourse 20 years later. Ecology and Society 24(1): 2.



PHOTO: W. CARTER/WIKIMEDIA

Evolutionary biology for the human age

How evolutionary biology can inform governance and policies on a human-dominated planet

Jørgensen, P. S., C. Folke, S. P. Carroll. 2019. *Evolution in*

the Anthropocene: informing governance and policy. Annual Review of Ecology, Evolution and Systematics 50: 527–546.

PHOTO: B. GONZALEZ-MON



It's all about who you trade with

The trade relationships that fish buyers have with others strongly influence sustainability and their capacity to adapt to changes
Gonzalez-Mon, B., Ö. Bodin, B. Crona, M. Nenadovic, X. Basurto. 2019. *Small-scale fish buyers' trade networks reveal diverse actor types and differential adaptive capacities. Ecological Economics* 164: 106338.

PHOTO: L. PEREIRA



A delicious transformation

Proof might really be found in the pudding. Chefs can be key changemakers in a sustainable transformation of our food system

Pereira, L. M., R. Calderón-Contreras, A. V. Norström, D. Espinosa, J. Willis, L. Guerrero Lara, Z. Khan, L. Rusch, E. C. Palacios, O. P. Amaya. 2019. *Chefs as change-makers from the kitchen: indigenous knowledge and traditional food as sustainability innovations. Global Sustainability* 2: e16.



PHOTO: S. STÄLLENHAG/STOCKHOLM RESILIENCE CENTRE

Imagine the future

Six characteristics necessary to make scenario processes more inclusive and able to address complex and context-specific problems

Pereira, L., N. Sitas, F. Ravera, A. Jimenez-Aceituno, A.

Merrie. 2019. *Building capacities for transformative change towards sustainability: imagination in intergovernmental science-policy scenario processes*. *Elementa: Science of the Anthropocene* 7: 35. *Ecological Economics* 164: 106338.

PHOTO: K. HELLMIG/AZOTE



Banking on a better seafood industry

Hardly any bank loan to industries within fisheries or aquaculture includes demands for a more sustainable business approach. Doing so could significantly reduce pressure on seafood resources

J.-B. Jouffray, B. Crona, E. Wassénus, J. Bebbington, B. Scholtens. 2019. *Leverage points in the financial sector for seafood sustainability*. *Science Advances* 5, eaax3324 *Ecological Economics* 164: 106338.



PHOTO: J. LOKRANTZ/AZOTE

How much is optimal?

Optimal antimicrobial use in animal farming must be analysed as a sustainability issue under a social-ecological perspective
Lhermie, G., D. Wernli, P. S. Jørgensen, D. Kenkel, L. W.

Tauer, Y. T. Gröhn. 2019. Global resistance to antimicrobials and their sustainable use in agriculture. The Lancet Planetary Health 3(3): 109–110.

Trusting what you know

New study tests individuals' confidence in their knowledge about climate change
Fischer, H., D. Amelung, N. Said. 2019. The accuracy of German citizens' confidence in their climate change knowledge. Nature Climate Change 9(10): 776–785.



PHOTO: S. KOHLMANN/FLICHER



Nurturing nature

New research explores how environmental stewardship attitudes are influenced by the benefits humans receive from their environment
Masterson, V. A., S. Vetter, T. Chaigneau, T. M. Daw, O. Selomane, M. Hamann, G. Y. Wong, V. Mellegard, M. Cocks,

M. Tengö. 2019. Revisiting the relationships between human well-being and ecosystems in dynamic social-ecological systems: implications for stewardship and development. Global Sustainability 2: e8.



Time for corporate biosphere stewardship

A handful of transnational corporations hold enough power to accelerate (or hinder) transformations towards sustainability
Folke, C., H. Österblom, J-B. Jouffray, E. F. Lambin, W. N. Adger, M. Scheffer, B. I. Crona, M. Nyström, S. A. Levin, S. R. Carpenter, J. M. Anderies, S. Chapin, A-S. Crépin, A.

Dauriach, V. Galaz, L. J. Gordon, N. Kautsky, B. H. Walker, J. R. Watson, J. Wilen, A. de Zeeuw. 2019. Transnational corporations and the challenge of biosphere stewardship. Nature Ecology & Evolution 3(10): 1396–1403.



PHOTO: PIXABAY

Adding realism to risks

A new application adds realism to an economic model that takes into account the probability of environmental risks

Crépin, A-S., E. Nævdal. 2019. *Inertia Risk: Models of Catastrophes*. *The Scandinavian Journal of Economics* <https://doi.org/10.1111/sjoe.12381>.



PHOTO: US GEOLOGICAL SOCIETY/FLICKR

Falling off the radar

Sophisticated risk frameworks operated by many international organisations, companies and governments ignore rapidly evolving global risks driven by environmental change

Keys, P. W., V. Galaz, M. Dyer, N. Matthews, C. Folke, M. Nyström, S. E. Cornell. 2019. *Anthropocene risk*. *Nature Sustainability* 2(8): 667–673.

PHOTO: US COAST GUARD



Forty years of conflicts

New study presents and analyses the first longitudinal database on fisheries conflicts

Spijkers, J., G. Singh, R. Blasiak, T. H. Morrison, P. Le Billon, H. Österblom. 2019. Global patterns of fisheries conflict: forty years of data. Global Environmental Change 57: UNSP 101921.

PHOTO: L. RYCHALSKI/PXHERE



Dancing on the volcano

Humanity is at a crossroads. We need to understand the underlying drivers of human behaviour to avoid collapse of the biosphere and our global civilisation

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

PHOTO: J. LOKRANTZ/AZOTE



Too warm to swim

Comprehensive global analysis shows a warmer ocean will hold lower animal abundance, with fish and mammals to suffer the most

Lotze, H. K., D. P. Tittensor, A. Bryndum-Buchholz, T. D. Eddy, W. W. L. Cheung, E. D. Galbraith, M. Barange, N. Barrier, D. Bianchi, J. L. Blanchard, L. Bopp, M. Buchner, C. M. Bulman, D. A. Carozza, V. Christensen, M. Coll, J. P. Dunne, E. A. Fulton, S. Jennings, M. C. Jones, S. Mackinson,

O. Maury, S. Niiranen, R. Oliveros-Ramos, T. Roy, J. A. Fernandes, J. Schewe, Y. J. Shin, T. A. M. Silva, J. Steenbeek, C. A. Stock, P. Verley, J. Volkholz, N. D. Walker, B. Worm. 2019. Global ensemble projections reveal trophic amplification of ocean biomass declines with climate change. PNAS of the United States of America 116(26): 12907–12912.

PHOTO: E. DRURY O'NEILL



PHOTO: E. DRURY O'NEILL

Float a loan to weather the storm

Patron-client relations in the Philippines buffer fisheries against immediate impacts of natural disasters. But long-term sustainability may suffer due to the combination with current fishery conditions

O'Neill, E. D., B. Crona, A. J. G. Ferrer, R. Pomeroy. 2019. *From typhoons to traders: the role of patron-client relations in mediating fishery responses to natural disasters. Environmental Research Letters* 14(4): 45015.



PHOTO: PEXELS

It takes a bit of nature to remain sane

A framework to incorporate nature's impact on mental health into city plans
 Bratman, G. N., C. B. Anderson, M. G. Berman, B. Cochran, S. de Vries, J. Flanders, C. Folke, H. Frumkin, J. J. Gross, T. Hartig, P. H. Kahn, M. Kuo, J. J. Lawler, P. S. Levin, T.

Lindahl, A. Meyer-Lindenberg, R. Mitchell, Z. Y. Ouyang, J. Roe, L. Scarlett, J. R. Smith, M. van den Bosch, B. W. Wheeler, M. P. White, H. Zheng, G. C. Daily. 2019. *Nature and mental health: an ecosystem service perspective. Science Advances* 5(7): eaax0903.

SUSTAINABLE DEVELOPMENT GOALS

PHOTO: WIKIMEDIA COMMONS



Agenda 2030 through the complexity lens

The UN Agenda 2030 is a step forward, but is still too fragmented, simplistic and linear in its design and monitoring
 Selomane, O., B. Reyers, R. Biggs, M. Hamann. 2019.

Harnessing insights from social-ecological systems research for monitoring sustainable development. Sustainability 11(4): 1190.

PHOTO: T. H. SNICKARS/AZOTE



If a city is resilient, is it also sustainable?

Researchers present a new framework to resolve this question
 Elmqvist, T., E. Andersson, N. Frantzeskaki, T. McPhearson, P. Olsson, O. Gaffney, K. Takeuchi, C. Folke. 2019.

Sustainability and resilience for transformation in the urban century. Nature Sustainability 2(4): 267–273.

Centre staff contributing to journals and committees

In 2019, several members of staff were involved in a wide variety of editorial engagements outside of the centre

Here are some examples:

Journal editors, board members and referees

Albert Norström: *Ecology and Society*
 Anne-Sophie Crépin: *Ecological Economics*; *Nature Sustainability*
 Beatrice Crona: *Global Sustainability*
 Erik Andersson: *Sustainability Science*
 Ingo Fetzer: *MDPI Systems*, *MDPI Water*; *PNAS*
 Lan Wang Erlandsson: *Nature Sustainability*; *Science of the Total Environment*
 Line Gordon: *Ecology and Society*
 Lisen Schultz: *Global Environmental Change*; *PNAS*
 Maja Schlüter: *Socio-Environmental Systems Modelling*; *Ecology and Society*
 Michele-Lee Moore: *Ecology and Society*
 Oonsie Biggs: *Anthropocene*; *BioScience*
 Peter Sogaard Jorgensen: *Ecology Letters*; *Sustainability Science*
 Sarah Cornell: *Environmental Science & Policy*
 Simon West: *Review for People and Nature*; *Frontiers in Psychology*
 Therese Lindahl: *Environmental and Resource Economics*; *Journal of Environmental Economics and Management*
 Thomas Hahn: *Environmental Science & Policy*; *Journal of Cleaner Production*
 Wijnand Boonstra: *Fish and Fisheries*; *AMBIO: A Journal of the Human Environment*

Committees and working groups

Anne-Sophie Crépin: member of the Swedish National Committee for Global Environmental Change
 Per Olsson: advisory committee for SDG Transformations Forum Council
 Robert Blasiak: pool of Experts for UN World Ocean Assessment
 Sara Elfstrand: steering committee Agroforestry Network
 Thomas Elmqvist: board chair for Sida Scientific council



Centre researcher Thomas Elmqvist was appointed editor-in-chief for *Nature* and RMIT University's new journal *Urban Sustainability* in October 2019. The open-access journal is part of *Nature's* partner journals portfolio, NPJ.

"Given the importance of urbanisation processes and impacts on both local and global scales, I view this new open-access journal as a very timely and excellent opportunity to serve the research community with an output of high-quality research on urbanisation processes and their multitude of consequences for global sustainability," says Elmqvist. In his new role as editor-in-chief, Elmqvist is supported by a team of five associate editors, including centre-associated researcher Timon McPhearson.

▶ Read more at www.nature.com/npjurbansustain/

Research highlights

The Beijer Institute and the Global Economic Dynamics and the Biosphere Programme

The collaboration with the Beijer Institute, SRC's founding partner, and the Global Economic Dynamics and the Biosphere (GEDB) Programme, both part of the Royal Swedish Academy of Sciences (the Academy), remains strong and important

EXAMPLES OF COLLABORATION include the Beijer Institute's research programme Complexity, Technology and Governance. As part of the programme a joint workshop on human-machine-ecology was held in January at Princeton University. In October leading Swedish and US academics, the private sector and UN organisations met in New York to explore risks and opportunities posed by AI (see page 58). The event was hosted by the Consulate General of Sweden in New York, the Beijer Institute, SRC and Princeton Institute for International and Regional Studies. A significant volume has been published during the year: *Global Challenges, Governance and Complexity: Applications and Frontiers*, a book edited by Victor Galaz who also leads the Complexity, Technology and Governance programme.

In January, Beijer and the SRC in collaboration with the NatCap group of Stanford University organised a major workshop at the Academy in Stockholm entitled Urbanisation in the Anthropocene – in support of a liveable planet. Other Beijer workshops focused on imaginaries and the biosphere, involving leading scholars from Harvard University and Stanford University, and on marine mammal health in collaboration with Princeton University.

The SRC, Beijer and GEDB also worked closely together in their contributions to the EAT-Lancet Commission on Food, Planet and Health. The research offers six strategies to feed 10 billion people healthy and sustainable diets. The progressive science-business collaboration with SeaBOS and the Keystone Dialogues continues in 2020 with jointly organised meetings in Norway and Thailand (see page 60). In addition, GEDB's work on biosphere finance and global health and biosphere stewardship has attracted a strong interest from the finance sector, in Sweden and globally with several interactions during the year.

Inspiring collaborations led to several joint publications including articles on humans as a major driver of evolution (*Annual Review of Ecology, Evolution, and Systematics*); the challenge of corporate biosphere stewardship (*Nature*



The Royal Swedish Academy of Sciences. Photo: F. All

Ecology & Evolution); identifying financial levers (*Science Advances*); proposing economic policies for planetary boundaries (*Nature Sustainability*); exploring market responses in small-scale fisheries (*Frontiers in Marine Science*); placing human behaviour as part of the biosphere (*Nature Sustainability*); revealing the role of migrants' remittances in regime shifts (*Environmental Research Letters*); clarifying urban resilience (*Nature Sustainability*); and unravelling the anatomy of the Anthropocene (*Nature*).

The third generation of Beijer Young Scholars, an international network of about 20 postdocs and late-PhD students had their first meeting in the spring, focusing on globalisation and the biosphere. Finally, the Stockholm Seminars, a series featuring some of the world's most prominent experts on global sustainability, held a special event celebrating the 200th Stockholm Seminars, entitled Water as the bloodstream of the Biosphere (read more on page 64–65).



Read more: www.beijer.kva.se and www.gedb.se

Ten years of nine planetary boundaries

As the framework celebrates its tenth anniversary, some of the lead authors behind it reflect on what it has achieved and the work that lies ahead

Many good things can happen over a cup of coffee. Will Steffen, a senior research fellow at the centre recalls the origin of what has become one of the most important frameworks within sustainability thinking. “I remember a breakfast meeting at a little cafe in central Stockholm in 2005 or 2006 with Johan Rockström and Bo Ekman (founder of the Tällberg Foundation). Johan had this idea to explore a concept he called planetary boundaries.” In 2008, a small group of researchers met in Tällberg, a small village in the centre of Sweden to discuss which “boundaries” influence the stability of the earth system in its current state. They emerged from the meeting with nine of them. On 24 September 2009, *Nature* published “A safe operating space for humanity”. Ten years later, lead author Johan Rockström believes the timing of their work was right.

“Earth system science in the decades preceding the framework led to this point where we could make a first estimate of the boundary conditions for a safe operating space for humanity. If we had not done it then other researcher groups would have arrived at similar conclusions.”

Significant interest beyond science

With over 3,600 citations to date, the article has sparked significant excitement across the natural and social sciences. Academic discussion in the natural sciences has focused on stress-testing the boundaries, fine-tuning the analysis and exploring alternative metrics. The social sciences foci have applied the framework particularly around equity issues, translating to regional and national levels, and combining with social boundaries. One example is Kate Raworth’s Doughnut economic model.

The framework has also attracted significant interest among policymakers and businesses. In 2012, the UN’s High Level Panel for the Rio+20 summit published report *Resilient People, Resilient Planet* using the planetary boundaries framework as a foundational part of the renewed argument for sustainable development. Downscaling or translation of the boundaries has been undertaken for several countries and regions including China, Columbia, the EU, Finland, Germany, the Netherlands, South Africa, Sweden and Switzerland. WWF has used the framework as a core part of its *Living Planet Report* (2016, 2018). Companies like H&M, Ikea, L’Oréal and Houdini are looking at ways to adapt the framework to their businesses.

Towards Planetary Boundaries 3.0

In 2015, an updated version was published in *Science*. It provided new data on some boundaries, most notably

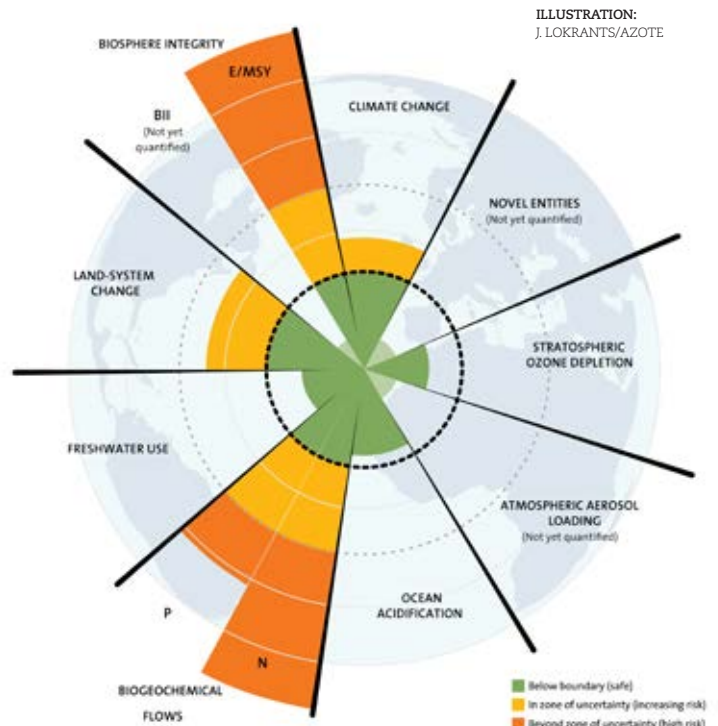


Illustration: J. Lokrantz/Azote

biodiversity, and assessed that land use had also crossed a boundary. But more work is needed. Katherine Richardson from Copenhagen University and a co-author of the research says, “Early on, we acknowledged that our analysis did not take into account interactions between the boundaries. This area needs much more research.” She warns there are “gaping holes” around the quantification of novel substances and aerosol loading at the global level. Steffen agrees. He recalls an early attempt to show all possible interactions among the processes, a “horrendous spaghetti diagram” in his own words.

“This was so confronting that we dropped development of that idea at the time, but now we have the tools and further understanding to return to the interactions challenge.”

Led by Sarah Cornell work is underway to develop the Planetary Boundaries 3.0 framework. This includes quantifying the two boundaries lacking numbers – aerosols and novel entities (for example genetically modified organisms, pesticides or even artificial intelligence). According to SRC’s science director Carl Folke, a co-author, the framework is more than just a tool for science, policy and business. “It has contributed to making people understand we live on a human-dominated planet,” he says.

That can only be a good thing.



A scientific story that matters

Sarah Cornell reflects on the planetary boundaries framework, which she has been working on since 2011

CHEMISTRY is all around us. When we meet Sarah Cornell over lunch at a noisy cafe in Stockholm, she looks around and then motions to the plate in front of her – a spicy cauliflower and falafel salad – and says: “It’s impossible for me to look at this without seeing its chemical components and understanding something about what those are and what they do.” Cornell is originally a chemist by training. Her PhD, from the University of East Anglia, was on the global nitrogen cycle. And though she now calls herself an interdisciplinarian, with passable skills in some of the methods from the humanities and insight into different schools of thought, her disciplinary background matters to how she sees the world. “It’s a way of decoding reality and the world around us. We all carry different lenses that help us understand what we see and what that means,” she says. Cornell grew up in Brazil as the daughter of protestant missionaries. At 16 she moved to the UK to finish her A levels, and she stayed in England through PhD studies and post-doctoral research. She didn’t envisage it then, but Sweden ended up being the third place where she has spent a large part of her life.

So how did she end up here?

Expanding understanding of global sustainability

In 2009 the first paper about the planetary boundaries was published. To Cornell the framework marked an important step by the scientific community and by the strategic leadership of major global change projects towards placing sustainability science in a real-world context, reaching outside of academia. When the opportunity came to join the centre in 2011, to work on further evaluating and developing the planetary boundaries framework, she took it. The work has been fast-paced and at times challenging – but rewarding and fun.

Cornell has worked on developing the framework with regards to the hard data and models that it rests on, as well as putting it into practice. One of her proudest moments was a symposium in 2016, where participants from science, policy, business and wider society discussed the framework’s progress “from concept to action”. For her, the event showed how much the planetary boundaries framework had expanded people’s understanding of global sustainability.

Like warning lights on a dashboard

Interest has continued to grow in different sectors that want to use the framework. At the moment Sarah is coordinating research projects funded by the clothing company H&M and L’Oréal, one of the global leaders within cosmetics. They are both looking at how to use the planetary boundaries in

sustainability target setting and how the framework plays into a circular economy model.

“It’s exciting to see the boundaries catch on in this way, and it has forced us to confront challenges of communicating the framework clearly,” she says. Two things stand out as key take-homes from the discussions with such partners. The first is not lose sight of the framework as a whole. “It doesn’t work to focus on only one or two of the boundaries, they all interact and so they all need to be kept in mind,” she explains. The other is that the wedges in the planetary boundaries figure should not be seen as budgets. “They are more like warning lights on a dashboard.” Cornell warns that using the planetary boundaries framework is not about figuring out how much more impact a company, sector or country can get away with but rather trying to minimise the pressure on a world that is already impacted. An even better thing would be to turn to activities with a positive impact, using the framework as a tool for seeing the bigger picture.

The next big task

Looking forward Cornell wants to move through a deeper understanding of how to translate the boundaries towards action. This, she says, is her theme for the academic year: thinking deeply on the safe operating space for humanity. Last year was her feminist year (“it’s going to be a long year”). She believes thinking about whose values are seen and whose voices get heard goes well together with a deeper understanding of the boundaries.

The next big task in the planetary boundaries work is to be clearer about its diagnosis. Looking across the world, what does overstepping the boundaries mean in different places? That knowledge would help us to be clearer about how we might respond – what can we do about the changing risks?

There is a sense of urgency when she talks about it. “We need to continue to develop the models and the data, there’s a lot of exciting work being done on that,” she says. “But we also need to act on what we already know.” And this, she says, comes back to how we understand and decode the world – and to how we communicate between our different understandings. “When researchers look at data, it tells them a whole story. Projections of temperature increase mean more to us than just this or that many degrees, they are part of a narrative of earth’s future,” she says.

“To a non-researcher, a policymaker or practitioner the numbers in a report may tell a completely different story, or not really tell a story, unless we are explicit and clear. It is our responsibility to make sure that we convey the scientific story that matters.”

Collaboration with Stanford University

With funding from the Swedish Marianne and Marcus Wallenberg Foundation, the centre has over the past five years developed a close collaboration with Stanford University. This continued to flourish in 2019

LED BY CENTRE SCIENCE DIRECTOR Carl Folke and Gretchen Daily from Stanford University, the focus of the collaboration has been the theoretical development, analysis and synthesis of humans in the biosphere and how we shape it from local to global levels. This has resulted in more than 55 publications as well as several high-level workshops and conference sessions with renowned scholars in the areas of nature for mental health, food systems transformations, sustainable urbanisation and scenarios. Garry Peterson, Cibele Queiroz, Jan Kuiper, Erik Andersson, Thomas Elmqvist, Therese Lindahl (the Beijer Institute), Amanda Wood, Line Gordon, Henrik Österblom, Jean-Baptiste Jouffray and Albert Norström are centre researchers who hold a key role in this partnership.

At the annual Natural Capital Symposium at Stanford in March 2019, the SRC officially became one of four NatCap academic partners, a milestone in our collaboration (see below). This allowed further consolidation and expansion of the SRC-Stanford collaboration. Other scientific highlights from 2019 included a paper on nature and mental health published in *Science Advances* and a paper on human behaviour in the Anthropocene published in *Nature Sustainability*. Researchers from the centre and Stanford also hosted a high-level workshop on sustainable urbanisation in the Anthropocene and multiple conference sessions at the Leverage Points Conference in Germany.

Looking ahead

2019 was also the kick-off for a second grant and a new phase of the collaboration. The new dynamics and challenges of the Anthropocene will be the central attractor for the upcoming research with particular foci on the role of food systems, ocean governance, urbanisation and human behaviour. In 2019, four papers addressing different perspectives on food systems resilience were published in *Global Food Security*. Three of them will be part of an upcoming special issue on food systems resilience. A high-level paper on long-term resilience of food groups to climate change is also in development. The pioneer work on transforming Nordic food diets will continue and further synergies of work between the SRC and Stanford University is expected.

Researchers from both institutions have become increasingly involved in IPBES and this is expected to continue. Particular input has been on developing scenarios for sustainability and global modelling of nature's contributions to people. Collaboration on ocean governance was strengthened between the SRC, the Stanford Center for Ocean Solutions and SeaBOS (see page 60). In 2020 exciting progress is expected to happen in this area.

Stockholm Resilience Centre joins Natural Capital Project partnership

In 2019, the SRC, together with its founding partner the Beijer Institute of Ecological Economics of the Royal Swedish Academy of Sciences, became official partners to the Natural Capital Project (NatCap), an international collaboration looking to better integrate the value nature provides to society. NatCap is centred at Stanford University and includes the University of Minnesota Institute on the Environment, the Chinese Academy of Sciences, The Nature Conservancy and World Wildlife Fund as core members.

“The powerful team at SRC will strengthen our initiatives in scientific innovation and help open new pathways towards green, inclusive growth around the world,” says Professor Gretchen Daily, co-founder and faculty director of the Natural Capital Project at Stanford University. The official announcement of the partnership took place at the 2019 Natural Capital Symposium in March, the Natural Capital Project's annual gathering.



Centre researcher Garry Peterson was among the SRC staff present at the official announcement of the new partnership. Pictured together with Anne Guery (chief strategy officer for NatCap), Professor Steve Polasky (co-founder of the Natural Capital Project) and Professor Ouyang Zhiyun from the Chinese Academy of Sciences. Photo: S. Castillo

SES-LINK


In 2019 the centre's SES-LINK group continued working on case studies and models to understand the intertwined dynamics of social-ecological systems (SES)

THE WORK FOCUSED on four key areas: 1) explaining and managing social-ecological change, e.g. restoring lakes that have moved beyond ecological tipping points, 2) understanding the importance of social structures and diversity of human behaviour for sustainability and resilience of SES, e.g. how coordination and coalition formation enable policy change, 3) cross-scale dynamics in food systems, e.g. spatial diversification as a response to environmental variability and 4) new perspectives for studying SES as intertwined and complex adaptive systems, such as process-relational ontologies.

The SES-LINK group published two joint publications that build on several years of collaborative work to enhance the conceptual and methodological foundations for analysing SES as complex adaptive and intertwined systems. The first publication presents a framework for analysing systemic change or lack thereof, such as regime shifts or traps as phenomena that emerge from interactions between human and non-human actors (5). It builds on Elinor Ostrom's social action situation and extends the concept to include social-ecological and ecological action situations. The framework supports the development of possible explanations of observed phenomena, i.e., the social-ecological interactions and outcomes that may have produced the phenomena, that can then be further explored in a field study or model. The second publication suggests a methodology for theorising about SES phenomena that combines generalising from case studies with agent-based modelling to develop, explore and specify possible explanations (6).

Members of the team have started several new research projects including two Swedish Research Council (VR)/Sida/Formas funded place-based studies focusing on small-scale fisheries management and climate change adaptation in East Africa from a mechanism-based and process-relational perspective, respectively; a Belmont Forum/Biodiversa project to develop social-ecological scenarios for aquatic ecosystem services focusing on lakes in Sweden, Germany and Canada; and an interdisciplinary research environment funded by VR to study approaches to causation in SES. These projects are building novel collaborations with researchers in Africa (Tanzania, Kenya, Mozambique), North America (Canada) and Europe (Sweden, Finland, Germany).

In addition, SES-LINK is hosting two visitors for a year with expertise in psychology and small-scale fisheries for collaborations to study confidence of knowledge in collective resource management and poverty traps in fisheries using agent-based modelling. Finally, the team was itself a case study for a PhD student in science-technology studies from Humboldt University, Berlin, who is interested in how SES researchers deal with complexity when studying and modelling SES.

 Read more: www.seslink.org

Relevant publications

1. Martin, R., M. Schlüter, T. Blenckner. 2020. The importance of transient social dynamics for restoring ecosystems beyond ecological tipping points. *PNAS*. <https://doi.org/10.1073/pnas.1817154117>
2. Orach, K., Duit, A., Schlüter, M., under revision. Sustainable natural resource governance under interest group competition in policy making. *Nature Human Behaviour*.
3. González-Mon, B., Ö., Bodin, E. Lindkvist et al., under revision. Spatial diversification as a mechanism to adapt to environmental changes in small-scale fisheries.
4. Hertz, T., M. Mancilla García, M. Schlüter. In press. Process ontologies for social-ecological systems (SES) research. *People and Nature*.
5. Mancilla García, Hertz, M. Schlüter et al. In press. Adopting process-relational perspectives to tackle the challenges of social-ecological systems research. *Ecology and Society*.
6. Schlüter, M., L. Haider, S. Lade, E. Lindkvist, R. Martin, K. Orach, N. Wijermans, C. Folke. 2019. Capturing emergent phenomena in social-ecological systems: an analytical framework. *Ecology and Society* 24. <https://doi.org/10.5751/ES-11012-240311>
7. Schlüter, M., K. Orach, E. Lindkvist, R. Martin, N. Wijermans, Ö. Bodin, W. J. Boonstra. 2019. Toward a methodology for explaining and theorizing about social-ecological phenomena. *Current Opinion in Environmental Sustainability* 39, 44–53. <https://doi.org/10.1016/j.cosust.2019.06.011>



PHOTO: M. SPARRÉUS/AZOTE

Humans, nature and the SDGs

The centre is a partner in ambitious research to gain a deeper understanding of the relationship between humans and their environment in achieving the Sustainable Development Goals

CENTRE RESEARCHER Tim Daw is the Swedish principle investigator for two projects that will look at the role of human-environment interactions in achieving the Sustainable Development Goals (SDGs). The projects are a collaboration between the centre, King's College London and the University of Southampton, UK, along with other partners in the United Kingdom and India. The projects are funded through the *Towards a Sustainable Earth initiative*, a collaboration between Swedish, Indian, Chinese and Japanese funding agencies.

In one of the projects, the SRC will collaborate with the University of Southampton, UK, and Jadavpur University,

India to analyse the synergies and conflicts between the SDGs and explore the resulting opportunities and trade-offs in policy in the Indian Sundarbans.

The SRC is also a partner in the Nature4SDGs project led by King's College London, in collaboration with the Ashoka Trust for Research in Ecology and the Environment, India and a number of other UK universities. The team will draw upon existing datasets from 11 sites in the Global South to analyse the relationship between natural resource management and the SDGs, including synergies and trade-offs.



PHOTO: TONYUYU1989/PXHERE

Nereus Program: an end and a new beginning for global ocean research

In 2019, the Nereus Program – Predicting Future Oceans came to an end. The Stockholm Resilience Centre was a key partner to this nine-year US\$13 million global ocean research programme, which wholly or in part funded three postdocs and three PhD positions at the centre

OVER THE COURSE of its nine years, the Nippon Foundation programme expanded from a core group of five institutions: University of British Columbia, Duke, Princeton, the UN Environment Programme World Conservation Monitoring Centre based at Cambridge University and the centre, to 19 institutes from around the world, each focusing on a scientific aspect of our future ocean. The research conducted under the programme spanned from oceanography and marine ecology to fisheries economics and impacts on coastal communities.

Research from the centre was led by Carl Folke and Henrik Österblom together with PhD students Andrew Merrie, Matilda Petersson and Jessica Spijkers. It provided novel insights on ocean governance and the human dimension of a changing ocean. To mark the successful end to the programme, a synthesis book – *Predicting Future Oceans: Sustainability of Ocean and Human Systems Amidst Global Environmental Change* – featured contributions from all Nereus Program fellows.



Earth Commission

Centre researchers Juan Carlos Rocha and Steven Lade are supporting the activities of the Earth Commission, through their participation in the Commission's secretariat. The Earth Commission is a group of 19 leading scientists across natural and social sciences, chaired by Joyeeta Gupta, Qin Dahe and Johan Rockström, who will assess the latest science to

underpin the development of science-based targets for systems like land, water and biodiversity. By setting such targets, companies and cities will be able to contribute to re-stabilising earth's natural systems and work towards ensuring a planet where humans can thrive.

THE CENTRE, along with the Beijer Institute of Ecological Economics, has become a partner of AI Innovation of Sweden. Founded in February 2019, AI Innovation of Sweden is a national initiative designed to "serve as an engine in the Swedish AI ecosystem". The purpose of the new partnership is to explore the broad biosphere sustainability dimensions of the rapid progress and applications of artificial intelligence in society. By linking to leading AI thinkers and doers in Sweden, SRC, together with the Beijer Institute, aims to develop a new research agenda and collaborations in this rapidly developing field. "These technologies are phenomenally powerful. They will increasingly shape our world – and our planet. It is really important that artificial intelligence is cognizant of the state of the planet," says Victor Galaz, deputy director of the Stockholm Resilience



Centre and programme director for the Beijer Institute's new programme Governance, Technology and Complexity.

THE ADAPTECONII INNOVATIVE TRAINING NETWORK,

exploring adaptation to the reality of biophysical constraints on the global economy, came to a close in 2019. AdaptEconII was a European Commission-funded Horizon 2020 Marie Skłodowska-Curie Action project. It funded 12 PhD projects at Stockholm University, Université Clermont Auvergne (UCA), and the University of Iceland. Centre researcher Sarah Cornell supervised PhD students David Collste, Jennifer Hinton and Timothée Parrique jointly with development economist Professor Arnaud Diemer at UCA. The students used systems thinking to outline socially and ecologically sustainable economic pathways. Key results from their work include a systems analysis of economic ideal types based on business purpose, ownership and investment; a conceptual model of the political economy of

degrowth and transitional policies. They also applied system dynamics modelling to the 2030 Agenda's Sustainable Development Goals, showing how better economics can help navigate ecological constraints and diverse social contexts.



**Sarah
Cornell**



**David
Collste**



**Jennifer
Hinton**



**Timothée
Parrique**

Continued assessment of the health of the Baltic Sea

THE BALTIC HEALTH INDEX, a regional study under the global Ocean Health Index framework, the first comprehensive ocean assessment to also include humans as part of the marine ecosystems, entered its second project phase in 2019. During this period, which will run until 2022, new data will be presented, adding to an already extensive

overview of environmental, social and economic information about the Baltic Sea. The project is led by centre researcher Thorsten Blenckner. In 2019 Susa Niiranen joined as researcher, Eleanore Campbell joined as data scientist and Andrea de Cervo as project assistant. The project is funded by the Johansson Family Foundation and Formas.

IN 2019, the centre joined the new Nature-based Solutions for Urban Resilience in the Anthropocene (NATURA) network, which brings together a host of other networks in Africa, the Asia-Pacific, Europe, North America and Latin America. It is funded by the US National Science Foundation for US\$2 million for five years. Centre associate research fellow Timon McPhearson will also act as one of the programme coordinators. The aim of NATURA is for researchers and practitioners to exchange knowledge, share data and

enhance communication on applications of nature-based solutions in a wide range of social, ecological and technological contexts. Furthermore, early-career researchers and practitioners will be sponsored by NATURA to pay five-week visits to network partners. NATURA will also train postdoctoral scholars and graduate students through learning exchanges to networks around the globe.

▶ See natura-net.org/

New funding

HENRIK ÖSTERBLOM and **OLOF OLSSON** received SEK 7.8 million from the Marianne and Marcus Wallenberg Foundation for the project “Sustainability science, dialogues and novel technologies for understanding and managing ocean ecosystem trade-offs”. The project will use autonomous vessels and artificial intelligence to better understand ecosystem interactions between forage

fish, top predators and fisheries in the Baltic Sea. The project also aims to develop tools that can be used to advance ecosystem-based management. The grant covers a project period of five years and will be conducted in close collaboration with the Swedish University of Agricultural Studies (SLU Aqua) and WWF Sweden.



Henrik Österblom

Olof Olsson



Johan Enqvist

JOHAN ENQVIST received a three-year mobility grant from the Swedish Research Council to look at how the 2018 water crisis in Cape Town affected the inhabitants’ water use and environmental awareness. “My focus is on mapping values, beliefs and social norms to see how they shape habits and behaviour,” Enqvist explains. Although employed by the Stockholm Resilience Centre, he will be working primarily from the African Climate & Development Initiative at the University of Cape Town.



My Sellberg

MY SELLBERG received just under SEK 1 million from Formas in order to better understand the barriers, enablers, benefits and trade-offs of diversifying agriculture towards increased production of fruits, vegetables and legumes in the region surrounding Lake Mälaren and Stockholm. The project is co-designed with Södertälje Municipality – a Swedish frontrunner on sustainable and healthy public meals and food businesses.



Jan Kuiper

JAN KUIPER received a four-year mobility grant from Formas to further develop the Nature Futures Framework. It focuses on creating positive visions and exploring people’s desired relationships with nature. Kuiper will continue to develop the framework as part of an ongoing case study on the development of the Hollandse Duinen national urban park in the Netherlands.



Caroline Schill

Simon West

Centre researchers **CAROLINE SCHILL** and **SIMON WEST** will lead a new project funded by Formas called “Living with the ‘new normal’”. It explores human responses to abrupt environmental changes in the Arctic. In the three-year project, Schill and West, along with Tracie

Curry (University of Alaska Fairbanks), will invite inhabitants from the village of Wainwright on Alaska’s North Slope to take photographs that represent their own perspectives and experiences. During the second year, the researchers will conduct a series of behavioural economic experiments. “We want to explore and test what it really means to bring these very different approaches together, and working closely with a community, in a transdisciplinary fashion,” says Caroline Schill. Ingrid Rieser, a filmmaker, will document the promises and pitfalls of engaging in such transdisciplinary research.

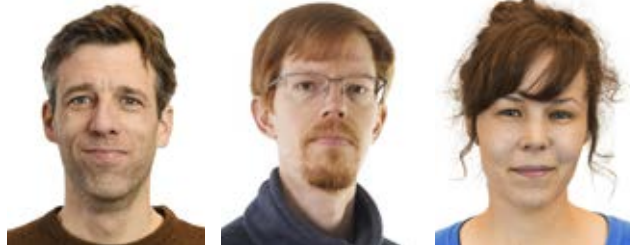
JUAN CARLOS ROCHA, GARRY PETERSON, SUSA NIIRANEN and **ANNE-SOPHIE CRÉPIN** received some SEK 8 million from the Belmont Forum to study marine arctic resilience. Specifically, the project will integrate models, local knowledge, and comparative case studies to assess the resilience of Arctic marine food webs to climate and fishing pressures, and how communities adapt or transform to such changes. The project is a collaboration with researchers in the U.S and Canada. The project will also hire two postdocs, one in Alaska and another in Montreal.



**Erik
Andersson**

**Timon
McPhearson**

Digitalisation and new technology can offer new ways for people to understand and engage in the stewardship of urban systems. Centre researcher **ERIK ANDERSSON** received NOK 11.5 million in funding from NordForsk for his project SMARTer Greener Cities, which is co-led by centre-affiliated researcher **TIMON MCPHEARSON** (The New School, New York). The three-year project aims to develop and test novel theories, tools and processes for more resilient and equitable urban futures. Grounded in three cases – Stockholm, Copenhagen and Helsinki – the project will be a collaborative effort between SRC and the University of Copenhagen, the University of Helsinki and SYKE (the Finnish Environment Institute). “We believe that we must cut across silos in disciplines, approaches and knowledge systems by bringing technology, people and nature together,” says Andersson.



**Wijnand
Boonstra**

**Erik
Andersson**

**Emma
Björkvik**

Centre researchers **WIJNAND BOONSTRA**, **ERIK ANDERSSON** and **EMMA BJÖRKVIK** together with Sofie Joosse, Jens Olsson (Swedish University for Agricultural Sciences) and Patrik Rönnbäck (Uppsala University) received just short of SEK 8 million in funding from Formas to study the use of urban water areas and the value they bring to city dwellers. Insights from this project will help improve future urban planning strategies.



Tiina Häyhä

Sarah Cornell

TIINA HÄYHÄ and **SARAH CORNELL** received SEK 1.9 million from Formas for a two-year project on finding ways to put systems thinking more prominently into circular economy strategies. Häyhä and Cornell will work closely with companies and other business-engaged stakeholders who are working towards implementing a circular economy in a sustainable way. “This work will bring new insights to circular economy literature by situating the framework in its wider social-ecological context,” says Häyhä.



Amanda Wood

AMANDA WOOD received SEK 4.5 million from Formas to continue her work on developing more sustainable food production systems in the Nordic countries. The funding will help advance research that can benchmark Nordic food systems against Sustainable Development Goals. An important part of this work will be to continue collaborating with research partners at the Finnish Environment Institute, University of Oslo and the University of Copenhagen. Furthermore, Wood will work closely with food system actors such as the Nordic Council of Ministers, policymakers, businesses, civil society groups and more.



Thomas Hahn

THOMAS HAHN received SEK 3 million from Formas for continued research on ecological compensation or biodiversity offsets. This is a relatively new policy tool based on the polluter-pays principle. Developers who impact negatively on ecosystems and biodiversity are obliged to compensate for these losses. Such ecological restoration will be necessary to achieve the No Net Loss goals of the post-2020 global biodiversity framework. In his research, Hahn will look at ways to design policy tools that can safeguard both ecological and social outcomes. The estimated project length is three years and includes collaboration with researchers from the United Kingdom and South Africa.



Thorsten Blenckner

THORSTEN BLENCKNER received SEK 3 million from Formas to look into the cumulative impacts of eutrophication, fisheries and climate in the Baltic Sea. The findings from this three-year project will be incorporated into the widely recognised assessment tool, the Baltic Health Index.

Scientific achievements and awards

Centre researchers recipients of 2019 Ecological Society of America awards

CENTRE RESEARCHERS Oonsie Biggs, Timon McPhearson, Albert Norström, Per Olsson, Garry Peterson, Laura Pereira and Victor Galaz won the 2019 ESA Innovation in Sustainability Science Award for their 2016 study *Bright spots: seeds of a good Anthropocene*, which was published in 2016 in *Frontiers in Ecology and the Environment*. The Innovation in Sustainability Science Award recognises the authors of a peer-reviewed paper published in the past five years exemplifying cutting-edge work on solution pathways to sustainability challenges. Their study, led by Elena Bennett from McGill University, Canada, analyses 100 initiatives that can serve as inspiration for a more sustainable Anthropocene, the new geological epoch which recognises that humans are profoundly altering the functioning of the earth's climate and ecosystems. These initiatives, or seeds as they are called, are part of a larger compilation of cases collected via the study website, *Seeds of Good Anthropocenes*.

Furthermore, centre researcher Thomas Elmqvist was among the recipients for the ESA Sustainable Science Award, for the 2016 study *Advancing Urban Ecology toward a Science of Cities*, published in *BioScience*. The Sustainability Science Award recognises the authors of the scholarly work that makes the greatest contribution to the emerging science of ecosystem and regional sustainability through the integration of ecological and social sciences. The *BioScience* study, which was led by centre associate research fellow Timon McPhearson, answers the question: how can urban ecology help our cities become more sustainable? The answer, according to the study, is better interdisciplinary collaboration and a renewed focus on bringing research into various aspects of urban planning, architecture and design. Only then can the research provide insights that take into account the many complex interactions of a city.

The awards were presented during the ESA's annual meeting in August 2019.

FRANCES WESTLEY, the former chair of the SRC board was in 2019 named honorary doctorate at Stockholm University. Westley, a professor of social innovation at the University of Waterloo, Canada, was among seven researchers to receive the title for their contribution to the university's research and education. She was also among the 40 awardees for social innovation by the Schwab Foundation for Social Entrepreneurship. Her work on the transformation to sustainable development and the importance of institutional entrepreneurs in resilience and socio-economic systems has gained international attention. She is now a member of the centre's new International Science Advisory Council.



PHOTO: M. SPARRIS/AZOTE



Carl Folke



Johan Rockström



Oonsie Biggs



Stephan Barthel



Per Olsson

Five centre researchers among world's most cited

Centre co-founders Carl Folke and Johan Rockström together with Oonsie Biggs, Stephan Barthel and Per Olsson were listed on the exclusive 2019 Clarivate Analytics overview of the world's most cited researchers. Brian Walker, a long-time senior research fellow, was also listed. The overview recognises researchers for their exceptional research performance, demonstrated by production of multiple highly cited papers that rank in the top 1% by citations for field and year in Web of Science. Carl Folke has been among the world's most highly cited since the start of the list in 2014. This year he made the remarkable achievement of being included in two separate categories: *Environment and Ecology and Social Sciences*. Nine researchers from Stockholm University were included on the list.

PHOTO: POLARBRÖD UTSTICKARPRISET



Victoria Bignet (left), Line Gordon, Brent Loken and Maya Rebermark accepted the award on behalf of the EAT-Lancet Commission.

IN NOVEMBER, the EAT-Lancet Commission won the 2019 *Utstickarpriset* from Swedish bread producer Polarbröd for its efforts to disseminate knowledge and hope about how the transition to a more sustainable food system can have a positive impact on human health and the state of the planet. *Utstickarpriset* is awarded to individuals and organisations who contribute to positive change through compassion, persistence and creativity.

PHOTO: K. KAROV



POSTDOCTORAL RESEARCHER Jonathan Donges was one of ten researchers awarded the Heinz Maier-Leibnitz Prize in 2019, the most important award for early career researchers in Germany. The recipients were chosen by a selection committee in Bonn appointed by the German Research Foundation and the German Federal Ministry of Education and Research.



Jamila Haider

A PAPER written by a host of former centre PhD students won the 2018 “Outstanding Paper” award in the journal *Sustainability Science* as a recognition of their efforts to enhance the understanding of sustainability science and high scientific quality. The paper, “The interdisciplinary journey: early-career perspectives in sustainability science” proposes a framework to help early-career sustainability researchers navigate interdisciplinary research journeys with breadth (epistemological agility) and depth (methodological groundedness). “As a group of young scholars at a sustainability science institution, we feel well situated to reflect on the formal and informal dimensions of this process. We hope that the lessons we have learned will be of use to other early-career scholars faced with similar opportunities and challenges,” says lead author L. Jamila Haider (pictured). She wrote the paper together with Jonas Hentati-Sundberg, Matteo Giusti, Julie Goodness, Maïke Hamann, Vanessa A. Masterson, Megan Meacham, Andrew Merrie, Daniel Ospina, Caroline Schill and Hanna Sinare.

Policy, practice and outreach



PHOTO: CGIAR

Global Resilience Partnership (GRP)


In 2019, the GRP continued to bring together diverse partners and ignite a resilience movement focused on action

2019 WAS A PIVOTAL YEAR for the GRP with many successes and an accelerating momentum hurtling forward into 2020. Hosted at the Stockholm Resilience Centre, the GRP is a community of public and private organisations joining forces towards a future where vulnerable people and places are able to thrive in the face of shocks, uncertainty and change. During 2019 the GRP and researchers from the GRAID programme (see page 52) convened a series of Deep Dive resilience dialogues with partners and allies. These dialogues explored how building resilience can tackle development challenges and identified the most effective ways to go about it. This enabled the GRP to sharpen its strategic focus and identify collaborative actions that deliver greater impact with partners, emphasising the voices of stakeholders in Least Developed Countries.

The dialogues kicked off in March at the Rockefeller Bellagio Center in Italy where the GRP convened a group of global experts and experienced practitioners. They were tasked with identifying three action areas critical to transforming and building resilient food systems in vulnerable and fragile regions. The dialogue series continued at Africa Climate Week, at the 13th Community-Based Adaptation Conference in Addis Ababa – where GRP also held its annual partners’ meeting – before moving onto the EAT Stockholm Forum and Asia-Pacific Climate Week. The dialogues culminated in New York ahead of the UN Climate Action Summit at the GRP-convened event, Building a Resilient Future where more than 500 practitioners, innovators and high-level leaders collectively prioritised over 100 resilience actions. These actions informed the development of the Climate Action Pathway on Resilience and Adaptation, under the UNFCCC’s Marrakech

Partnership. The dialogues and Building a Resilient Future led to the inception of a global movement for resilience with a clear pathway forward, signed by over 50 organisations. The next stage for this growing movement is to put the resilience and adaptation pathway into action and demonstrate tangible progress by November 2020 at COP26 in Glasgow.

On the ground, the GRP continued to present resilience solutions at the intersection of food and water security, peace and stability, and disaster resilience through its latest Innovation Challenge. The 2019 winners exemplified a broad range of solutions connected to essential interventions areas such as nature-based solutions, inclusive finance and empowering marginalised groups. To date, the GRP has run three Innovation Challenges, whose projects have supported 5.7 million people. In October, the GRP launched its “Resilience Insights Report” and microsite, distilling the most compelling results from across the partnership. GRP’s Resilience Innovation concept for Peace and Stability in Fragile and Conflict-prone Regions was selected as one of the nine winners of the Global Environment Facility (GEF) Innovation Challenge Programme. The GRP also collaborated closely with Ocean Unite and global insurer and reinsurer AXA XL to launch the Ocean Risk and Resilience Action Alliance. The Alliance fosters crucial collaborations between the finance and insurance sectors, governments and environmental organisations to build resilience in communities and regions most exposed to ocean risk.

 Read more: www.globalresiliencepartnership.org




When the impossible suddenly becomes possible

Deon Nel, CEO of the centre-based Global Resilience Partnership, has taken his experiences growing up in South Africa into his career dealing with global development challenges

WHEN IT COMES to understanding the power of change, growing up under the notorious apartheid regime in South Africa counts as a compelling experience. At the time, Deon Nel often felt that this regime was so powerful and entrenched that it would be impossible to change. Through mounting civil society pressure both within South Africa and internationally, coupled with economic and political pressure, the system was eventually dismantled.

“What always amazes me is how quickly this change happened, when it eventually came. In 1987 it seemed South Africa was as far away from a peaceful democracy as it had ever been, and yet a mere three years later Nelson Mandela was released from prison and change was inevitable. Living through that time instilled a belief in me that change is always possible regardless of how impossible it might seem,” he says.



When we work together with grassroots organisations we can put pressure on the political and economic system.

This experience gave him the drive to solve difficult development challenges and work for necessary changes, no matter how hard they are to achieve. For the first time in decades, there has been a slowing and even a reversal of

development trends. With increased extreme weather and geo-political instability, food insecurity is on the rise. This is hitting the world’s poorest and most vulnerable first and hardest. Learning from the fall of apartheid, Nel believes that change really can happen. “When we work together with grassroots organisations we can put pressure on the political and economic system.”

He says, “Transforming people’s lives in these complex contexts will require moving from reactive and often incremental development approaches towards resilience approaches that are proactive and systemic. Most importantly, it will require a shift from treating people at the frontline as victims needing external help, towards joining forces with them as empowered and innovative agents of change within their societies.”

There is credibility to Nel’s words. He has spent most of his career working in and with developing countries, particularly on sustainability and conservation issues. In his previous role as the global conservation director at WWF International, he helped guide WWF’s conservation efforts spanning around 100 countries. He also has experience with developing partnerships between the public sector, private sector and with multilateral development banks. Since Nel took over as the head of the GRP in August 2018, the GRP team has brought together a variety of stakeholders ranging from community groups to insurance companies to mobilise action. “Solutions and innovations already exist. We are looking to tap into these solutions and innovations to share and expand what is already being done to boost resilience in fragile and vulnerable countries and communities.” Working in this way GRP is able to leverage the full potential of the partnership and create a whole that is stronger than the sum of its parts and get back on track to meeting the pledge of “leaving no one behind”.

Guidance for Resilience in the Anthropocene (GRAID)

The start of 2019 marked another exciting year for GRAID in its role as a knowledge partner to the Global Resilience Partnership (GRP), representing the beginning of a strategic alignment process that will see GRAID and GRP integrate into one body of work

AS PART OF a strategic alignment process, GRAID and GRP co-designed, convened and facilitated a series of Deep Dive dialogues that brought together GRP partners and other key stakeholders and served to join these two bodies of work under a single strategic and operational structure. These dialogues have been central in shaping the future direction of the GRP and an initial portfolio of collaborative actions that are being catalysed with GRP partners in its new phase. The Deep Dive process also helped build momentum on resilience towards the UN Climate Action Summit in September 2019, and beyond. The dialogues were also central in identifying different visions of sustainable futures, contextual challenges and initiatives that could contribute to overcoming challenges and building sustainable futures.

In addition, GRAID continued to move other initiatives forward, such as the piloting of the Wayfinder guide in Senegal, and a second pilot in the Khetha project, run by the WWF in South Africa. Before Wayfinder the field of resilience practice was scattered and although a variety of tools existed, none of them explicitly aimed to foster transformative change towards sustainability. Now available free online, GRAID wanted to provide additional support for the uptake and implementation of the Wayfinder approach. To achieve this, two Wayfinder training workshops for development practitioners were hosted, one in Bangladesh in October and one in South Africa in November. Several organisations have expressed interest in using the Wayfinder approach following these training sessions, and these opportunities will be followed up in 2020.

GRAID also provided support in the design and delivery of the SRC-Swedish Institute's Transforming Change programme (pictured). It aims to strengthen the capacity of African changemakers, support peer-peer (South-South) learning, and nudge at the global systems of development practice. Key topics of the programme included SDG synergies, navigating power and gender (in)equity, stretch collaboration (that is, partnering in conflict and insecurity), healing and reconciliation across systems, understanding change from multiple perspectives, organisational cultures of resilience, and more. The first cohort completed one online module and three modules in person (South Africa in March

2019, Rwanda in May 2019 and Ghana in August 2019). A second cohort has now been selected and the online module completed, with in-person modules continuing in 2020.

Additional highlights include providing insight briefs on gender equality and (in)equity, synthesising key lessons and principles for designing transformative spaces in the Global South, and the contributions to the IPBES Global Assessment process, in particular on gender, equity and the implications for the SDGs.

▶ Read more: www.graid.earth





PHOTO: J. BUMROONGCHAI

SwedBio

From a growing collaborative programme to a new director, SwedBio has had a momentous year

IN 2019, SwedBio continued to connect knowledge across sectors, and from local to global processes through participating in a number of international policy events, such as the Convention on Biological Diversity (CBD) and IPBES. SwedBio's collaborative programme involved 34 partner organisations this past year.

Human rights in the CBD post-2020 global biodiversity framework

In 2019, SwedBio continued to support local and indigenous groups' participation in the international policy arena, including the CBD. It also co-hosted a side event at CBD's 11th meeting of the Ad Hoc Open-ended Working Group on Article 8(j) and Related Provisions, an important meeting for ensuring that local and indigenous voices are integrated into the post-2020 global biodiversity framework. The side event, *Human rights for thriving indigenous peoples, local communities and healthy ecosystems in the post-2020 global biodiversity agenda*, was co-hosted alongside the following partners: Asia Indigenous Peoples Pact, Forest Peoples Programme (FPP), International Development Law Organization (IDLO), Natural Justice and the Secretariat of the CBD. This work will continue in 2020 when SwedBio co-hosts another workshop on how a human rights-based approach can enable conservation, sustainable use and fair and equitable sharing of the benefits of biodiversity, and how it can best be included in the CBD post-2020 global biodiversity framework.

Pollinators' dialogue

In January 2019, SwedBio co-convoked a dialogue together with Inter Mountain Peoples Education and Culture in Thailand Association, Pgakenyaw Association for Sustainable Development, UNESCO Natural Sciences Sector and the Karen community of Hin Lad Nai. The dialogue, which revisited key messages from the IPBES "Assessment Report on Pollinators, Pollination and Food Production", contributed to methods of development for co-production

among science, Indigenous and Local Knowledge (ILK), and policy practice. The dialogue also considered revision and uptake of the IPBES pollination assessment as part of a post-assessment. A report from the dialogue provides feedback on key messages with relevance to ILK holders and experts on pollinators and pollination. The report has been published in English, Spanish and Thai.

Marine portfolio

After the expansion of SwedBio's marine portfolio in 2018, 2019 saw most of the on-the-ground work begin to give results. This was done together with the 13 collaborative programme partner organisations: African Women Fish Processors and Traders Network; Blue Ventures; Forest Peoples Programme; Gender in Aquaculture and Fisheries (GAFS); ICLEI Cities Biodiversity Center; International Collective in Support of Fishworkers (ICSF); National Research Foundation, South Africa; Natural Justice; Social Need Education and Human Awareness (SNEHA); Sustainable Development Fund (SDF); Wan Smolbag Theatre Group (WSB); World Conservation Society, Myanmar; and WorldFish.

Within the marine portfolio, one new area of focus in 2019 has been on gender and aquaculture, where two partners, GAFS and SDF, have been focusing their efforts. GAFS is working with aquaculture and seaweed production in Kenya and India as a way to bring gender researchers and other researchers into dialogue with coastal groups, industry, government policymakers and NGOs in order to expand policies related to gender. SDF, based in Thailand, is working to mainstream gender and justice issues in coastal aquaculture in Thailand, Bangladesh and India through establishing a coalition of women as well as policy recommendations. Results from both of these projects can be expected in 2020.

▶ Read more: www.swed.bio



Using computer games to redesign urban areas

How a workshop methodology involving Minecraft helped turn a dumping site into a popular park

Thanks to a workshop methodology involving the popular computer building game Minecraft, a derelict, run-down dumping site in Addis Ababa, Ethiopia, has been turned into a lush and popular park. The Ras Mekonnen urban park was the focus of a creative collaboration between UN-Habitat, the Addis Ababa City Administration, and the Urban Natural Assets for Africa (UNA): Rivers for Life project led by ICLEI Cities Biodiversity Center and funded by SwedBio. During a four-day workshop, city officials and community stakeholders, including women and youth



PHOTO: UN-HABITAT

developed proposals on how the site could be brought back to life. With the help of Minecraft, the participants visualised how the park could look while maintaining biodiversity and important ecosystem services.

Based on the proposals from the workshop, the river tributaries were uncovered, trees were planted and gabions were built to prevent erosion. A playground, lawns, benches, bins, bike lanes and a solar light system were added while a beautiful old fountain was renovated. "The positive effects have been immediate", explains Ellika Hermansson Török,

a senior adviser at SwedBio, "Women with children and the youth nearby have started coming to the park, and the greenery management and administration activity have provided job opportunities to those living in the area".


The workshop methodology involving Minecraft was originally developed by UN-Habitat in collaboration with the game's developer, Mojang. Minecraft is one of the best-selling video games of all time, selling over 175 million copies.

A nice fit

There are many reasons why Henrik Brundin and SwedBio make a good match. The new director offers valuable experience from his time managing development projects across Sweden and Eastern Africa

AMID INCREASING CLIMATE pressures and contrasting governance systems, sustainable development is no simple task. Despite this, Henrik Brundin has made it his life's work to support cooperative and sustainable management of the environment, starting from a local perspective and aiming for a global impact.

“I have been leading international development organisations in the field of natural resource management, sustainable small-scale agriculture and poverty reduction,” he says about his more than 15-years' experience working in East Africa.



I have witnessed first-hand how unsustainable practices lead to loss of fertile land and biodiversity, a situation made worse by the climate crisis and occurrence of extreme weather events

While living in Tanzania and Kenya, he served on the board of directors for several development organisations. Having gained practice and management skills from agroforestry projects, Brundin engaged with the local communities and learned Swahili. He worked to enhance land management that acknowledges the value of trees grown alongside crops for a more sustainable and equitable practice of agriculture.

“I have witnessed first-hand how unsustainable practices lead to loss of fertile land and biodiversity, a situation made worse by the climate crisis and occurrence of extreme weather events,” he says.

Brundin's dedication to sustainable development is not only clear in the trajectory of his work abroad, but also through his actions coordinating several sustainable development projects. He has held the position of deputy CEO for We Effect and Vi Skogen, both of which work to reduce poverty and inequality, and spread knowledge about the benefits of agroforestry. His development work also involved negotiations with international organisations such as Livelihoods Funds and Nordic Climate Fund, in order to increase investments towards the Sustainable Development Goals.

Currently, he is on the board of directors for Fairtrade International in Sweden, which relates to his work on sustainable production and improving livelihoods. Furthermore, he was responsible for developing a methodology for soil carbon offsetting, a technique based on sustainable agriculture land management practices. Considering his extensive experiences with sustainable land management and development practice, it seemed like a natural fit for Brundin to become director of SwedBio in early 2019. He believes in SwedBio's method of working from a local to global level through partnerships with local organisations that represent farmers, fishers, Indigenous Peoples groups and networks focusing on livelihood improvement, biodiversity and climate change.

Despite humanity facing huge challenges, he remains positive and SwedBio is in a unique position to address these issues. “We partner with local organisations and facilitate knowledge exchange through a whole chain of actors that allows us to influence global policy discussions and negotiations. This brings real world, on-the-ground examples to the highest possible political levels, such as the Conference of the Parties on biodiversity and climate,” he says.



The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)

Centre contributes to the IPBES Global Assessment, the world's most up-to-date audit of the state of nature and the support nature provides to human civilisation

IN EARLY MAY 2019, news all over the world covered a report stating that human society is under urgent threat from loss of earth's natural life and that one million species are at risk of extinction. The report, published by IPBES, is the largest and most up-to-date stocktake of the state of nature and the support it provides to humans. More than 145 leading experts from 50 countries – plus contributions from 310 more experts – worked on the report, which was based on some 15,000 references.



PHOTO: WIKIMEDIA COMMONS

“Nature is essential to human well-being and development. We found that declines in biodiversity and ecosystem services will undermine our ability to meet 35 of the 44 Sustainable Development Goal (SDG) targets related to poverty, hunger, health, water, cities, climate, the ocean, life on land,” says centre senior advisor Belinda Reyers. She is among several SRC staff to have contributed to IPBES's work over the years, most recently the new global assessment. Reyers was a coordinating lead author of chapter 3 in the new global assessment, which looked at “progress towards meeting major international objectives related to biodiversity and ecosystem services”. Together with former director Johan Rockström she was also part of an expert group that produced a scoping report that eventually led to the production of the assessment. Centre research fellow Ana Paula Aguiar was a lead author of chapter 5, “Scenarios and pathways towards a sustainable future”. Postdoctoral researcher Odirilwe Selomane was an IPBES fellow who also contributed to chapter 5.

Developing IPBES

Centre staff, particularly SwedBio under the leadership of former director Maria Schultz, were deeply involved in the establishment of IPBES in 2012. Since then staff have contributed in a variety of ways, most recently in connection with the global assessment:

14 MEMBERS OF STAFF have been significantly involved in IPBES in different kinds of expert roles such as coordinating lead authors of assessments, experts in scoping processes, members of expert groups, leads of method developments or members in IPBES's prestigious fellowship programme.

128 SRC PUBLICATIONS are referenced in the IPBES Global Assessment 2019. Of those publications 77 members of staff are listed as lead authors or co-authors.

SRC'S CORE THINKING IS EVIDENT across the different sections of the IPBES Global Assessment 2019. Examples include sections such as “Resilience, adaptability and transformability in social-ecological systems”.

SRC HAS INFLUENCED THE IPBES GLOBAL ASSESSMENT 2019 through different engagements in the interface of science and society. This is, for example, visible in references to the “Arctic Resilience Report”, Future Earth and its project Seeds of the good Anthropocene, “Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems”, the Regime Shifts Database and WWF's “Living Planet Report” 2016 on risk and resilience in a new era. But, even more so through SRC's in-house programmes and significant contributions from SwedBio and GRAID.

ANOTHER INDICATION OF SRC'S IMPORTANT ROLE WITHIN IPBES is that the centre has had three early-career researchers who have taken part in the prestigious fellowship programme at IPBES: Jan Kuiper, Zuzana Harmáčková and Odirilwe Selomane. The programme has very strict selection criteria to ensure balanced geographical and gender representation. These fellows are contributing as experts and are linked to an expert group. So far IPBES has provided fellowships to 79 people from 55 countries, from a pool of 1,116 applicants.

▶ Read more: www.ipbes.net



EAT EAT began 2019 with an answer to its founding question: how can we achieve healthy, sustainable food systems?

THANKS to the work of founding partners and collaborators including 37 scientists from 17 countries, the report “Food in the Anthropocene – the EAT–Lancet Commission on healthy diets from sustainable food systems” was published in *The Lancet* in January 2019. The research offers six strategies to feed 10 billion people healthy and sustainable diets. Cited in 507 scientific papers, the response has broken *The Lancet* Commission media coverage and download records, and won a record number of awards. To meet massive interest, EAT shared the Great Food Transformation narrative through its founder and executive chair, Dr Gunhild Stordalen, as its high-level ambassador to exclusive business, policy and civil society groups. For her work, she received the UN Foundation Global Leadership Award.

Partnerships with policy and business leaders extended the report’s impact across the globe. EAT launched a pilot with the City of Copenhagen and Climate-KIC, using EAT–Lancet guidelines to inform shifts towards healthy and sustainable food environments, procurement practices, public food access and more. At the C40 World Mayors Summit, 14 cities signed the Good Food Declaration, committing to sustainable food policies that will help address the global climate emergency. Internationally, the report has provided a unifying framework for the European Commission’s vision across director generals leading development, agriculture, health, trade and the environment. It has influenced regional work in Colombia and India. EAT’s interdisciplinary Science to Solutions Dialogues informed the logical frame for the One Planet Business for Biodiversity initiative supported by French president Emmanuel Macron and Danone CEO

Emmanuel Faber. EAT’s Food Service Pilot launched, offering food service companies science-based targets to reduce climate impacts like GHG emissions and biodiversity loss.

Other activities in 2019 included:

- The Food Systems Dialogues (FSDs) – co-created by Dr David Nabarro, EAT, World Economic Forum and World Business Council for Sustainable Development – launching and hosted in 25 countries, driving interdisciplinary discussion and coordination towards food systems change.
- A UNICEF and EAT formal collaboration on Children Eating Well (CHEW) to protect and promote young people’s rights to nutritious, safe, affordable, Eat–Lancet-aligned diets.
- As part of the EU Horizon 2020 CO-CREATE consortium, EAT designed and piloted a dialogue tool to engage youth in policymaking on childhood obesity.
- International Federation of Medical Students’ Association adopted a policy elevating EAT–Lancet as a reference for medical curriculums, impacting 1.3 million medical students.

Additional EAT science contributions were included in the “Exponential Climate Action Roadmap”, The Food and Land Use Coalition’s global report and UNICEF’s “State of the World’s Children” report. While 2019 has been a “Super Year in Science”, with urgent calls for the Great Food Transformation, the work is far from done.

▶ Read more: www.eatforum.org/

Launch of US-Swedish initiative on artificial intelligence and sustainability

US and Swedish academia, the Swedish government, Google, Ericsson, USAID, UNDP and UN Global Pulse met to explore how artificial intelligence can – and already is – helping to reach targets related to the UN Sustainable Development Goals

THE EVENT on 15 October 2019 marked the beginning of a new initiative coordinated by the Beijer Institute of Ecological Economics (at the Royal Swedish Academy of Sciences), Princeton University (Princeton Institute for International and Regional Studies) and the Stockholm Resilience Centre. AI Innovation of Sweden, a national centre for applied AI research and innovation, also took part. Centre deputy director Victor Galaz (pictured) is one of the founders of the initiative. He believes there is a need to have a serious discussion across academia, civil society, policy and business about how AI can help expand our planetary

PHOTO: SWEDISH CONSULATE IN NEW YORK



support systems – climate stability, biodiversity and living oceans. Otherwise, he warns, these technologies may well lead to accelerated climate and ecological disruption.

“It is becoming increasingly clear that the world not only needs responsible AI, but planetary responsible AI,” he says.

PHOTO: A. CAUSEVIC



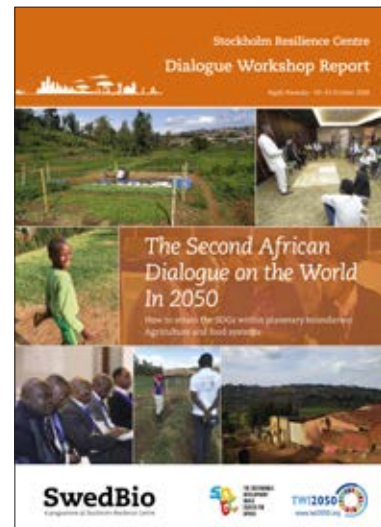
ON 22 NOVEMBER, the Beijer Institute for Ecological Economics and Stockholm Resilience Centre, in collaboration with FutureWork Forum and the Institute for Future Studies, organised a breakfast seminar on the impact AI may have on the environment and the economy. Moderated by Victor Galaz, the seminar included a panel debate with Susanne Ackum (FutureWork Forum), Magnus Nyström (Stockholm Resilience Centre), Pontus Strimling (Institute for Future Studies) and Carina Johed (Planethon).

New report from The World in 2050 initiative

Report from second dialogue on Africa's contribution to reaching the UN Sustainable Development Goals on agriculture and food systems

HOW CAN AFRICAN agriculture and food systems reach the UN Sustainable Development Goals (SDGs) while staying within planetary boundaries? And how do the visions for agriculture and food systems in Africa align with the perspectives expressed in global scenarios? These were among the questions asked during the second dialogue on the role of Africa in reaching the UN SDGs. Taking place in

Kigali, Rwanda in October 2018, the dialogue was organised by the SDG Center for Africa in partnership with SwedBio and Stockholm Resilience Centre. The report from the meeting was published in 2019. As with the first dialogue in 2017, the Kigali follow-up is part of The World in 2050, a global research initiative in support of a successful implementation of the United Nations' 2030 Agenda.



Centre collaborates with L'Oréal on sustainability in the cosmetics industry

The science-business research project with global beauty group L'Oréal will examine the sustainability of L'Oréal's work

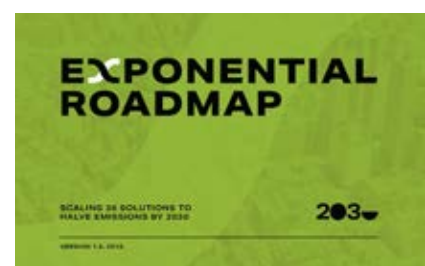
IN 2013, L'Oréal made a commitment that 100% of their products will have an improved environmental or social profile by end of 2020. One objective of the collaboration with the SRC is to assess how well the cosmetics company's current sustainability practices and metrics deal with global environmental problems, using the planetary boundaries as a framework. "The message from global change science to society is increasingly clear: there are limits to the environmental harm our collective activities can cause without societies worldwide feeling the impact. We have to translate our research into terms that businesses can put into practice if we want to work within the 'safe operating space' for humanity," says Sarah Cornell, who leads the L'Oréal-Stockholm Resilience Centre collaboration.

Exponential Roadmap

New report provides 36 sustainability solutions, ranging from solar and wind to electric bikes, commercial shipping and reduced red meat consumption, with the potential to scale rapidly

AHEAD OF THE 2019 United Nations Climate Action Summit in New York City in September, an international group of experts made up of 55 authors from across academia, industry, policy and consultancy published the report "Exponential Roadmap: scaling 36 solutions to halve emissions by 2030". The solutions – ranging from solar and wind to electric

bikes, commercial shipping and reduced red meat consumption – have the potential to scale rapidly. The report highlights four approaching tipping points that combined will accelerate the transformation: growing social movements; emerging political support for more ambitious targets; solar and wind energy have reached a tipping point and are now cheaper than fossil fuels



in many places; and digitalisation and global communications allow more rapid scaling than previous transformations. Johan Rockström, Owen Gaffney and Johan Falk contributed to the report from Stockholm Resilience Centre.

▶ Read more and download the report here: www.exponentialroadmap.org

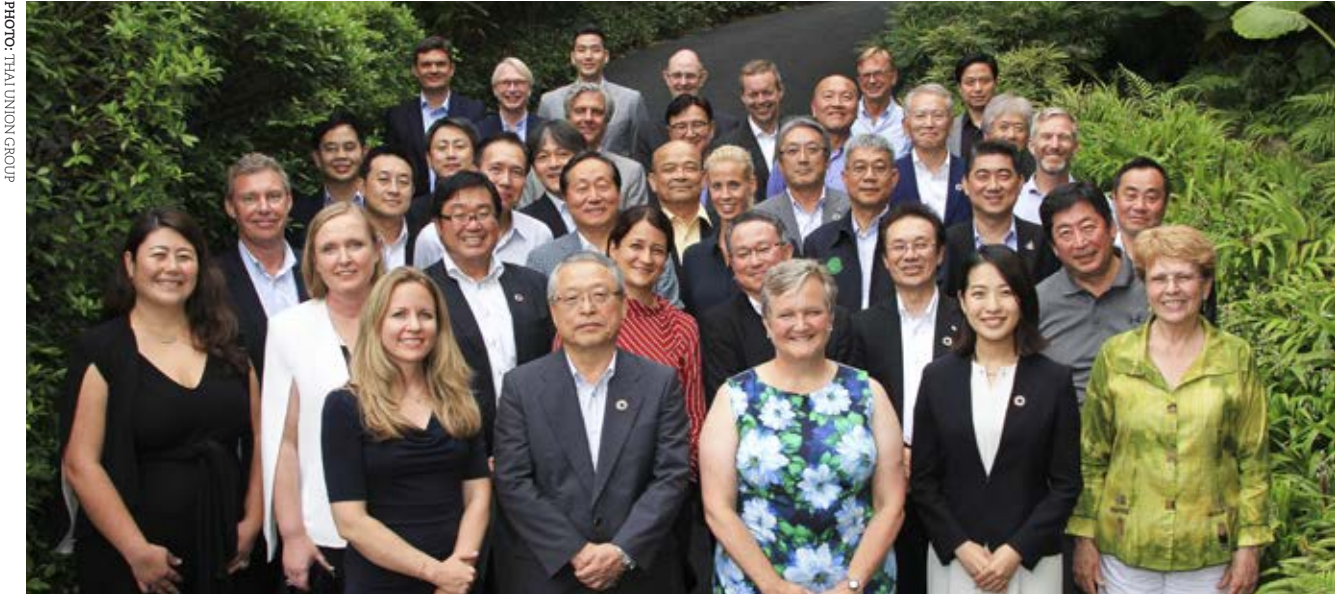


PHOTO: THAI UNION GROUP

Seafood Business for Ocean Stewardship (SeaBOS)

The unique initiative, which brings together the world's largest seafood producers, continues its work towards a more sustainable business sector

IN AUGUST 2019, SeaBOS concluded its fourth member meeting in Phuket, Thailand. The members agreed to connect with invited experts to advance actions on reducing illegal, unreported and unregulated fishing, eliminating forced labour, enhancing seafood traceability and reducing antibiotics use. Members identified the importance of urgently improving regulations associated with fisheries and aquaculture management and ocean pollution – including plastics and climate change. The meeting also established a new task force on Climate Resilience, to address the key impacts of climate change on the seafood industry, while also exploring ways to reduce the carbon footprint of food production. The inaugural chair, Shigeru Ito from Maruha Nichiro Corporation, described the meeting results as increasing evidence of the benefits of collaboration between science and industry.

Parallel to the meeting, SeaBOS and the UN Global Compact Action Platform for Sustainable Ocean Business

announced they are joining forces to accelerate progress on ocean health and governance. The UN Global Compact Action Platform for Sustainable Ocean Business is leading a global multi-stakeholder initiative, addressing both ocean health and ocean productivity. In October, SeaBOS also joined the Global Ghost Gear Initiative, the world's first global platform for tackling abandoned, lost and discarded fishing gear, also known as ghost gear.

About SeaBOS

SeaBOS is the result of a science-based identification of “keystone actors” in global seafood carried out by the Stockholm Resilience Centre in collaboration with the Royal Swedish Academy of Sciences, originally published in 2015. It currently consists of ten of the largest seafood producers in the world, engaged in wild capture fisheries, aquaculture and feeds, with companies based in Europe, North America and Asia. Stockholm Resilience Centre and the Royal Swedish Academy of Sciences are scientific partners to the initiative. It is funded by the members, with support from the Walton Family Foundation, the David & Lucile Packard Foundation and the Gordon and Betty Moore Foundation.



PHOTO: D. CARTER/CEO AUSTRAL

IN JULY 2019, Martin Exel was appointed as the new managing director for SeaBOS. He has a background in fisheries management, working with the Australian government, and has been general manager of environment and policy for Austral Fisheries for the past 23

years. Austral is the first carbon-neutral fishing company in the world. He has also coordinated and chaired the Coalition of Legal Toothfish Operators (COLTO), which has been instrumental in addressing IUU fishing and eliminating seabird bycatch in the Southern Ocean.



Applying resilience at local and regional levels in Sweden

The project “Resilience in practice for Swedish governance” tests and develops methods for how resilience thinking can be used in the strategic sustainability work of local and regional government organisations

THE BROADER AIM of this project is to build capacity of government organisations to deal with the complex and interconnected sustainability challenges we are facing. The initiative builds on recent research showing that resilience practice can contribute to the integration of different Sustainable Development Goals and the ability to adapt to change through more effective systems of evaluation and learning. However, methods for resilience practice need to be tailored to each context. In close collaboration with the participants, this project served to further adapt resilience approaches to the context of local and regional strategic planning for sustainable development in Sweden.

Three municipalities, one region and the EU rural development programme participated in the project. During 2019, civil servants from each organisation participated in two workshops to learn about resilience thinking and practice and share their experiences. Between these two occasions, they carried out pilot activities in their own organisations to test some of what they had learned and share the knowledge with others. Evaluations of the project show that the participants would recommend it to other organisations. The project is carried out together with Albaeco, a research communication organisation, and is funded by Formas, the Swedish government research council for sustainable development.

Media impact

In sheer volume of media articles written about the centre's research, 2019 broke all records

WHEN CONSIDERING all media stories where SRC's work was highlighted but its name not, our media analysis tool picked up 6826 stories in print, online or broadcast. Stories where our name was included amounted to 2953, a slight increase from 2018 (2,660), which was already an exceptional year.

The year started with a bang. The launch of the EAT-Lancet report on healthy food systems generated a massive media impact with at least 4,200 stories published worldwide. In Altmetric's annual analysis of all research outputs published, the report reached 16th place (Altmetric score: 4,633, based on an index that calculates media, blogs, social media and other impact). Given that approximately 3 million academic papers are published each year, this is a considerable success. SRC executive director Line Gordon presented the findings at the press conference for the launch in London at the Wellcome Trust.

But the media success came at a cost. Centre deputy director Victor Galaz analysed the social media impact of the report and revealed that an orchestrated social media backlash in support of meat grew rapidly around the time of the launch. Galaz's analysis in *The Lancet* also indicates the pro-meat campaign may even have had a bigger influence on social media than the campaign run by the institutes involved in the study.

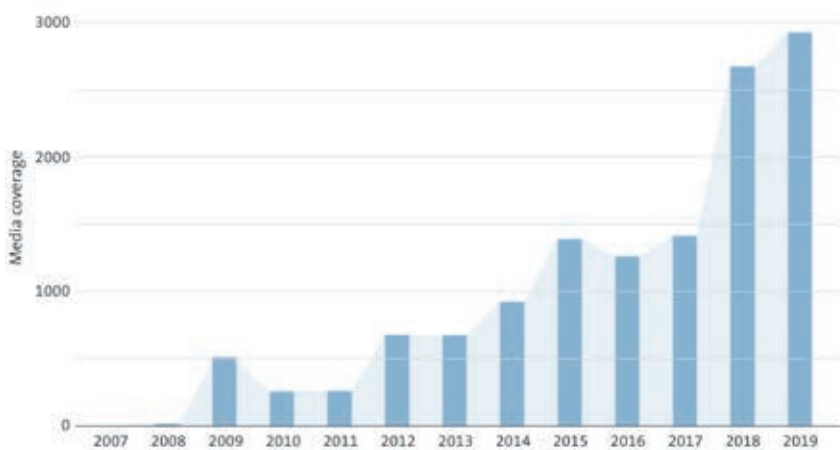
Newsweek's headline, "There's a small, elite group of companies that basically controls the global environment", captured the essence of "Transnational corporations and the challenge of biosphere stewardship", a large analysis of corporate control of the biosphere led by the centre's leadership including Line Gordon, Beatrice Crona, Henrik

Österblom, Carl Folke and Victor Galaz and colleagues, in *Nature Ecology & Evolution*.

The year ended with another bang. An article in *Nature* by centre staff provided a formal mathematical definition of a climate emergency. The article, entitled "Climate tipping points – too risky to bet against", went viral attracting about 740 media articles worldwide and becoming the second biggest climate research story of the year, according to an analysis by Carbon Brief, and the fifth biggest story of the year across all scientific disciplines according to Altmetric database (score 9,052).

And finally, Belinda Reyer's paper in *Science*, "Pervasive human-driven decline of life on Earth points to the need for transformative change", would have topped the list with a media impact of 2,396 according to Altmetric.

Annual stories generated in media



Selected news stories where centre research was highlighted.

Seminars and events

PHOTO: E.FOUJANTHIN



Centre director Line Gordon was the main speaker at the Fridays for Future climate demonstration on 27 September in Stockholm. It attracted 50,000 people and ended in the Kungsträdgården park for concerts and speeches.

#FridaysForFuture: Centre researchers help public awareness

GRETA THUNBERG'S science-based #FridaysForFuture movement has created a global mobilisation against environmental change. It has also encouraged researchers to reach out with their knowledge on the topic. In 2019, Stockholm-based researchers from a wide variety of disciplines set up a weekly "Researchers Desk" in downtown Stockholm to discuss and answer questions from concerned citizens. It started as part of the first global strike in March 2019 but continued throughout the year, including the strikes in September and December. Several centre researchers were involved. The initiative was borne out of former teacher Toya Westberg's concern that climate and sustainability science was not made sufficiently available to schools and to the general public. Today, the initiative is highly sought after. Schools want to know more about climate change and its many implications both on society and individuals. For instance, centre guest researcher Helen Fischer talked to



PHOTO: M. JOHANSSON

secondary school students about climate communication and psychology. She was intrigued by the students' interest and knowledge of the topic. Elsewhere, centre researchers My Sellberg and David Armstrong McKay held one of the most well attended talks on tipping points and transformation during the annual youth activist conference from Power Shift Network.



Stockholm Seminars

In 2019, the Stockholm Seminars celebrated its 200th seminar, highlighting three generations of water resilience researchers at Stockholm Resilience Centre

WHEN THE SRC was launched in 2007 the Stockholm seminars were already an institution. It started in 2000 with the idea of seizing the opportunity when high-level experts came to Stockholm for various meetings and commitments. Since then the seminars have featured prominent experts on global sustainability. The vision behind the seminar has always been to encourage interactions not only within the sustainability science community but also between science

and society as a whole. The seminars are open to the public. With the Royal Swedish Academy of Sciences as a venue, they are hosted by the Beijer Institute of Ecological Economics at the Royal Swedish Academy of Sciences, Albaeco, Future Earth and Stockholm Resilience Centre. In 2009, a celebratory 100th seminar was held. Nine years later, in March 2019, it was time for the 200th seminar. Coinciding with World Water Day, three generations of water



resilience researchers at Stockholm Resilience Centre shared their research and reflections on the multiple ways that freshwater sustains the biosphere and human development.

This included Blue Planet Prize 2018 awardee Professor Malin Falkenmark's life work of articulating water's fundamental role for earth's life support system, innovating the understanding of water scarcity, and propelling the recognition of green water as a valuable and manageable resource; centre director Dr Line Gordon's decade-long research unravelling the critical roles of "invisible" water for social-ecological resilience; and Dr Lan Wang-Erlandsson's account of the newest advancements towards a revised freshwater planetary boundary.

Seminars 2019

6 MARCH

Ecological apocalypse can also be a source of hope: cascading regime shifts within and across scales

Juan Rocha, researcher at Stockholm Resilience Centre

22 MARCH

Water as the bloodstream of the biosphere

200th Stockholm Seminar: with

Carl Folke, director of the Beijer Institute of Ecological Economics of the Royal Swedish Academy of Sciences and science director of Stockholm Resilience Centre at Stockholm University;

Malin Falkenmark, professor at Stockholm Resilience Centre and Stockholm International Water Institute;

Line Gordon, director and associate professor, Stockholm Resilience Centre; and

Lan Wang-Erlandsson, PhD, Stockholm Resilience Centre.

Seminar facilitated by **Louise H. Segerstad**, Stockholm Resilience Centre

28 MAY

The role of narratives in social resilience

Michèle Lamont, professor of sociology and of African and African American studies, Harvard University

21 AUGUST

Deep learning for a better understanding of the Earth System?

Markus Reichstein, director of the Biogeochemical Integration Department at the Max-Planck Institute for Biogeochemistry, Jena

12 DECEMBER

Enhancing food system resilience, with examples from the UK and Australia

John Ingram, University of Oxford

Centre researchers contribute to biosphere exhibition at Stockholm interior design store Svenskt Tenn

THE EXHIBITION, called Welcome to the Biosphere, was a collection of artistic interpretations of the complex relationship between climate change, norms, ethics and economics. All works were produced by Lars Arrhenius and Eric Ericson in collaboration with Svenskt Tenn's curator, Karin Södergren.

Several researchers from the centre and the Beijer Institute of Ecological Economics provided the artists with scientific input and knowledge support.

Svenskt Tenn is owned by the Kjell and Märta Beijer Foundation and the store's entire profit is given to research, education and cultural projects. This includes funding the Beijer Institute. The Beijer Institute is one of the main recipients.



PHOTO: SVENSKT TENN



PHOTO: A. CAUSEVIC

In an attempt to create a “back door” to the COP25 talks in Madrid, the Nordic Cooperation invited the public to watch and participate in a wide range of climate events in relation to the UN climate negotiations. Staff from the centre contributed with talks on sustainable food production, the future of Nordic cities and the future of our ocean. The latter included the exhibition of the Radical Ocean Futures project by Andrew Merrie, which depicts utopian and dystopian marine futures through stunning images designed by concept artist Simon Stålenhag.

Call for ocean action in West Africa



PHOTO: A. MERRIE

STAFF FROM THE SRC'S

communication group were central to organising and facilitating the Blue Oceans Conference in Monrovia, Liberia, 18–21 March 2019, the first of its kind in West and Central Africa. The conference was hosted by the Government of Liberia, the Embassy of Sweden in Monrovia and Conservation International. It was also a strategic follow up to the inaugural United Nations Oceans Conference 2017, co-hosted in New York by the Fijian and Swedish Governments.

The conference in Liberia contributed to fulfilling Swedish commitments to support other countries to move towards reaching the global goal “SDG 14 – Life Below

Water” under Agenda 2030. It brought together over 400 participants from 70 countries and five continents. They included high-level government officials, senior ministers, heads of international organisations, foreign government representatives, civil society, business and private sector, women and youth organisations, as well as community leaders.

Among the many high-ranking officials from Liberia were: Nathaniel Blama, executive director of the Environmental Protection Agency; James Kollie, commissioner of the Liberia Maritime Authority; and Gesler Murray, minister of mines and energy. Swedish high-level representatives included Ingrid Wetterqvist,

ambassador at the Embassy of Sweden in Monrovia; Helen Ågren, ambassador for the Global Oceans at the Swedish Ministry for Foreign Affairs; and Linnéa Engström, vice-chair of the European Parliament’s fisheries committee.

“The conference design was sensitive to both issues of human rights and poverty alleviation and these were considered especially critical in the context of the development of the blue economy as not only being about development of industry but also about finding new alternative livelihoods for Liberia’s poorest,” says centre research liaison officer Andrew Merrie, who was part of the team who designed and delivered the conference.

Education

2019 saw the launch of new education programmes and a number of improvements to existing ones



PHOTO: M. HUITRIC

THE CENTRE'S independent courses allow students from a diverse range of academic and professional backgrounds to engage with what the SRC does. The Världens Eko course continues to attract students with thought-provoking lectures on sustainability. The online course Introduction to Sustainability Science allows students from near and far to study at the centre. The number of applicants far exceeds the

number of spaces on the course. Finally, the course Urban Social-ecological Systems brings academics and practitioners together in discussing and developing urban projects around Stockholm City, providing a rewarding balance of learning and practice for all.

Together with partners in Finland, Latvia and Estonia we launched the first of three intensive four-day courses focusing

on multidisciplinary and practical urban planning and collaboration. The courses bring together 25 of the brightest students from Nordic-Baltic universities on urban development. As part of the first course, they worked together on a real-life planning case, taking on the challenge of developing sustainable cities. This year, the course focused on a district located south-west of Tallinn, characterised by Soviet-period housing, diverse ethnicity and ageing dwellers. Special emphasis was placed on improved health and well-being and their link to nature-based solutions. Overall, the three courses emphasise interaction and co-creation of knowledge and give the students the chance to build vital new networks both with fellow students as well as with experts and practitioners within the field.



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Master's programme in Social-ecological Resilience for Sustainable Development (SERSD)

Students from our master's programme continue to work through their courses while also contributing to SRC

activities. During the UN COP25 meeting in Madrid in December 2019, students Chris Vettos, Kristen Lindström, Nadja Najjar, Naomi Terry and Nick Fitzpatrick provided social media updates from the summit. The second-year students started work on their master's theses, covering a range of topics and cases from across the world. As always, we look forward to their results in the coming year. This year, Stockholm University also launched a mentoring programme to help alumni and students network and boost opportunities to make personal and professional contacts. Already, current students have connected with former students who are now working in academia, the Swedish Society for Nature Conservation and the Swedish Ministry of Foreign Affairs, to name a few. We hope that this programme will support our students as they take their next career steps, and we look forward to learning how SERSD and the SRC have supported past students in their professional lives and how we can further develop this support.

The Resilience Research School

Autumn 2019 was a busy period for the PhD programme coordinators and administrators. The Stockholm Resilience Centre became the first department at Stockholm University to have its PhD programme evaluated. The assessment was part of the process to ensure and develop the quality of Stockholm University's higher education. A report was submitted to the university describing the overall programme design, courses, research environment, measures and processes to ensure high research standards. The report also provided an opportunity to review and reflect on how we can improve our PhD programme. 2019 also saw the introduction of five new promising PhD students: Alice Dauriach, Maganizo Kruger Nyasulu, Maria Schewenius, Arne Tobian, and Emmy Wassénus. We would also like to congratulate Victoria Bignet, David Collste, Johanna Hedlund, Jennifer Hinton, Jean-Baptiste Jouffray, Katja Malmborg, Matilda Petersson, Luigi Piemontese and Jessica Spijkers for successfully defending their licentiate theses this year. 2020 looks set to become an exciting year, with eight PhD defences planned.

Introducing the 2019 PhD class

Alice Dauriach

How do financial markets, large corporations, and financial secrecy interact with the earth system at a global level? Alice Dauriach's project will uncover if and how financial secrecy enables the pursuit of environmentally damaging economic activities, with the risk of disrupting critical biomes and eroding the resilience of the biosphere. Secrecy jurisdictions (or "tax havens"), allow a degree of opacity in global financial markets, which undermines the

enforcement of regulations, the tax revenue of nations and the accountability of government officials. This may ultimately reduce the ability of countries to democratically govern the use of natural commons and to lead the transformation to sustainability in the context of Agenda 2030. The thesis is a collaboration between the GEDB Programme at the Royal Swedish Academy of Sciences and the Stockholm Resilience Centre.



Arne Tobias

How far can we push the planet? The planetary boundaries framework is an intriguing concept that aims at depicting the outer limits of tolerable change to the earth system. But how tight are these different aspects of the earth system interlinked, what feedbacks take place and how would the safe operating space for humanity look if the interactions among individual planetary boundaries were taken into account? Computer models, like the dynamic global vegetation model

LPIML can help provide a better grasp and understanding of how these interactions could look. How strong are they? What happens to the state of other boundaries if one is transgressed? Are there regional differences? Arne Tobias's thesis, carried out in collaboration with the Potsdam Institute for Climate Impact Research in Germany, is part of the Earth Resilience in the Anthropocene project and is inspired by the questions raised above.

Emmy Wassénus

We often hear that we need a food system transformation to change the way we produce and consume food. However, research on food production systems remains siloed within agriculture, animal farming, aquaculture and fishing. In her PhD, Wassénus attempts to break out of this by addressing the global food system as one interconnected system. The project explicitly focuses on the risks to sustainability and human health present in the current system. Using systems lenses such as diversity, connectivity and feedbacks, she addresses emergent risks from our increasingly globalised and

highly connected food production system. A global scale lens helps piece together the implications of a global system on local producers and consumers. It also highlights the variation that exists within food production. Food production is practised both by small-scale, rural farmers and fishers but also in high-tech industrial systems owned by transnational corporations. This variety, both in practices and risks, is one of the complexities we face when trying to understand and change the current system. The project is organised under the GEDB programme at the Swedish Royal Academy of Sciences.





Maganizo Kruger Nyasulu

Attaining the Sustainable Development Goals (SDGs) of eradicating hunger and securing sustainable food for all by 2030 constitutes a major global challenge, particularly in sub-Saharan Africa (SSA). Here, malnourishment, poverty and population growth are the highest in the world, in regions subject to extreme water variability and scarcity. A key question is how much water is required and available to attain the SDGs in SSA now and in future climatic conditions? Nyasulu's project analyses how much green water (infiltrated rain in soil supporting rainfed farming) is available and needed for sustainable intensification of agriculture

in SSA. This is a critical knowledge gap since the SDGs neglect the link between water, food and sustainability. Blue water in irrigation tends, wrongly, to be seen as the path to delivering dramatic increases in food. Based on this Nyasulu will analyse green water management potentials and produce a map of the green/blue water index for SSA. It will be the first attempt at exploring water resilience, and on how to maintain capacity of landscapes to generate ecosystem services and moisture feedback. His research is carried out in collaboration with researchers at Potsdam Institute of Climate Impact Research and US Geological Survey.

Maria Schewenius

How can XR technologies and AI be used as an integrated part of an "urban tinkering" approach to plan and design for urban resilience? Emerging digital technologies offer new possibilities for collecting, analysing and visualising environmental data (environmental intelligence). The development is taking place while cities are both experiencing local effects of the increasing changes to the global earth systems and are the drivers behind many of the changes. Cities have the power to become hubs for desirable social-ecological transformations. However, urban planning is in need of new tools to facilitate the inclusion of more groups and perspectives in the planning process,

for supporting transformations of urban landscapes for sustainability. Schewenius's project will focus on augmented reality and virtual reality (AR and VR, respectively) which together are known as extended reality technologies (XR), and artificial intelligence (AI). It will explore which new opportunities and limitations the technologies offer, or do not offer, in different urban contexts for promoting complex adaptive systems thinking and green, blue and grey innovations, in an almost playful approach known as urban tinkering. The project is carried out in collaboration with the University of Gävle and the University of Exeter.



Current PhD student Yosr Ammar received an award as one of the top 10 early career presentations during the Future Oceans2 Integrated Marine Biosphere Research conference in June 2019 in Brest, France.



Executive programme in resilience thinking

PHOTO: M. SPAREJUS/AZOTTE



Participants 2019/2020, from left to right: Mats Rahmström (CEO Atlas Copco), Sofia Svingby (VP sustainability Atlas Copco), Magnus Billing (CEO Alecta), Henrik Furhoff (CEO IPCO). Sara Öhrvall (chief digital customer experience and communications officer, SEB), Lotta Lyrå (CEO Clas Ohlson), Freddy Sobin (CEO KICKS), Magdalena Gerger (CEO Systembolaget), Malin Sandquist (director corporate, public and legal affairs, Systembolaget), Siv Malmgren (CEO John Mattson Fastigheter), Staffan Pehrson (CEO Nefab), Jerker Johansson (executive chair Blue Water Energy), Klas Balkow (CEO Axfood), Marcus Wallenberg (chair FAM, SAAB, SEB and Patricia Industries), Jonas Samuelson (CEO Electrolux).

OUR EXECUTIVE PROGRAMME in Resilience Thinking ran for a second time, connecting CEOs and board members of large companies to sustainability scientists and experts. This commissioned education programme was well-received by the participants in 2018, and the interest in 2019 was even higher, with more applicants than the course could take in. A novelty this year was that two alumni from 2018 came

back as lecturers, to share how they work towards sustainability – Henrik Henriksson (CEO, Scania) and Karl-Henrik Sundström (CEO Stora Enso).

▶ Read more: www.executive.stockholmresilience.org

PHOTO: N. THAM



BALTICLEAD

The BALTICLEAD programme is a leadership programme funded by the Swedish Institute and hosted by the centre. It is designed to enable participants to address some of the world's biggest social and ecological challenges and explore opportunities to build globally relevant solutions

A group of 18 participants from Armenia, Belarus, Georgia, Lithuania, Poland, Russia, Sweden and Ukraine formed the cohort of

the 2019 BALTICLEAD programme. The participants, including CEOs, founders, academics, NGO leaders and more, brought a wide range of experiences to the two modules of this year's BALTICLEAD programme. The programme is a co-learning experience based on SRC's research and the participants' own expertise, and is designed to enable participants to address some of the world's biggest social and ecological challenges and explore opportunities to build globally relevant solutions.

Centre researcher and director of

BALTICLEAD, Per Olsson emphasises the importance of bringing these participants together, "We contribute with insights from our research and particularly the importance of linking humans and the environment when dealing with innovation that can have an impact at scales that matter in the Anthropocene. It is the participants' individual expertise, shared knowledge and potential impact of the network they themselves create that facilitate opportunities for societal impact and transformation".

The scientific and social-ecological backbone of BALTICLEAD is mixed with tools and concepts useful in entrepreneurial contexts. Over the course of the programme, the participants took part in intensive workshops, presentations, dialogues, games, networking and site visits. Being part of the network is considered a strong source of inspiration to the participants, in learning how to create a safe operating space for both people and planet. "We deliberately design for this, by facilitating learning both on an individual level and for the group as a whole, and by encouraging and fostering networks of change-makers that can achieve transformations towards regenerative futures," Per Olsson says.

▶ Read more: www.balticlead.org

Master's theses 2019

Social-ecological Resilience for Sustainable Development (SERSD)

Nicole Chabaneix

Adaptive co-management for local water resilience: the case of community-led ecosystem-based adaptation in the Peruvian Andes

David Enarsson

Grassroots niches transforming cities toward post-growth futures: A case study of the collaborative economy in Gothenburg, Sweden

Melissa Ingaruca

Synergies of radical paradigms and emerging technologies in knowledge production for transforming the modernist urban design. A focus on artificial intelligence, extended reality and sensor technology

Krisztina Jónás

Beyond 'common sense': unveiling human behavior in nudging and affordance theory and how it informs social-ecological transformation theory

Jenny Kaleinek

Exploring change agent strategies in navigating transformation towards safe and just agri-food systems in South Africa - A case study of the SPAR Rural hub project

Frida Lager

Ain't our business? A study of transnational climate change impacts on Swedish consumption through the lens of Brazilian soy

Sofia Maniatakou

Unraveling diverse values of ecosystem services: a socio-cultural valuation using the Q-methodology in Messenia, Greece

Vivika Mäkelä

Pedagogy and Human-Nature Connection: A case study of two pedagogical approaches and their relation to pupils' human-nature connection in northern Mato Grosso, Brazil

Felix Nasser

Climate-smart cocoa in Ghana: Examining discourses, trade-offs and implications for cocoa smallholders

Moa Olsson

Exploring Social-Ecological Response Capacity to Drought of Swedish Farms

Sophie Plitt

Digital Tools for Urban Green Infrastructure: Investigating the potential of e-tools to inform and engage stewards

Ivan Simon Kallstenius

Patterns of Collaboration for Sustainability in the Global Clothing Industry

Licentiate theses

Victoria Bignet

Social-ecological approaches for assessment of healthy diets from sustainable food systems

David Collste

Navigating towards the Safe Operating Space: Systems thinking and the SDGs

Johanna Hedlund

No environmental problem is an island: Aligning networks of transboundary collaboration to complex policy issue interdependencies

Jennifer Hinton

Profit-Oriented and Post-Growth Economies: Building Theory for Social-Ecological Resilience

Jean-Baptiste Jouffray

From Corals to Corporations: Social-ecological dynamics in the Anthropocene ocean

Katja Malmberg

How on Earth: Operationalizing the ecosystem service

Matilda Petersson

Non-state actors and global fisheries governance

Luigi Piemontese

Global and continental perspectives on the sustainability of future agricultural water management

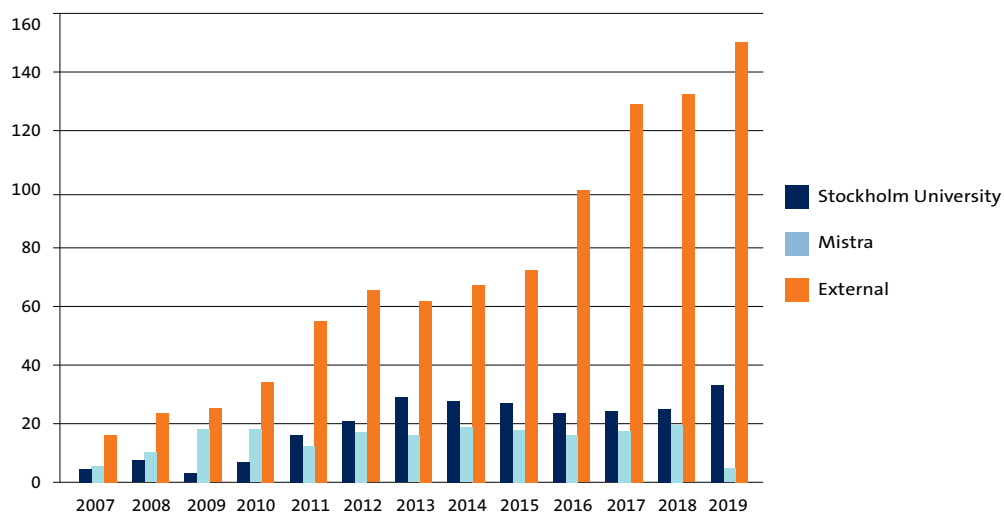
Jessica Spijkers

Identifying Global Patterns of International Fisheries Conflict

Appendix:

Finances

2019 Total	188.3	MSEK
Stockholm University	33.3	MSEK
Allocated fund from Stockholm University	23.3	MSEK
Allocated funds for special aims (from e.g. Bolin Centre for Climate Research, temporary SU core funds)	10	MSEK
MISTRA core grant (remaining funds spent)	4.7	MSEK
External grant total (funds spent)	150.3	MSEK
The Swedish Research Council	12.6	MSEK
Formas	25.3	MSEK
Swedish Environmental Protection Agency	1.6	MSEK
Sida (GRAID/GRP)	27.1	MSEK
Sida (SwedBio)	44.6	MSEK
Nippon Foundation	0.8	MSEK
Walton Family Foundation	2.2	MSEK
The David and Lucile Packard Foundation	1	MSEK
Gordon and Betty Moore Foundation	2	MSEK
Ellen MacArthur Foundation/H&M	2.8	MSEK
L'Oréal	1.3	MSEK
EU	11.4	MSEK
Marianne & Marcus Wallenberg Foundation	2.8	MSEK
Swedish Institute	8.3	MSEK
Johansson Family Foundation	0.9	MSEK
Zennström Philanthropies	0.5	MSEK
Other	7.3	MSEK



Staff

Centre management

Line Gordon, *executive director*
 Victor Galaz, *deputy director*
 Beatrice Crona, *deputy science director*
 Lisen Schultz, *deputy director of transdisciplinarity*
 Carl Folke, *science director*
 Olof Olsson, *managing director*
 Henrik Österblom, *science director*

Administration

Tobias Andersson, *archivist and tech support*
 Astrid Auraldsson, *coordinator to executive director*
 Bengt Hall, *IT-support*
 Gunnar Jacobsson, *IT-support*
 Thérèse La Monde, *financial officer*
 Christina Leijonhufvud, *affiliated administrator (Beijer Institute)*
 Cecilia Linder, *human resources specialist*
 Siv Ericsson, *head of administration (temporary)*
 Susan Norke, *financial controller*
 Johan Gistorp, *head of administration*
 Tanja Litvinova, *financial and HR officer*
 Emina Muratspahic, *head of finance*
 Lina Blomdahl, *office coordinator (consultant)*
 Anette Mack, *human resources assistant (consultant)*
 Lina Mårtensson, *human resources specialist (consultant)*

Practice, Policy and Communication

Eva Brattander, *monitoring officer*
 Owen Gaffney, *director international media and strategy*
 Hannah Griffiths, *communications officer*
 Marika Haeggman, *communications officer*
 Sturle Hauge Simonsen, *head of communications*
 Louise Hård af Segerstad, *communications strategist*
 Helene Karlsson, *communications officer*
 Johanna MacTaggart, *coordinator*
 Andrew Merrie, *communications officer*
 Fredrik Moberg, *senior strategic advisor*
 Jenny Nylander, *event coordinator*
 Ashley Perl, *communications officer*
 Agneta Sundin, *affiliated communications officer (Beijer Institute)*

Modeling and Visualisation lab

Emma Sundström, *system developer*
 Örjan Bodin, *senior lecturer*

SwedBio

Henrik Brudin, *director*
 Pamela Cordero Fannkvist, *financial controller and administrator*
 Daniele Crimella, *programme officer*
 Sara Elfstrand, *programme coordinator*
 Ellika Hermansson Török, *senior advisor (acting director)*
 Claudia Ituarte Lima, *programme officer*
 Pernilla Malmer, *senior advisor*
 Tristan Tyrrell, *programme officer*
 Hanna Wetterstrand, *programme officer*

Guidance for Resilience in the Anthropocene: Investments for Development (GRAID)

Ana Paula Aguiar, *researcher*
 Million Belay, *researcher*
 Eva Brattander, *monitoring officer*
 Andrea Downing, *researcher*
 Zuzana Harmáková, *postdoc*
 Emma Hultgren Ludvigsson, *programme officer*
 Amanda Jimenez, *postdoc*
 Ida Karlsson, *editor, Rethink (temporary)*
 Abdou Ka, *project assistant*
 Jan Kuiper, *postdoc*
 Albert Norström, *researcher (acting director GRAID)*
 Michele-Lee Moore, *director GRAID*
 Belinda Reyers, *researcher*
 Cibele Queiroz, *postdoc*
 Sonja Radosavljevic, *postdoc*
 Odi Selomane, *research assistant*
 Grace Wong, *researcher*

Global Resilience Partnership (GRP)

Anastacia Brainich, *officer*
 Hanna Ellström, *administrative coordinator*
 Ida Gabriellsson, *communications officer*
 Deon Nel, *director*
 Nathaniel Matthews, *senior advisor*
 Maya Rebermark, *head of communications*

Education

Miriam Huitric, *programme director and director of studies (master's students)*
 Tim Daw, *acting programme director and director of studies (master's students)*
 Magnus Nyström, *senior lecturer and director of studies (PhD students)*
 Cornelia Ludwig, *education coordinator*

BALTICLEAD leadership programmes

Cecilia Emilsson, *project coordinator*
 Helene Karlsson, *project manager*
 Nadja Tham, *project assistant*
 Kristina Tysk, *project coordinator*
 Per Olsson, *head of programme*

Research staff

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 Thorsten Blenkner, *senior researcher*
 Örjan Bodin, *senior lecturer*
 Wijnand Boonstra, *researcher*
 Johan Colding, *researcher*
 Sarah Cornell, *researcher*
 Beatrice Crona, *senior researcher*
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 Elin Enfors, *researcher*
 Malin Falkenmark, *senior researcher*
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 Romina Martin, *researcher*
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 Magnus Nyström, *senior lecturer*
 Per Olsson, *researcher*
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 Johan Rockström, *professor*
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 Lisen Schultz, *researcher*
 Hanna Sinare, *researcher*
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 Patricia Villarrubia, *project assistant*
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 Amanda Wood, *researcher*
 Angela Guerreo, *research assistant*

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 Fernando Jaramillo
 Louise Karlberg
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 Åsa Gren
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 Steven Lade
 Vanessa Masterson
 Kirill Orach
 Miina Porkka
 Andrew Ringsmuth
 Juan Carlos Rocha Gordo
 Peter Sogaard Jorgensen
 Arie Staal
 Simon West

Resilience Research School members

Yosr Ammar, *PhD student (SRC staff)*
Supervisor: Thorsten Blenckner

Victoria Bignet, *PhD student (SRC staff)*
Supervisor: Johan Rockström

Emma Björkvik, *PhD student (SRC staff)*
Supervisor: Wijnand Boonstra

David Collste, *PhD student (SRC staff)*
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Linus Dagerskog, *PhD student (SEI staff)*
Supervisor: Johan Rockström

Laura Elsler, *PhD student (SRC staff)*
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Jennifer Hinton, *PhD student (SRC staff)*
Supervisor: Sarah Cornell

Jean-Baptiste Jouffray, *PhD student (SRC staff)*
Supervisor: Magnus Nyström

Niak Koh, *PhD student (SRC staff)*
Supervisor: Thomas Hahn

Sofia Käll, *PhD student (GEDB staff)*
Supervisor: Beatrice Crona

Katja Malmborg, *PhD student (SRC staff)*
Supervisor: Elin Enfors

Megan Meacham, *PhD student (SRC staff)*
Supervisor: Garry Peterson

Kirill Orach, *PhD student (SRC staff)*
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Celinda Palm, *PhD student (SRC staff)*
Supervisor: Sarah Cornell

Matilda Petersson, *PhD student (SRC staff)*
Supervisor: Henrik Österblom

Luigi Piemontese, *PhD student (SRC staff)*
Supervisor: Fernando Jaramillo

Maria Schewenius, *PhD student*
(Gävle University College)
Supervisor: Fredrik Moberg

Chandrakant Singh, *PhD student (SRC staff)*
Supervisor: Ingo Fetzer

Jessica Spijkers, *PhD student (SRC staff)*
Supervisor: Henrik Österblom



PhD council leadership

Alice Dauriach was elected chair of the centre's PhD council for the year 2019/2020.

New staff 2019

Linnea Almroth, *(consultant)*
John Martin Anderies, *researcher*
Abigayil Blandon, *research assistant*
Henrik Brundin, *director, SwedBio*
Eleanore Campell, *computer analyst*
Cecilia Emilsson, *project assistant*
Johan Gistorp, *head of administration*
Angela Guerrero, *researcher assistant*
Lars-Göran Johansson, *researcher*
Anette Mack, *HR administration*
Ana Carolina Marciano, *programme officer, SwedBio*
Lina Mårtensson, *human resources specialist*
Maganizo Kruger Nyasulu, *PhD student*
Laura Pereira, *researcher*
Arthur Perrotton, *project manager*
Agnes Prandindita, *research assistant*
Maya Rebermark, *head of communications, GRP*
Arne Tobian, *PhD student*
Geoffrey Wells, *researcher*



In May 2019, Johan Gistorp was appointed the new head of administration at the centre. Gistorp has a background in economics from Uppsala University. He previously worked as deputy director general for the Government Offices of Sweden.

Guest researchers

Jan-Claas Dajka
Lancaster University

Samuel Zipper
University of Victoria

Obbe Tuinenburg
Utrecht University

Weng Wei
Potsdam Institute for Climate Impact Research

Edgar Fernandez Fernandez
University of Rennes

Jan Bebbington
University of Birmingham

Nuria Descalzo Ruiz
University of Burgos

Maria Reaney
University of Southampton

Iratye Rubio Benito del Valle
University of Vigo

Mario Angst
Eawag: Swiss Federal Institute of Aquatic Science and Technology

Kara Pellow
University of Maine

Clara Larissa Wriessnegger
Carl-von-Ossietzky University Oldenburg

Samuel Zipper
University of Kansas

Francheska Tacke
University of Copenhagen

Alicia Donnellan Barraclough
University of Bergen

Francisco de Vasconcelos
Umeå University

Elisabeth Krueger
Princeton University

Andrew Carlson
Princeton University

Victor Wegner Maus
Vienna University of Economics and Business



As part of a collaboration between Stockholm Resilience Centre, Princeton University and Potsdam Institute for Climate Impact Research, Princeton postdocs Andrew Carlson and Elisabeth Krueger visited the centre in late 2019. Carlson's research is focused on the structure and function of fisheries as coupled human and natural systems while Krueger's research interest is in the evolution of human-environment interactions and in contributing to the transition of society towards sustainability. Both are associated with the Princeton Environmental Institute.



Centre publications 2019

Journal articles

- Adrian, J., M. Amos, M. Baratchi, M. Beermann, N. Bode, M. Boltes, A. Corbetta, G. Dezecache, J. Drury, Z. Fu, R. Geraerts, S. Gwynne, G. Hofinger, A. Hunt, T. Kanters, A. Kneidl, K. Konya, G. Köster, M. Küpper, G. Michalareas, F. Neville, E. Ntontis, S. Reicher, E. Ronchi, A. Schadschneider, A. Seyfried, A. Shipman, A. Sieben, M. Spearpoint, G.B. Sullivan, A. Templeton, F. Toschi, Z. Yücel, F. Zanlungo, I. Zuriguuel, N. van der Wal, F. van Schadewijk, C. von Krüchten, N. Wijermans. 2019. A glossary for research on human crowd dynamics. *Collective Dynamics* 4(A19): 1-13.
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- Baird, J., L. Schultz, R. Plummer, D. Armitage, Ö. Bodin. 2019. Emergence of collaborative environmental governance: what are the causal mechanisms? *Environmental Management* 63(1): 16-31.
- Baird, J., R. Plummer, L. Schultz, D. Armitage, Ö. Bodin. 2019. How does socio-institutional diversity affect collaborative governance of social-ecological systems in practice? *Environmental Management* 63(2): 200-214.
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