



# GLOBAL ECONOMIC DYNAMICS AND THE BIOSPHERE

THE ROYAL SWEDISH ACADEMY OF SCIENCES

*The Erling-Persson Family Academy Programme*

## REPORT 2014



# Introduction and background

This is the second annual report of the Global Economic Dynamics and the Biosphere programme (GEDB). This five-year research programme at the Royal Swedish Academy of Sciences, which is being funded by the Family Erling-Persson Foundation, is addressing the economic dynamics of global change and its implications for a sustainable future.

Beginning at large scale with the Industrial Revolution, human influence is now affecting every aspect of Earth and the biosphere on a scale that matches the great forces of nature. A growing number of scientists believe we have entered a new geological era – the Anthropocene. Since “the great acceleration” in the middle of the 20th century, an expansion of human wellbeing and rapid development of knowledge have taken place. One of the great challenges in the Anthropocene is to continue such positive development in a way that enables existing and future generations, including those still living in poverty, to benefit from this expansion. This requires recognition that in a globalised world, the economy, society, technology and the environment interact in new ways.

A core task is to manage economic development and use of natural resources so as to maximise wellbeing within the frames set by the capacity of the biosphere to sustain this development.

Knowledge about the interplay between global environmental change and human affairs, from local to global levels, is greatly in demand from governments, the business sector and international organisations such as the United Nations. GEDB aims to contribute to a better understanding of this interplay by combining economic studies with a range of disciplines to produce high-quality science of relevance to society. GEDB builds on the recognition that social systems are intricately and inextricably linked to natural systems and embedded in the biosphere. With that viewpoint, any attempts to move towards sustainable futures need to recognise both the social and ecological aspects of sustainability challenges. Much of the research from which GEDB draws its vision and builds its work refers to social-ecological systems, a term we continue to use throughout the remainder of the report.

## Aims and visions

- To create a platform for interdisciplinary scientific collaboration on the challenges of global change and sustainability, with specific focus on how local-to-global, cross-scale interactions affect human wellbeing and the sustainable use of resources.
- To facilitate and promote collaboration between early career economists and scientists from other social sciences and the natural sciences.
- To combine diverse knowledge systems and experiences, and conduct research for a broader understanding about the preconditions and opportunities for sustainable societal development in the new global context.



# Research Programmes

To achieve our key aims, we have created an organisational structure for GEDB which we believe is flexible enough to provide for the emergent and innovative nature of this scientific field, yet strong enough to provide the scientific rigour essential to ensure high-impact scientific work of relevance for society. The three research areas identified previously as priorities for GEDB continue to lead research in the programme:

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## *Macroeconomic models that explicitly consider and integrate the biosphere*

This involves promoting cutting-edge work on economic models based on the recognition that the economic system is embedded in the biosphere. The aim is to integrate the latest developments within economic theory with methods used in sustainability science, as well as creating economic models that include many more environmental factors than existing models in use today.

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## *Trade in, and consumption of, marine resources and the effects on social-ecological systems*

This research area examines how existing and emergent markets affect the functioning of marine social-ecological systems at different scales. It looks at both the social and environmental components of fisheries and aquaculture production systems, and includes studying market structures, actors and commodity chains. Work under this theme will also analyse interactions (local-regional-global) that determine the effects on systems at the different geographical and institutional levels. The fisheries and aquaculture focus is included for two key reasons. First, because trade with marine commodities is significantly less

explored than trade with agricultural products, yet fish is an important aspect in future global food security. Second, marine systems can be seen as a test case in which we develop relevant methods to study cross-scale links between production, trade and consumption, which can then be transferred to other social-ecological systems.

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## *Interactions between financial markets and the biosphere*

This work explores the interconnectivity between global financial processes and large-scale biophysical processes. The work underway explores how financial actors, instruments and flows affect social-ecological processes. Examples include studies on the role of financial instruments for commodities and their possible associations to land use change; and the impact of novel financial instruments for biosphere stewardship.

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The three core areas will provide the creative framework for all research conducted within GEDB. Researchers are free to pursue any research topic under the three broad themes listed above. Collaboration between researchers, both within the programme and those in close partner organisations, Beijer Institute and Stockholm Resilience Centre (SRC), or other international networks, is encouraged. To enable this, GEDB continues to provide funding to develop workshops and working groups, invite key collaborators and participate in conferences and meetings. This framed creativity as an organisational form has proven highly successful for producing excellent, high-impact science at both Stockholm Resilience Centre and the Beijer Institute.

# Research highlights

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## *Rethinking natural habitats*

Protecting wildlife while feeding a global population predicted to reach 9 billion by 2050 will require a holistic approach to conservation that considers human-altered landscapes such as farmland, according to an article in *Nature* co-authored by Gretchen Daily and led by her PhD student Chase Mendenhall at Stanford University.

Wildlife and supporting natural habitats may become an increasingly scarce commodity. Current projections forecast that half Earth's plants and animals will become extinct over the next century because of human activities, particularly agriculture. However, altering agricultural landscapes could play a vital role in nurturing wildlife populations, while also feeding a growing human population.



Gretchen Daily capturing and releasing bats in the forest and farmland of southern Costa Rica.

The *Nature* article shows that a long-accepted theory for estimating extinction rates, predicting ecological risks and making conservation policy recommendations is overly pessimistic. An alternative framework offers more effective ways of accounting for human-altered landscapes and assessing ecological risks, according to the authors.

### *Nature is not an island*

The study examined the well-established biological 'equilibrium theory of island biogeography', whereby landscapes fractured by human development are considered virtually incapable of supporting wildlife, thus driving establishment of nature reserves as the only solution.

To test the "island" theory against a more holistic theory of agricultural or countryside biogeography, populations of bats acutely sensitive to deforestation were studied within a mosaic of forest fragments and farmland in Costa Rica and on lake islands in Panama.

The "countryside theory" performed well whereas the "island" theory failed to accurately forecast bat responses to forest losses in the Costa Rican countryside. It predicted e.g. that Costa Rican coffee plantations would provide inadequate habitat to sustain a single bat species. In reality, they typically supported 18 bat species, compared with 23-28 in tropical forest fragments and nature reserves, indicating that human-altered landscapes can foster more biological diversity than previously anticipated.

### *Conservation and food production need to co-exist*

The study points to the need for new approaches that integrate conservation and food production, making agricultural land more hospitable to wildlife by reducing chemical inputs, preserving fragments of forest and other natural habitats and rewarding farmers for the resulting benefits.

"A theory of countryside biogeography is pivotal to conservation strategy in agricultural ecosystems, which occupy roughly half of the global land surface and are likely to increase in the future", the researchers conclude.

Mendenhall, C.D., D.S. Karp, C.F.J. Meyer, E.A. Hadly, and G.C. Daily. 2014. Predicting biodiversity change and averting collapse in agricultural landscapes. *Nature* 509: 213-217.

### *Missing signals from ecosystem to consumer*

Overfishing and environmental degradation are threatening fish stocks worldwide. With nearly 40 % of all seafood traded internationally, consumers are often far from the ecosystems supplying the fish they buy. To prevent local fishery declines from adding up to large-scale ecological collapses and to promote governance for sustainable development, signals from local ecosystems need to carry through long, complicated food production chains all the way to the consumer. Eco-labelling and eco-certification can guide consumers in some countries

to more sustainable seafood products, but price, the most influential factor for many customers at the fish counter, seldom does.

In an article in the journal *Fish and Fisheries*, Beatrice Crona together with GEDB and SRC colleagues identify factors weakening signals through the value chain. They also present a method to test these mechanisms and propose how the problem can be addressed.

### *Consumers can make a difference*

Rising prices can change shopping habits and reduce demand for, and pressure on, threatened products and stocks. It can also indicate declining supplies and thereby raise awareness of problems in marine ecosystems. However, despite publicity about failing stocks and ecosystems, the consistent availability of fish at affordable prices sends contradictory signals to consumers.

There are several reasons for this. Dwindling catches can be masked by changes in fishing practices such as increased effort, technological advances and fishing deeper or further from shore. Global trade also allows companies to substitute supplies among different regions and among species. Moreover, supply chain structures can exert a downward pressure on fish retail prices, decreasing fishers' earnings rather than increasing consumer prices. Aquaculture adds to the picture as a supplier of substitutable products that may reduce global market prices.

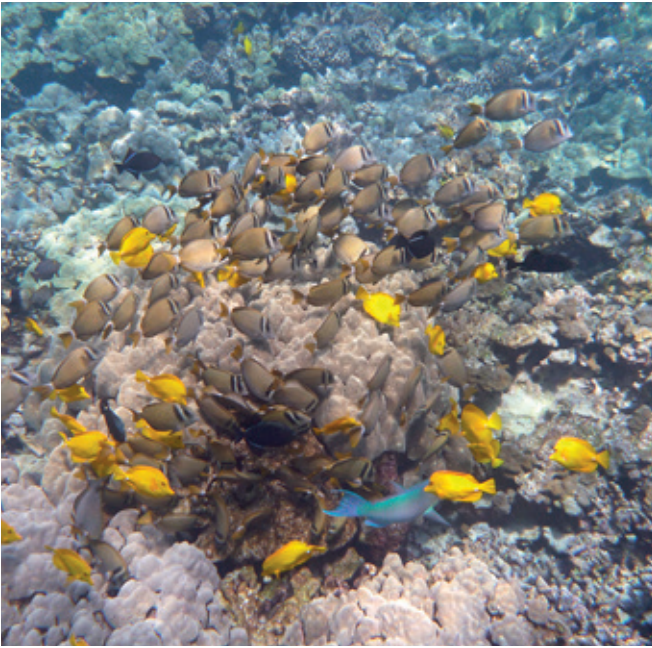
### *Strategies to strengthen signals*

Beatrice Crona and co-authors suggest strategies to address these weakened signals. One way is introducing schemes that track and trace seafood from source to retail in order to guide consumers, along with promoting sustainability certification schemes such as the Marine Stewardship Council. Public awareness can also be raised by targeting public and political actors directly with publicity campaigns or by other 'non-market' means. In addition, the central role of some market actors can be turned in favour of sustainability. For instance by requiring entire value chains to support and demand sustainable practices or by agreeing with other key actors to reduce competition for fish and to promote sustainable fishing. The authors underscore that these strategies in isolation are not enough, and that they should be used in complementary ways.

Crona, B., T. Daw, W. Swartz, A. Norström, M. Nyström, M. Thyresson, C. Folke, J. Sundberg H. Österblom, L. Deutsch, and M. Troell. In press. Masked, diluted, drowned out: Global seafood trade weakens signals from marine ecosystems. *Fish and Fisheries*.

### *Hawaiian reefs through the resilience lens*

With the world's coral reefs endangered by various threats such as global warming, ocean acidification, overfishing and pollution, there is an urgent need to anticipate and prevent further losses of coral and to reverse shifts in already degraded reefs. Avoiding regime shifts in coral reefs is important because they are among the most biologically diverse ecosystems on earth and harbour approximately 25% of all marine species.



Hawaiian coral dominated reef.

Such challenges require a better understanding of the resilience of these complex reef systems and of the human and natural factors threatening them. This is the conclusion of a study in a *Philosophical Transactions* special issue on marine shifts around the world, led by Jean-Baptiste Jouffray.

### *Novel approach reveals the picture*

Using one of the most comprehensive coral reef datasets available, Jean-Baptiste Jouffray and colleagues developed new methodology for detecting, visualising and defining multiple reef regimes across 302 sites in the Hawaiian archipelago. The study offers a promising avenue to use this novel approach for analysing other ecosystems too.

## Activities

### *Magnifying impact*

Gretchen Daily organised two workshops in 2014, one in February and one in October, with researchers from the Natural Capital project, GEDB, SRC, and the Beijer Institute, to integrate resilience and natural capital approaches. The overarching objective is to develop the knowledge foundations and an action plan for greatly magnifying the uptake and impact of ecosystem services, natural capital and resilience approaches by researchers and decision-makers worldwide. A high-level meeting, *Stockholm Natural Capital Solutions Summit*, building on this is being planned for May 2015. This meeting will gather representatives from global business corporations, international NGOs and the science community.

While previous scientific debate has largely been centred around the shift between coral-dominated reefs and the undesired large fleshy algae-dominated reefs, Jouffray and co-workers were surprised to find that over half the reefs studied in Hawaii belong to a third state dominated by turf algae. This raises the question of whether turf-dominated reefs are stable or transitional states moving towards macroalgae dominance or, conversely, towards coral recovery. Time-series data showing changes in the reefs over a period of time will be required to investigate the question further.

### *Like fish, like reef*

Higher numbers of herbivorous (algae-eating) fish proved to be the strongest indicator of reef status throughout the Hawaiian islands. The greater the number of herbivorous fish found at a study site, the healthier the coral and the smaller the algal presence. However, deeper analysis of the fish distribution data revealed that type of herbivore is also important. This opens up an avenue for more refined and efficient management of reefs.

Furthermore, the study found that sewage and other effluents from human settlements were the second greatest factor in reef decline in Hawaii, confirming findings elsewhere.

The study was based on a collaboration with researchers from Stockholm Resilience Centre, the Center for Ocean Solutions at Stanford University, the National Oceanic and Atmospheric Administration, Scripps Institute of Oceanography and Conservation International-Hawaii.

Jouffray J-B, Nyström M., Norström A.V., Williams I.D., Wedding L.M., Kittinger J.N. and Williams G.J. 2015. Identifying multiple coral reef regimes and their drivers across the Hawaiian archipelago. *Phil.Trans. R. Soc. B* 370: 20130268.

### *EAT – a new platform for linking food, health and sustainability*

EAT is a new global long-term initiative with the overall objective of integrating food, health and sustainability, three tightly interdependent areas essential for human prosperity, which are often disconnected in policy, practice and science. On 26-27 May 2014, the first EAT Stockholm Forum was organised as a high-level event, with the aim of initiating collaboration and exchange of knowledge, experience and ideas. From H.R.H. The Prince of Wales to President Bill Clinton, via a wide array of experts on nutrition, non-communicable diseases and sustainable business strategies, the message was clear: what you eat determines not only your health, but also the health of the planet. GEDB researchers were involved in several parts of the EAT Stockholm Forum process, from writing background papers to leading and





Indonesian fishing families answering questions on the abundance of different local fish species.

Beatrice Crona and colleagues from Stockholm Resilience Centre meeting with Swedish Crown Princess Victoria in preparation for the EAT Stockholm Forum.

reporting on several of the small workshops called “Competence Forums”. GEDB Director Carl Folke serves on the advisory board of EAT. On 3 June, a post-EAT Science Workshop was arranged at the Academy by Beatrice Crona, GEDB, Line Gordon, SRC, and Therese Lindahl, the Beijer Institute. Together with Chatham House, one of the world’s leading think tanks, a briefing paper for the 2015 EAT Stockholm Forum is in preparation where GEDB researchers are analysing industry and news messages about perceptions of health and sustainability for an upcoming paper

### *Fieldwork in Indonesia*

From 28 August to 7 September 2014, Eny Buchary and Tracy Van Holt conducted preliminary fieldwork focusing on understanding interactions between terrestrial and aquatic social-ecological systems. Together with an NGO collaborator and local communities, they explored how land use change brought about by oil palm plantation activities may have affected inland fisheries and food security. They learned from fishers about how fish populations have changed and how the relative abundance of most commercially exploited fish has been declining since the 1970s. Larger-sized and more commercially marketable fish species appear to be more available around peatlands. Peatlands seem to offer unique conditions that support fish biodiversity and abundance. In some areas, these peatlands are being affected by oil palm plantations, compromising their role in supporting inland fisheries. The researchers shared their findings with the community in a village workshop and the preliminary results were presented in Mexico, 22–26 September 2014 at the Second World Small-Scale Fisheries Congress. A proposal to expand the study area and scope will be submitted in early 2015.

### *Exploring “big data”*

The programme hosted a one-day workshop on “Big (New) Data” on 3 October to explore innovative approaches to gather large datasets on global phenomena. The seminar explored ways in which the rapid evolution in information and communication technologies can improve the ability to match data on human behaviour and ecological change at relevant spatial and temporal scales. Large sets of data also enable research connecting social-ecological systems across vast scales. As the presentations and applications showed, these new data – ranging from mobile data to Twitter – offer potential for detecting social-ecological regime shifts, changes in ecosystem services and climate change impacts at very large scales.

### *Global social-ecological connectivity*

Globalisation is not only increasing the flows of people, ideas, capital and technology at the global scale, but is also creating novel and large-scale social-ecological connections. Increased global connectivity can create new systemic risks at the global level, as experienced during the 2008-2009 global food crisis and the recent Ebola outbreak in West Africa. However, increased connectivity could also act as an engine for diversity, robustness and innovation as social actors tap into its benefits. A seminar arranged by GEDB at the Royal Swedish Academy of Sciences on 27 November explored these issues together with the 2014 Volvo Environment Prize Laureate Professor Eric Lambin. Professor Lambin, at Université Catholique de Louvain, Belgium, and Stanford University, USA, has for decades been developing methods of analysing satellite images by linking them to socio-economic data.



VICTOR GALAZ



MAX TROELL



GUSTAV ENGSTRÖM



JEAN-BAPTISTE JOUFFRAY

## Staff news

Other speakers were Associate Professor Niki Frantzeskaki, Erasmus University, Rotterdam; Professor Emily Boyd, University of Reading, UK; and Associate Professor Henrik Österblom, Stockholm Resilience Centre. Victor Galaz moderated this half-day seminar.

### *Transforming seafood supply chains*

Tracy Van Holt was awarded a €29,995 seed grant "Toward a more sustainable seafood system: When do innovations make a difference at larger scales?" from the International Social Science Council, which will soon become part of Future Earth. Along with colleague Wendy Weisman she is planning a workshop for January 2015 where several leaders in the seafood industry will share their experiences in transforming their supply chains to be more sustainable. The outcome from the workshop will form the basis for a three-year project application to study relationships and incentives throughout supply chains that foster sustainability.

### *Changing Planet website*

A new platform and steering group to coordinate and enhance synergies for global dynamics research within GEDB, the Beijer Institute and Stockholm Resilience Centre was launched during the year under the name "Changing Planet" ([www.changingplanet.se](http://www.changingplanet.se)). The new initiative and site gathers new articles, events, videos, blogposts and information about projects, with the common theme being "Global dynamics and cross-scale linkages between humans and the rest of the biosphere".

Executive Director **Beatrice Crona** is currently on parental leave (until August 2015) and the programme is being managed by Associate Professor **Victor Galaz**, together with Programme Director Professor Carl Folke. Associate Professor **Max Troell** recently joined the programme part-time to help facilitate the work on marine trade and consumption during Beatrice Crona's leave.

Dr. **Gustav Engström** has recently been recruited to a half-time post to help advance the programme's work on macroeconomic models and the biosphere. Gustav Engström is an economist at the Beijer Institute of Ecological Economics with many years of experience in exploring economic models, complexity and links to social-ecological systems.

**Jean-Baptiste Jouffray**, previously employed as a research assistant in the programme, is now a joint PhD candidate of GEDB, the Beijer Institute and Stockholm Resilience Centre. He has a background in natural sciences, with an undergraduate degree in Biology of Organisms, Populations and Ecosystems from University Paul-Sabatier (France) and an MSc in Ecology from Stockholm University. In his current research, Jean-Baptiste is focusing on marine ecosystems, looking at cross-scale interactions between drivers of social-ecological systems.

Dr. Mark Sanctuary has taken up a new post at the Stockholm School of Economics, but will be affiliated to GEDB part-time (10%) to help strengthen the links between the two institutions. We foresee a number of joint activities for 2015, including lectures and workshops.

As in the previous year, in 2014 the programme hosted four researchers from the Early Career Academy, along with two high-profile senior academics, Professor Gretchen Daily and Professor James E. Wilen. Communication and Finance-HR officers are employed jointly with the Beijer Institute.

A number of research assistants (primarily Master's level students) are employed on short-term contracts to assist programme researchers in collecting and analysing data. This greatly facilitates and speeds up the research process, while simultaneously providing a good opportunity for young scholars to interact with senior scientists and learn from active participation in the research process. As such, it supplies an important training function within the programme.

## COLLABORATORS AND PARTNERS

GEDB has a wide network of collaborators, national and international. Two key national partners are SRC and the Beijer Institute of Ecological Economics.

GEDB also collaborates on issues of marine fisheries and trade dynamics with the Nereus programme, in which the University of British Columbia, Princeton, Duke and Cambridge University are all partners.

Other international institutional collaborations include: The Natural Capital Project, the Woods Institute, the Center for Conservation Biology (all at Stanford University, USA); the Ocean Tipping Point group at the National Center for Ecological Analysis and Synthesis (NCEAS), University of California Santa Barbara, USA; and the UN Sustainable Development Solutions Network (SDSN).

In addition, researchers employed within GEDB collaborate with a large number of scientists at universities across the world.

## LOOKING AHEAD

The Programme continues to explore new terrain at the intersection between economics, global change and economics. We will continue our engagement with the UN Sustainable Development Solutions Network (SDSN) in collaboration with the Earth Institute at Columbia University. Our research on cross-scale dynamics in marine systems including trade continues and has recently expanded to include issues of transformation towards sustainability with support from the International Social Science Council (ISSC) and Future Earth. We are moving into a very intense phase of work with financial markets, and we are launching a seminar series and crash course on the subject in the first months of 2015. Our collaborations with Stanford University researchers continue and a large science-business conference on globalisation, natural capital, resilience and ecosystem services is planned for May 2015, spearheaded by Professor Gretchen Daily.

The GEDB programme is also exploring a number of exciting collaboration opportunities with the Stockholm School of

Economics, including workshops, teaching and co-recruitment of staff. We foresee that this collaboration will help create synergies between the two organisations, with a complementary research focus and international networks.

The collaboration with the NCEAS working group on 'Ocean Tipping Points' to examine tipping points in global ocean ecosystems and the drivers behind these continues, and brings together researchers from GEDB with the marine theme at SRC to facilitate synergistic activities.

The primary communication strategies for the first two years will be geared towards broad dissemination of key research activities and ongoing research online, and targeted dissemination of scientific outputs to relevant academic communities. A programme website will be set up during the first half of 2015.

Finally, the ambition of GEDB is to provide findings relevant to policy and broader society. Staff members regularly interact with policymakers, for example by contributing to reports, making presentations or by direct dialogue.



# Appendix

## STAFF:

Eny Buchary	Early Career Academy Researcher
Beatrice Crona	Executive Programme Director (on leave)
Gretchen Daily	Visiting Professor
Carl Folke	Director
Victor Galaz	Executive Programme Director
Johan Gars	Early Career Academy Researcher
Jean-Baptiste Jouffray	PhD candidate
Sofia-Kristin Kokinelis	Finance and HR administrator
Sofia Käll	Research assistant
Grazzia Maria Matamoros	Research assistant
Matilda Petersson	Research assistant
Mark Sanctuary	Early Career Academy Researcher
Agneta Sundin	Communications Officer
Max Troell	Associate Professor, Researcher
Tracy Van Holt	Academy researcher
James E. Wilen	Visiting Professor

## ADVISORY BOARD

GEDB has an advisory board comprising a number of prominent academics. The role of the advisory board is to advise on strategically important research directions and decisions, and to provide guidance, suggestions, contacts and networks for collaboration. Members of the advisory board are also invited to participate in research endeavours in the form of working groups/workshops with a specific thematic focus.

### Advisory board members:

Neil Adger	University of Exeter
Kenneth Arrow	Stanford University
Scott Barrett	Columbia University
Steve Carpenter	University of Wisconsin
Jane Lubchenko	Oregon State University
Bonnie McCay	Rutgers University
Stephen Polasky	University of Minnesota
Marten Scheffer	Wageningen University

## JOURNAL ARTICLES PUBLISHED:

- Andersson, E., S. Barthel, S. Borgström, J. Colding, T. Elmqvist, C. Folke, and Å. Gren. 2014. Reconnecting cities to the biosphere: Stewardship of green infrastructure and urban ecosystem services. *Ambio* 43(4):445–453.
- Barrett, S., T.M. Lenton, A. Millner, A. Tavoni, J. Anderies, S.R. Carpenter, F.S. Chapin III, G.C. Daily, C. Folke, V. Galaz, T.P. Hughes, A.-S. Crepin, P.R. Ehrlich, N. Kautsky, E. Lambin, R. Naylor, K. Nyborg, S. Polasky, M. Scheffer, J. Wilen, A. Xepapadeas, and A. de Zeeuw. 2014. Climate engineering reconsidered. *Nature Climate Change* 4:527–529.
- Bodin, Ö., B. Crona, M. Thyresson, A.L. Golz, and M. Tengö. 2014. Conservation success as a function of good alignment of social and ecological structures and Processes. *Conservation Biology* 28(5):1271–1379.

- Brauman, K.A., D.L. Freyberg, and G.C. Daily. 2014. Impacts of land-use change on groundwater supply: An ecosystem services assessment in Kona, Hawaii. *Journal of Water Resources Planning and Management*
- Epanchin-Niell, R., and J.E. Wilen. 2014. Individual and cooperative management of invasive species in human mediated landscapes. *American Journal of Agricultural Economics* 97(1): 180–198.
- Frishkoff, L.O., D.S. Karp, L.K. McGonigle, C.D. Mendenhall, J. Zook, C. Kremen, E.A. Hadly, and G.C. Daily. 2014. Loss of avian phylogenetic diversity in neotropical agricultural systems. *Science* 345(6202): 1343–1346.
- Galaz, V., H. Österblom, O. Bodin, and B. Crona. 2014. Global networks and global change-induced tipping points. *International Environmental Agreements: Politics, Law and Economics*
- Gould, R.K., N.M. Ardoin, U. Woodside, T. Satterfield, N. Hannahs, and G.C. Daily. 2014. The forest has a story: Cultural ecosystem services in Kona, Hawaii. *Ecology and Society* 19 (3):55.
- Mendenhall, C.D., D.S. Karp, C.F.J. Meyer, E.A. Hadly, and G.C. Daily. 2014. Predicting biodiversity change and averting collapse in agricultural landscapes. *Nature* 509: 213–217.
- Mendenhall, C.D., L. Frishkoff, G. Santos-Barrera, J. Pacheco, E. Mesfun, F. Mendoza Quijano, P.R. Ehrlich, G. Ceballos, G.C. Daily, and R.M. Pringle. 2014. Countryside biogeography of a neotropical herpetofauna. *Ecology* 95: 856–870.
- Metian M., S. Pouil, A.M. Boustany, and M. Troell. 2014. Farming of bluefin tuna – reconsidering global estimates and sustainability concerns. *Reviews in Fisheries Science & Aquaculture* 22(3):184–192.
- Moksnes, P.O., D.O. Mirera, E. Björkvik, M.I. Hamad, H.M. Mahudi, D. Nyqvist, N. Jiddawi, and M. Troell. 2014. Stepwise function of natural growth for *Scylla serrata* in East Africa: A valuable tool for assessing growth of mud crabs in aquaculture. *Aquaculture Research* 1–16.
- Norström, A. V., A. Dannenberg, G. McCarney, M. Milkoreit, F. Diekert, G. Engström, R. Fishman, J. Gars, E. Kyriakopoulou, V. Manoussi, K. Meng, M. Metian, M. Sanctuary, M. Schlüter, M. Schoon, L. Schultz, and M. Sjöstedt. 2014. Three necessary conditions for establishing effective Sustainable Development Goals in the Anthropocene. *Ecology and Society* 19(3):8.
- Queiroz, C., R. Beilin, C. Folke, and R. Lindborg. 2014. Farmland abandonment: Threat or opportunity for biodiversity conservation? A global review. *Frontiers in Ecology and the Environment* 12:288–296.
- Reimer, M., J. Abbott, and J.E. Wilen. 2014. Unravelling the multiple margins of rent generation from individual transferable quotas. *Land Economics* 90(3): 538–559.
- Rist, L., A. Felton, M. Nyström, M. Troell, R. A. Sponseller, J. Bengtsson, H. Österblom, R. Lindborg, P. Tidåker, D. G. Angeler, R. Milestad, and J. Moen. 2014. Applying resilience thinking to production ecosystems. *Ecosphere* 5(6):73.
- Sandström, A., B. Crona, and Ö. Bodin. 2014. Legitimacy in co-management: The impact of preexisting structures, social networks and governance strategies. *Environmental Policy and Governance* 24(1):60–76.
- Tallis, H., J. Lubchenko, and G.C. Daily (and 237 co-signatories). 2014. Working together: A call for inclusive conservation. *Nature* 515(7525):27–28.

Troell M., R.L. Naylor, M. Metian, M. Beveridge, P.H. Tyedmers, C. Folke, K.J. Arrow, S. Barrett, A.-S. Crépin, P.R. Ehrlich, Å. Gren, N. Kautsky, S.A. Levin, K. Nyborg, H. Österblom, S. Polasky, M. Scheffer, B.H. Walker, T. Xepapadeas, and A. de Zeeuw. 2014. Does aquaculture add resilience to the global food system? *Proceedings of the National Academy of Sciences* 111(37):13257–13263.

Von Heland, F., B. Crona, and P. Fidelman. 2014. Mediating science and action across multiple boundaries in the Coral Triangle. *Global Environmental Change* 29:53–64.

Von Heland, J., and C. Folke. 2014. A social contract with the ancestors – Culture and ecosystem services in Southern Madagascar. *Global Environmental Change* 24:251–264.

## BOOKS:

Rockström, J., M. Falkenmark, C. Folke, M. Lannerstad, J. Barron, E. Enfors, L. Gordon, J. Heinke, H. Hoff, and C. Pahl-Wostl. 2014. *Water Resilience for Human Prosperity*. Cambridge University Press, Cambridge, UK.

## BOOK CHAPTERS

Ebbesson, J., and C. Folke. 2014. Matching scales of law with social-ecological contexts to promote resilience. In: A. Garmestani, and C. Allen, editors. *Social-Ecological Resilience and Law*. Columbia University Press, New York, NY, USA, pp 265–292.

Tallis, H., A. Guerry, and G.C. Daily. In press. Ecosystem services. In: *The Encyclopedia of Sustainability*, Springer, New York, NY, USA.

## ARTICLES IN PRESS:

Blenckner, T., M. Llope, C. Möllman, R. Voss, M. Quass, M. Casini, M. Lindegren, Blenckner, T., M. Llope, C. Möllman, R. Voss, M. Quass, M. Casini, M. Lindegren, C. Folke, and N.C. Stenseth. In press. Climate and fishing steer ecosystem regeneration to uncertain economic futures. *Proceedings of the Royal Society B: Biological Sciences* 282(1804).

Bratman, G.N., G.C. Daily, B.J. Levy, and J. Gross. In press. The benefits of nature experience: Reduced negative affect and improved cognition. *Landscape and Urban Planning*.

Cao, L., R. Naylor, P. Henriksson, D. Leadbitter, M. Metian, M. Troell, and W. Zhang. In press. China's aquaculture and the world's wild fisheries. *Science* 347(6218): 133–135.

Champetier, A., D. Sumner, and J.E. Wilen. In press. The bioeconomics of honey bees and pollination. *Environmental and Resource Economics* 60(1): 143–164.

Conversi, A., V. Dakos, A. Gårdmark, S. Ling, C. Folke, P. Mumby, C. Greene, M. Edwards, T. Blenckner, M. Casini, A. Pershing, and C. Möllmann. In press. A holistic view of marine regime shifts that spans multiple ecosystems and stressors. *Philosophical Transactions of the Royal Society London, Biological Sciences* 370(1665) [published online November 2014].

Crepin, A.-S., and C. Folke. In press. The economy, the biosphere, and planetary boundaries: Towards biosphere economics. *International Review of Environmental and Resource Economics*.

Crona, B., T. Daw, W. Swartz, A. Norström, M. Nyström, M. Thyresson, C. Folke, J. Sundberg H. Österblom, L. Deutsch, and M. Troell. In press. Masked, diluted, drowned out: Global seafood trade weakens signals from marine ecosystems. *Fish and Fisheries*.

Crona, B.I., T.M. Daw, S. Gelcich, X. Basurto, D. Squires, E. Havice, A. Khan, V. Chomo, M. Troell, and E. Buchary. In press. Local-global interactions between SSF and seafood trade: A typology of interaction dynamics. *Marine Policy*.

Crona, B.I., T.V. Holt, M. Petersson, T. M. Daw, and E. Buchary. In press. Using social-ecological syndromes to understand impacts of international seafood trade on small-scale fisheries. *Global Environmental Change*.

Defeo, O., M. Castrejón, R. Pérez-Castañeda, J.-C. Castilla, N.L. Gutiérrez, T. Essington, and C. Folke. In press. Co-management in Latin American small-scale shellfisheries: Assessment from long-term case studies. *Fish and Fisheries* [published online October 2014].

Gould, R.K., S. Klain, N.M. Ardoin, T. Satterfield, U. Woodside, N. Hannahs, G.C. Daily, G.C., and K.M. Chan. In press. A protocol for eliciting non-material values using a cultural services frame. *Conservation Biology* [published online October 2014].

Guerry, A.D., J. Lubchenco, S. Polasky, R. Chaplin-Kramer, G.C. Daily, A. Duraipappah, C. Folke, R. Griffin, J. Hoekstra, P. Kareiva, B. Keeler, S. Li, E. McKenzie, B. Reyers, T. Ricketts, J. Rockström, H. Tallis, O. Zhiyun, and M.H. Ruckelshaus. In press. Natural capital informing decisions: From promise to practice. *Proceedings of the National Academy of Sciences*.

Jouffray, J.B., M. Nyström, A.V. Norström, I.D. Williams, L.M. Wedding, J.N. Kittinger, and G.J. Williams. In press. Identifying multiple coral reef regimes and their drivers across the Hawaiian archipelago. *Philosophical Transactions of the Royal Society B: Biological Sciences* 370(1659) [published online November 2014].

Krause, G., C. Brugere, A. Diedrich, M.W. Ebeling, S.C.A. Ferse, E. Mikkelsen, J.A. Pérez Agúndez, S.M. Stead, N. Stybel, and M. Troell. In press. A revolution without people? Closing the people-policy gap in aquaculture development. *Aquaculture*.

Li, C., H. Zheng, S. Li, X.S. Chen, J. Li, W.H. Zeng, Y. Liang, S. Polasky, M.W. Feldman, M. Ruckelshaus, Z. Ouyang, and G.C. Daily. In press. Impacts of conservation and human development policy across stakeholders and scales. *Proceedings of the National Academy of Sciences*.

Möllman, C., C. Folke, M. Edwards, and A. Conversi. In press. Marine regime shifts around the globe: Theory, drivers and impacts. *Philosophical Transactions of the Royal Society London, Biological Sciences* 370(1665) [published online November 2014].

Österblom, H., and C. Folke. In press. Globalization, marine regime shifts and the Soviet Union. *Philosophical Transactions of the Royal Society London, Biological Sciences* 370(1665) [published online November 2014].

Scheffer, M., J. Bascompte, T. Bjorndam, S.R. Carpenter, L.B. Clark, C. Folke, P. Marquet, N. Mazzeo, M. Meerhoff, O. Sala, and F. Westley. In press. Dual thinking for scientists. *Ecology and Society*.

Scheffer, M., S. Barrett, S. Carpenter, C. Folke, A.J. Greene, M. Holmgren, T.P. Hughes, S. Kosten, I. van de Leemput, D. Nepstad, E.H. van Nes, E.T.H.M. Peeters, and B.H. Walker. In press. Creating a safe operating space for the world's iconic ecosystems. *Science*.

Steffen, W., K. Richardson, J. Rockström, S. Cornell, I. Fetzer, E. Bennett, R. Biggs, S.R. Carpenter, W. de Vries, C.A. de Wit, C. Folke, D. Gerten, J. Heinke, G.M. Mace, L.M. Persson, V. Ramanathan, B. Reyers, and S. Sörlin. In press. Planetary boundaries: Guiding human development on a changing planet. *Science* 347(6223).

Thi Da, C., L.L.H., Phuoc, H.N. Duc, M. Troell, and H. Berg. In press. Use of wastewater from striped catfish (*Pangasianodon hypophthalmus*) pond culture for integrated rice-fish-vegetable farming systems in the Mekong Delta, Vietnam. *Agroecology and Sustainable Food Systems*.

## OTHER:

Plummer, R., L.Schultz, D. Armitage, O. Bodin, B. Crona, and J. Baird. 2014. Developing a diagnostic approach for adaptive co-management and considering its implementation in biosphere reserves. *Beijer Discussion Paper* 245:1–10.

## CONFERENCES, WORKSHOPS AND PRESENTATIONS:

Buchary, E. 2nd World Small-Scale Fisheries Congress, CINVESTAV and Too Big To Ignore Project, Mexico, 22–26 September 2014. Presentation: *Perceptions of small-scale inland fishers on the state of fisheries in Central Kalimantan*, Indonesia.

Buchary, E. Community workshop with members of the fishing communities in the villages of Bereng Bengkel, Kameloh Baru and Danau Tundai, Central Kalimantan, Indonesia. 7 September 2014. Organiser and presentation.

Crona, B. EAT Science Workshop, SRC, Stockholm Sweden. 21 February 2014. Workshop: *SRC research on stewardship of cultural landscapes*.

Crona, B. Global Trends in Fisheries Governance workshop, Swedish Agency for Marine and Water Management, Stockholm, Sweden. 29 January 2014. Advisor.

Crona, B. SPACES project. Next steps meeting/workshop, Askö & SRC, Stockholm, Sweden. 20 October 2014. Organiser.

Daily, G.C. Cambridge University, Cambridge, UK. 19 June 2014. Presentation: *The earth genome project*.

Daily, G.C. Symposium From Sustainable Development to Global Sustainability. Cambridge University, Cambridge, UK. 31 October 2014. Presentation.

Daily, G.C. Design Meeting for the Natural Capital and Resilience Platform, Stockholm, Sweden. 2–3 June 2014. Organizer.

Daily, G.C. Environmental Protection Agency, Stockholm, Sweden. 20 March 2014. Presentation: *Mainstreaming natural capital into decisions*.

Daily, G.C. Joint Seminar of Leipzig Research Community, Leipzig, Germany. 20 November 2014. Presentation: *Science frontiers in natural capital*.

Daily, G.C. Meeting of the Papal Academies of Social and Natural Sciences, Vatican City. 30 April–6 May 2014. Presentation: *Valuing nature in decisions*.

Daily, G.C. Natural Capital Project Advisory and Governing Committee Meetings, Stanford, USA. 22–23 October 2014. Organiser: *Pathways to Impact*.

Daily, G.C. Natural capital Project Annual Meeting, Stanford, USA. 24–28 March 2014. Organiser and presentation: *Strategy*.

Daily, G.C. SRC & Natural Capital Project Workshop, Stockholm, Sweden. 2–7 February 2014. Organiser and keynote speaker: *Where we've come from and the opportunities ahead*.

Daily, G.C. SRC & Natural Capital Workshop II, Stockholm, Sweden. 2–3 October 2014. Organiser: *Workshop on integrating natural capital and resilience approaches into decision-making*.

Daily, G.C. SRC & Natural Capital workshop III. Stockholm, Sweden. 14 November 2014. Co-organiser.

Daily, G.C. World Water Week Symposium, Stockholm, Sweden. 4 September 2014. Presentation: *Targeting watershed investments for multiple benefits*.

Daily, G.C. Xi'an Jiaotong University, Xi'an, China. 21 June 2014. Presentation: *Bringing China's dream to the world*.

Folke, C. SARAS Symposium Imagining resilience: Art-science collaboration for sustainability, South American Institute for Resilience and Sustainability Studies, Maldonado, Uruguay. 15–18 December 2014. Presentation: *Reconnecting to the biosphere: the teleportation project*.

Folke, C. Rhodes University, Grahamstown, South Africa. 2 December 2014. Presentation: *Reconnecting Development to the Biosphere*.

Folke, C. Seeds of the Good Anthropocenes workshop, SAPECS, SRC and STIAS, South Africa. 3–5 November 2014. Keynote speaker: *Anthropocene, Resilience and Transformation*.

Folke, C. STIAS (Stellenbosch Institute for Advanced Study), Stellenbosch, South Africa. 23 October 2014, Presentation: *Social-Ecological Systems, Resilience Thinking, and Sustainability*.

Folke, C. Nelson Mandela University, Port Elizabeth, South Africa. 21 October 2014. Presentation: *Reconnecting Development to the Biosphere*.

Folke, C. University of Cape Town. Cape Town, South Africa. 16 October 2014. Presentation: *Reconnecting Development to the Biosphere*.

Folke, C. Towards an ecosystem-based legal framework for the Baltic Sea symposium. Stockholm University, Stockholm, Sweden. 7 October 2014. Presentation

Folke, C. Breaking the Silos: towards and integrative research agenda on the health and sustainability dimensions of food, EAT Science Workshop. Stockholm, Sweden. 28 May 2014. Presentation: *The Anthropocene Challenge*.

Folke, C. EAT Food Forum. Stockholm, Sweden. 26–27 May 2014. Competence forum EAT Science. Chair.

Folke, C. Resilience and Development: Mobilizing for Transformation, Resilience 2014. Montpellier, France. 5–8 May 2014. Panelist.

Gars, J. WCERE Conference, Istanbul, Turkey. 28 June–2 July 2014. Presentation: *Optimal policy under potential regime shifts and resource scarcity in the economics of climate change*.

Jouffray, J.B. 3-day workshop, Bremen, Germany. September 2014. Presentation: *Identifying multiple coral reef regimes and their drivers across the Hawaiian archipelago*.

Jouffray, J.B. NCEAS Ocean Tipping Points- All Hands Meeting, Honolulu, Hawaii, USA. 19 December 2014. Presentation.


Jouffray, J.B. Resilience 2014 – Conference, Montpellier, France. 4–8 May 2014. Presentation: *Identifying multiple coral reef regimes and their drivers across the Hawaiian archipelago*.

Troell, M. Swedish Agency for Marine and Water Management, SwAM, Stockholm, Sweden. 29–30 January 2014. Presentation: *Global trends in fisheries governance – Improving sustainability*.

Wilén, J.E. International institute of Fisheries Economics and Trade, Brisbane, Australia. 7–11 July 2014. Presentation (2x) and panellist: *Quantifying Impacts of parasitic sea lice and farmed salmonids; Designing pro-poor fisheries management institutions*.

Wilén, J.E. North American Fisheries Society, Quebec City, Canada. 17–21 August 2014. Presentation, panellist: *Bioeconomic drivers of exploitation dynamics in trophic systems*.





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