A Global Collaborative Network for Analyzing Social-environmental Systems

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A proposal for an academic exchange between Princeton University, the Stockholm Resilience Centre at Stockholm University, the Centre for Ecological and Evolutionary Synthesis at the University of Oslo, and the Venice International Center for Climate Studies at the Ca’Foscari University of Venice

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OVERVIEW
The Princeton Environmental Institute (PEI) and the Department of Ecology and Evolutionary Biology (EEB) propose to develop a global research network to foster the analysis of social-environmental systems. Our partner institutes are the Stockholm Resilience Centre (SRC) at Stockholm University, Sweden; the Centre for Ecological and Evolutionary Synthesis (CEES) at the University of Oslo, Norway; and the Venice International Center for Climate Studies (VICCS) at the Ca’Foscari University of Venice, Italy.

Our collective work is aimed at improving our understanding of social-environmental systems, defined as those that include interaction between humans and the earth. Social-environmental issues span many scales, from common pool resource problems in small-
scale artisanal fisheries to the global problem of climate change. At Princeton, we have
strength in theoretical ecology and the climate sciences. But in order to properly address many of the most pressing social-environmental questions, we also need expertise in sociology, anthropology and environmental economics. We are looking to reach out to three institutions that are world leaders in these areas. The resulting international research network will develop our understanding of social-environmental systems in ways that no single institution can do alone; furthermore, this network will broaden and diversify the skill sets within the departments here at Princeton.

Our global network is aimed at fostering collaboration between the researchers and academics/professors at all of the participating institutions, with a focus on an exchange of graduate students, post-doctoral researchers and faculty. Princeton researchers will spend time with our network partners, working with their scientists on new and ongoing projects. In turn, our network partners will send their researchers to us via funds obtained by each participation institution. As a pilot, the first two visiting student research collaborators (VSRCs), from the Stockholm Resilience Centre are currently at Princeton, and we have previously hosted a postdoc from CEES (Oslo) and a VSRC from Venice. Further, three former Princeton postdocs are currently in Stockholm at the SRC. With this global collaborative network, Princeton and our partners will form a nexus for social-environmental research, placing us at the heart of this research field in the US and internationally.

**PROJECT DESCRIPTION**

In the Millennium Ecosystem Assessment, a UN-led study on the world's ecosystems released in 2005, 1400 scientific experts stated that many of the ecosystems that we depend on for human welfare and economic development are deteriorating (MEA 2005). Today, it is estimated that 60 per cent of the world's ecosystems are exploited in an unsustainable manner, and the crucial services that these ecosystems provide, such as air- and water purification, the pollination of crops and the seas' capacity to produce fish, are in serious decline. These changes are occurring so rapidly that societies are struggling to adapt to these new environmental conditions, and are currently unable to effectively develop strategies and frameworks for the sustainable use of ecosystems (Barrett 2013).

The study of **social-environmental systems** focuses on solving these problems (Levin et al. 2012). It is a field that synthesizes knowledge and skills from economics, ecology, sociology, anthropology and political science. This synthesis of disciplines presents a challenge, because it demands that we break down traditional barriers and collaborate across disciplines that heretofore have been separated. Our global collaborative network addresses this challenge by building an interdisciplinary framework for social-environmental scholars of the future: our PhD students and post-docs, giving them the opportunity to work with international leaders in these diverse fields.

Social-environmental science is a relatively young field, mainly because traditional disciplines, such as ecology and economics, have acted separately from one another. A social-environmental perspective, emergent as a synthesis of different fields, provides new insights and solutions. For example in fisheries management, resource economists, rather than marine ecologists, traditionally derived many of the tools used to regulate fishing. These tools rested on simplistic descriptions of ecosystem dynamics, and as a result led to numerous failures in fisheries management (Worm et al. 2009). Over the last decade, however, ecologists and economists have been working together, improving fisheries
management by integrating a deeper understanding of marine ecosystems with an understanding of economics. The result is Ecosystem Based Fisheries Management, which is revolutionizing the way marine systems are governed (Levin and Lubchenco 2008). Most recently, ecosystem-based fisheries managers are interacting with anthropologists and other social scientists to include an understanding of human behavior in fisheries management decision-making. This interaction is essential to further improve fisheries management. At a much larger scale, global climate change is a broad and distributed problem. To understand climate change, physical scientists model ocean and atmospheric dynamics; ecologists study the effects of a changing climate on marine, lentic and terrestrial ecosystems; and social scientists examine how people might respond to climate change, developing novel solutions to the problems that could arise (Dunne et al. 2012).

Climate change and fisheries problems are being attacked from increasingly interdisciplinary perspectives. Similarly, solutions to problems from forestry, water use and other areas depend on broad collaboration. To this end, we aim to build a framework that will allow Princeton scholars to collaborate with researchers from a range of fields, to deepen our understanding of these issues and ultimately contribute to their solutions.

**Network Goals**

Our global collaborative network will develop an environment for cross-disciplinary collaboration, focusing on social-environmental research. The time is ripe for this network, as the field of social-environmental sciences is still developing, and we have an opportunity to place Princeton University at the center of such research internationally. Within this broad objective, our global collaborative network has two specific themes:

- Increased experience for our junior researchers
- The analysis of social-environmental dynamics in marine systems

The first specific goal reflects the motivation of many of our PhD students and post-docs at PEI and EEB, who are looking to kick-start their careers in social-environmental science by expanding their network of collaborators and by learning new skills. The second specific goal reflects two projects we already have with our partner institutes. These are described in more detail in the following sections. Due to these existing research ties, and because we have the support of our researchers, many of whom are already working on shared projects, we believe our global collaborative network will hit the road running from the start, producing novel and important research.

**Who we are:**

PEI and EEB include international leaders of theoretical and applied ecology and environmental science, the marine and atmospheric sciences, and climate policy. Our graduate students and post-docs work on a range of topics, from the behavior of fishermen and its impact on sustainable fisheries management, to elephant conservation, to the financial costs of global climate change. Simon Levin will lead our global collaborative network. He has worked for several decades on problems that have social, economic and ecological dimensions, including substantive interactions with all of the proposed partner institutions. Working with Levin to run our global network will be James Watson, who recently finished a 2-year post-doc with Levin, and is now a permanent Researcher at our network partner, the Stockholm Resilience Centre (SRC). Over the next four years he will split his time between the institutes, maintaining Visiting Scholar status at Princeton.
Watson has worked on several social-environmental projects, at a range of scales, from small-scale fisheries to issues of global governance. As well as building collaborative bridges from Princeton’s end, he is part of the network leadership at our partner, the SRC.

The initiative has the enthusiastic support of Stephen Pacala, the director of PEI, and Daniel Rubenstein, the chair of EEB (see their letters of endorsement). Pacala and Rubenstein are themselves world-renowned social-environmental scientists, and they each have committed matching funds (from PEI and EEB), as complementary support for our global collaborative network.

There are a number of projects ongoing at EEB that connect Princeton and our network partners. Levin and Watson have an NSF-funded project looking at the role of human behavior in fisheries. This is a 4-year project, still in its early stages. It will provide partial support for several graduate students working on these problems, as well as for two new post-docs who will also be working on this project. At least two of the prospective students (Emma Fuller and Andrew Tilman), as well as the two postdocs (Emily Klein and Matthieu Barbier) have all expressed strong interest in spending time at the Stockholm Resilience Centre and CEES, as this will allow them to expand their research into new areas, in particular a comparative analysis of Swedish, Norwegian and American fishermen.

Another project we share is GreenMar – a Norwegian grant held at the Centre for Ecological and Evolutionary Synthesis (CEES) in Oslo. There Dr. Anne-Marie Eikeset (a Levin Lab alumna) is leading an international team of social, ecological and climate scientists studying the arctic. This region is undergoing severe changes, for example in the amount of summer sea ice, and little is known about how arctic countries are likely to respond to these changes. GreenMar is a new 3-year project (still in the final stages of contract approval with Princeton) that has mobility funds for CEES researchers to come to Princeton. We are looking to our global network fund to allow Princeton researchers to make in-kind visit to CEES. EEB PhD student Emma Fuller and current post-doc Juan Bonachela (soon to be faculty at Strathclyde University, UK) are participating in this project.

A broad group of researchers have expressed interest in our global collaborative network. In addition to those already mentioned, Profs. Michael Oppenheimer, Ignacio Rodriguez-Iturbe, Lars Hedin, Jorge Sarmiento, David Wilcove, Naomi Leonard and Corina Tarnita; post-docs Anieke Van Leuwen and Bror Jonnson, and graduate students Eleanor Brush and Lisa McManus, all have expressed an interest in participating in our global network. As a specific example, graduate student Lisa McManus will collaborate with Watson at the SRC on her PhD dissertation, involving research focused on modeling the resilience of the Coral Triangle to increasing ocean temperatures and acidity.

Beyond PEI and EEB, we have strong ties to the Atmospheric and Oceanic Sciences Program, the Woodrow Wilson School, and with Prof. Naomi Leonard at the Department of Mechanical and Aerospace Engineering. Researchers in these units have worked closely with PEI and EEB faculty and students on many social-environmental projects and our global collaborative network will strengthen our joint-work. Lastly, we have strong connections to the National Oceanic and Atmospheric Administration (NOAA) facility – the Geophysical Fluid Dynamics Laboratory (GFDL), with which we have worked closely for several decades.

Many ongoing social-environmental projects at PEI and EEB rely on our collaboration
with GFDL (for example GreenMar with CEES), and through our network, visiting researchers from our partner institutes will have an opportunity to work with GFDL scientists.

Our faculty and researchers at PEI and EEB are already known internationally for their work on ecological and climate problems, and our ambition now is to give our researchers the best opportunity to expand their work into the territory of social-environmental science, by giving them access to world-renowned environmental economists (VICCS), social scientists (SRC) and social-environmental researchers (CEES). We aspire to make Princeton a world leader of social-environmental science, and our global collaborative network will give us the opportunity to do so.

**Our Network Partners:**
Our partner institutes are the Centre for Ecological and Evolutionary Synthesis at the University of Oslo, Norway; the Stockholm Resilience Centre at Stockholm University, Sweden; and the Venice International Center for Climate Studies at the Ca’Foscari University of Venice, Italy. Each of these institutes offer unique contributions to our global network, and all of them are globally known for their research on social-environmental problems.

*The Centre for Ecological and Evolutionary Synthesis* (CEES) is a Norwegian and Nordic Centre of Excellence, employing around 115 persons (including 32 PhD students and 49 postdocs). Our PI there is Prof. Nils Stenseth: the founding chair of CEES, and the current president of the Norwegian Academy of Science and Letters. CEES’s mission is to combine the competence of ecologists, evolutionary biologists, climatologists, statisticians, mathematicians and economists in order to approach major, but still unresolved, scientific challenges. CEES has strong and extensive experience in doing so.

Our global collaborative network will benefit greatly from several ongoing international projects held at CEES that are providing a world class, multidisciplinary research environment. First, CEES is part of a large multi-institute project called NorMER: Climate Change Effects on Marine Ecosystems and Resource Economics. This project involves collaboration among scientists from 10 different institutions who jointly educate 17 PhD students and 8 postdocs on topics related to climate change ([http://www.normer.org](http://www.normer.org)). The focus is on ecology, evolution and economics with a focus on how human communities are to adapt to changing environmental conditions due to climate change. Simon Levin is a member of the international advisory committee for NorMER, and chaired the committee at last year’s meeting.

Secondly, as previously described the project: Green Growth Based on Marine Resources: Ecological and Socio-Economic Constraints (GreenMAR), will address the fundamental challenge of how we use our renewable natural resources more efficiently, while ensuring that ecosystems retain their functionality ([http://www.greenmar.uio.no](http://www.greenmar.uio.no)). The GreenMAR project consists of a network of institutes, spanning ecological and social expertise, which are developing a complex-adaptive-systems approach to management, such that “green growth” is ensured. The project is focusing on Nordic marine systems, which host some of the largest commercial fish stocks in the world, and it includes significant funds for mobility. As part of our global network, CEES will use these funds to send their researchers to us.
The ongoing scientific focus at CEES and the proposed research network are highly complementary, as is evident in the NorMER and GreenMAR projects. Indeed, as already mentioned Levin is on the scientific advisory board of NorMER and is part of the GreenMAR project; our CEES PI - Prof. Stenseth - is a PI on both the NorMER and GreenMAR projects. These existing connections will give our Princeton researchers easy access to these projects. Furthermore, Stenseth is President of The Norwegian Academy of Science and Letters and fellow of several other academies, including the European Science Academy and the French Academy of Science. He is one of the most cited European ecologists with outstanding experience in chairing interdisciplinary and international research teams. Through these roles, Stenseth has trained a large number of students and postdocs who today have established strong research groups of their own (http://www.kees.uio.no/academic-progeny). In our network, our Princeton researchers will benefit from these connections, giving them the best opportunity to internationalize their research.

The Stockholm Resilience Centre (SRC) is a young and unique institution. In 2006, the Swedish Foundation for Environmental Research (Mistra) invested 205 million Swedish crowns (or close to 30 million USD) in the creation of the Stockholm Resilience Centre. The aim was to create a world-leading interdisciplinary research center that advances the understanding of complex social-environmental systems and generates new and detailed insights, and the means for the development of management and governance practices. The Stockholm Resilience Centre advises policymakers from all over the world, and develops innovative collaboration with all relevant actors, from those working at local scales (e.g. pollution in Stockholm), to the global policy arena (e.g. climate change mitigation).

The SRC’s strength is in its broad base of interdisciplinary researchers. Sociologists, anthropologists, economists and biologists all sit at SRC. These researchers have pushed forward our thinking on social-environmental systems and sustainability science. For example, much of the work done at SRC focuses on resilience: the ability for social-environmental system to absorb and recover from disturbance (Folke 2006). In particular, the SRC founded the idea of planetary resilience, focusing on what are called "planetary boundaries" (Rockström et al. 2009). These boundaries delineate a safe operating space of human wellbeing: boundaries exist for ocean acidification, atmospheric ozone, biodiversity, freshwater availability, and chemical pollution. If these boundaries are exceeded, then we risk turning the earth into an inhospitable place. This concept is central to international sustainability efforts, and has gained wide press http://www.ted.com/talks/johan_rockstrom让人们了解环境引导我们发展.html.

The Stockholm Resilience Centre already has strong ties to PEI and EEB through Prof. Levin, who has a history of collaboration with our PIs there – Profs. Carl Folke and Johan Rockström. Indeed, Levin will be on SRC’s scientific advisory board starting later this year. Folke and Rockström are the co-founders of the SRC, both being leadings scientists of social-ecological research. Folke is among the top (no 3-5 in 2011-2013) of the most cited scientists worldwide in the area of Environment/Ecology (Thomson Reuter Essential Science Indicators, 2013). Similarly, Rockström is an internationally recognized scientist on global sustainability issues. He led the recent development of the planetary boundaries framework (see TED talk link above), and has twice been nominated as the “Swede of the
Year” for his work on environmental issues. Together, Folke and Rockström have developed the SRC into an international hub for social-ecological research, where collaboration across social, ecological and economics disciplines is the norm.

Several researchers at SRC are Levin-Lab alumni: Drs. Jon Norberg, Maja Schlüter and James Watson. It is with these already-existing connections that we are looking to strengthen collaborative research ties between Princeton and SRC. As we have already mentioned, several EEB and PEI PhD students and post-docs currently work with SRC researchers, and their participation in our global network will allow them to maintain these links. SRC has obtained funds from the Swedish Research Council to send their PhD students and researchers to Princeton each year. In this the inaugural year, we have two Visiting Student Research Collaborators (VSR Cs) joining us from January-April: Jonas Hentati-Sundbyberg and Helen Moore. For the SRC, our global collaborative network is the first step towards building a larger, international network of institutes studying social-environmental problems. It is important that we join them now, giving us the opportunity to be at the center of this growing network from the beginning.

The Venice Institute for Climate Change Studies (VICCS) is an inter-disciplinary research centre based at the Ca’Foscari University of Venice, focusing on the assessment, detection, quantification, communication and facilitation of sustainable solutions to global change problems. Its mission is to investigate and model the feedbacks between society and the climate system, and provide reliable, rigorous, and timely scientific results to help develop climate change adaptation and mitigation policies. It is a hub of interdisciplinary research, with a focus on business, environmental economics and climate policy.

The University of Venice has a strong tradition in a number of relevant fields: environmental economics, resources management, adaptation and mitigation policy, risk analysis, paleoclimatology, renewable energies, and human health. The University of Venice is able to bring together a vast range of high quality expertise in these areas at VICCS; which serves as a nexus for these different departments. VICCS is led by our network PI – Prof. Carlo Carraro, a Professor of economics and the current president of the Ca’Forcar University of Venice. He is also a Princeton alumnus, having attained his PhD here. Carraro has long worked to integrate ecology and economics together to answer questions of climate change. This long-standing goal is manifested in VICCS, where faculty with a spectrum of skills analyze a range of topics. In addition, VICCS’s staff also are heavily linked to policy creation at national and international levels, being represented at the Euro-Mediterranean Center on Climate Change (http://www.cmcc.it/), the leading Italian research institute on climate science and policy.

VICCS also manages several training and education programs. In 2008 the University of Venice started the Graduate School in Global Change Science and Policy, in collaboration with the Euro-Mediterranean Center on Climate Change, the University of Salento and University of Sassari, with the aim of promoting and coordinating advanced studies on climate change impacts and policy. Based at the Department of Economics at the University of Venice, the school supports and organizes advanced training and research activities with an emphasis on the development of innovative management strategies for both physical and socio-economic climate related problems. One Carraro student, Alessandro Tavoni, spent more than a year visiting Princeton while completing his Ph.D. studies, so this pathway also has a demonstrated feasibility. Our Princeton graduate students and post-docs will have the opportunity to take classes while at VICCS, and be
involved in the interdisciplinary research going on there.

WORK PLAN
Our global collaborative network will be overseen by: Profs. Simon Levin, Nils Stenseth, Carl Folke, Johan Rockström and Carlo Carraro. We will further strengthen our network by including a junior co-leader at each institute, who will help it operate. These co-leaders are Drs. James Watson (Princeton/SRC), Maja Schlüter (SRC), Anne-Marie Eikeset (CEES) and Mauro Cannone (VICCS). Together, the network leaders and co-leaders will operate the global network in three main areas:

1) The exchange of graduate students, post-docs and faculty,
2) Participation of researchers at international conferences,
3) An interdisciplinary conference at Princeton University.

In response to an annual call for application (without a deadline), Princeton graduate students and post-docs who wish to spend time at our research partners will send 1-page applications, describing what they propose, with whom they want to collaborate and why it would be important to their studies/research. Applications can be submitted at any time, and can be for visits ranging from a few weeks to a few months. We anticipate strong involvement from PEI and EEB, for we have a number of research projects ongoing with our partner institutes, and a number of PhD students and post-docs have already confirmed that they will apply, if funds become available. Although the focus of our network will be the exchange of graduate students and post-docs, we will also support the exchange of faculty and other senior researchers. Depending on the level of demand, Levin and Watson will be responsible for establishing an evaluation process.

As well as sending Princeton participants to our research partners, we will also serve as hosts, at the expense of our partners. As documented above, all three of our partners have sent researchers in the past, and plan to send more. All network partners are committed to supporting the costs of visiting Princeton, including living expenses and bench fees, and Princeton hosts are committed to providing desk space and logistic support (e.g. computer help, library access). Our partners have already identified funds that will allow their researchers to continue to spend time at Princeton in subsequent years. CEES has funds from Nordforsk (the Norwegian research council; http://www.nordforsk.org/en) under the collaborative grant “GreenMar”. The SRC has funds from the Swedish Research Council (Vetenskapsrådet; http://www.vr.se/) and VICCS has internal – University of Venice – funds. This support will sponsor their graduate students and post-docs to visit Princeton as VSRCs and Visiting Collaborators. At our end, obtaining the global collaborative network fund will allow us to complete the exchange, by sending our researchers to our network partners. This is fundamental to operationalizing PEI and EEB’s social-environmental science aspirations.

In parallel to the exchange of PhD students and post-docs, we want to support the participation of Princeton researchers at international conferences. This will help develop their careers, as well as internationalize Princeton University. We request funds that will support visits to multiple conferences each year. Like the research visits to our network partners, there will be an open call for conference funds, and Levin and Watson will establish a committee to evaluate these.

The third part to our global network is the creation of a conference on social-environmental
research. This will start in the first year of operation as the annual meeting, held at Princeton, of our network partners. Here, we will review and plan for our collective research. In subsequent years, we will invite research groups from outside our network who are leaders in social-environmental science more broadly. Many of us already have links to these other groups, and we anticipate significant interest and participation. In the last year of funding, we will also invite management agencies, technology companies and educational institutes in an effort to broaden the impact of our research. By connecting to management agencies like the National Oceanic and Atmospheric Administration (NOAA), technology companies like Google (their Ventures lab), Ideo (a leading design agency), the Changing Places Research Group (MIT Media Lab), Tesla (an electric car company), and Siemens (clean tech/sustainable infrastructure renewables), as well as educational institutes like local high schools and colleges, we will (1) develop solutions to real-world social-environmental problems using our research, and (2) foster a unique environment for social-environmental education.

Timeline:
2014  
- April: call for applications for research visits and conference participation. 
  Network partner PIs will meet online and formally initiate our global collaborative network.
- Aug-Dec: first cohorts of Princeton researchers visit network partners.
2015  
- March: first annual meeting at Princeton University involving network partners only.
- Research visits and conference participation continues.
2016  
- March: second annual meeting / conference at Princeton University, outside guests and groups are invited.
- Research visits and conference participation continues.
2017  
- March: final annual meeting / conference. Outside group invitations are continued, with expansion to those from the private sector and also local educational institutes. We will also explore sources of funds to support our annual social-environmental science conference in the future.

Visibility and potential future participants:
We will create a website that provides information about our global collaborative network options. The website will describe our network partners and alumni; will highlight key collaborative research; provide information on the annual meeting/conference and explain how to apply for the various funds (for the extended stays at our network partners, and participation at conferences). Furthermore, throughout the year we will make regular announcements about our network opportunities through email blasts and other mechanisms.

Several of our researchers (here and at our network partners) have already expressed interest in being involved in our network. Here is the list (ss = senior scientist, pd = post-doc, gs = graduate student):

Princeton: Jorge Sarmiento (ss), Stephen Pacala (ss), Michael Oppenheimer (ss), Ignacio Rodriguez-Iturbe (ss), Naomi Leonard (ss), Daniel Rubenstein (ss), Lars Hedin (ss), David Wilcove (ss), Corina Tarnita (ss), Juan Bonachela (pd), Anieke Van Leuwen (pd), Emily Klein (pd), Matthieu Barbier (pd), Emma Fuller (gs), Andrew Tilman (gs), Eleanor Brush (gs), Lisa McManus (gs).
**SRC:** Maja Schlüter (ss), James Watson (ss), Juan Carlos Rocha (pd), Steven Lade (pd), Marc Metian (pd), Eny Buchary (pd), Wijnand Boonstra (pd), Andrew Merrie (gs), Emilie Lindkvist (gs), Susa Niiranen (gs).

**VICCS:** Mauro Cannone (ss), Carlo Barbante (ss), Carlo Giupponi (ss), Andrea Critto (ss), Silvio Giove (ss), Simona Masina (ss), Chiara Mio (ss), Antonio Nawarra (ss), Marcello Vichi (ss), Animesh K. Gain (pd), Elena Argiriadis (gs), Barbara Bendandi (gs), Shouro Dasgupta (gs), Fabio Farinosi (gs), Azizul Hague (gs), Irene Mavilia (gs), Daniele Peano (gs), Fabio Polo (gs), Michela Segnana (gs).

**CEES:** Anne Maria Eikeset (ss), Andries Richter (ss), Florian Diekert (pd), Thomas Svennungsen (pd), Barbara Fischer (pd), Yngvild Vindenes (pd), Elisabeth Thuestad Isaksen (gs), Giovanni Romagnoni (gs).

**SUMMARY**
In summary, we propose to develop a global collaborative network for social-environmental research. We will focus on the exchange of graduate students, post-docs, and faculty, giving them the opportunity to work with leaders of a range of fields relevant to social-environmental research. We will strengthen existing ties with three institutes, each renowned for their work on different aspects of social-environmental science: the Stockholm Resilience Centre, the Centre for Evolutionary and Ecological Synthesis and the Venice Institute for Climate Change Studies. Our network will give our students and researchers the best opportunity to develop cutting edge research, and realize PEI’s and EEB’s ambitions to be global leaders of social-environmental science.