# 2014 Annual Report

# GreenMAR

## GREEN GROWTH BASED ON MARINE RESOURCES: ECOLOGICAL AND SOCIO-ECONOMIC CONSTRAINTS

## APPLICATION INFORMATION

**Call:** Collaboration Projects Green Growth in an Era of Climate Change

**Application title:** Resource-based green growth under climate change: Ecological and socio-economic constraints (ResGreen)

**Project title:** Green growth based on marine resources: Ecological and socio-economic constraints (GreenMAR)

**Application id:** 61582

**Submitted by:** Nils Chr. Stenseth

**Reporting period:** 01.04.2014-31.12.2014

## PARTICIPANTS

**Overview of participants:** Per country, gender, type of participant (team leader, involved researcher, other participants, numbers in total).

| Name | Position | University affiliation | Citizenship |
|---|---|---|---|
| Nils Christian Stenseth | PI/Node leader | University of Oslo (CEES) | Norwegian |
| Anne Maria Eikeset | Co-PI/Cluster Leader | University of Oslo (CEES) | Norwegian |
| Joël Durant | Researcher | University of Oslo (CEES) | French |
| Leif Christian Stige | Cluster Leader | University of Oslo (CEES) | Norwegian |
| Marcos Llope | Researcher | University of Oslo (CEES) | Spanish |
| Florian Diekert | Collaborator | University of Oslo (CEES) | German |
| Sissel Jentoft | Collaborator | University of Oslo (CEES) | Norwegian |
| Kjetill Jakobsen | Collaborator | University of Oslo (CEES) | Norwegian |
| Tore O. Elgvin | Communicator of Science | University of Oslo (CEES) | Norwegian |
| Kristina Kvile | Collaborator | University of Oslo (CEES) | Norwegian |
| Giovanni Romagnoni | Collaborator | University of Oslo (CEES) | Italian |
| Bastiaan Star | Collaborator | University of Oslo (CEES) | Dutch |
| Anna-Marie Winter | PhD Student | University of Oslo (CEES) | German |
| Jon Ove Hagen | Node leader | University of Oslo (Geo) | Norwegian |
| Thorben Dunse | Post-Doc | University of Oslo (Geo) | German |
| Andreas Kääb | Collaborator | University of Oslo (Geo) | German |
| Thomas Schuler | Collaborator | University of Oslo (Geo) | Norwegian |
| Carl Folke | Node Leader | Stockholm Resilience Center (SRC) | Swedish |
| Thorsten Blenckner | Cluster Leader | SRC | German |
| Susa Niiranen | Post-Doc | SRC | Finnish |
| Emma Björvik | PhD student | SRC | Swedish |
| Wijnand Boonstra | Cluster Leader | SRC | Dutch |
| Henrik Osterblom | Collaborator | SRC | Swedish |
| James Watson | Collaborator | SRC | English |
| Matilda Valman | Post-Doc | SRC | Swedish |
| Maja Schlüter | Collaborator | SRC | German |
| Saskia Otto | Collaborator | SRC | German |
| Brynhildur Davidsdottir | Cluster Leader & Node Leader | University of Iceland | Icelandic |
| Ragnar Arnason | Advisor/Mentor | University of Iceland | Icelandic |
| Dadi Mar Kristofferson | Collaborator | University of Iceland | Icelandic |
| Gudrun Marteinsdottir | Collaborator | University of Iceland | Icelandic |
| Niall McGinty | Collaborator | University of Iceland | Irish |
| Gunnar Olafur Haraldsson | Advisor/Mentor | University of Iceland | Icelandic |
| Fredrik Salenius | PhD Student | University of Iceland | Finnish |
| Sigurður Eyberg Jóhannesson | PhD Student | University of Iceland | Icelandic |
| Conor Byrne | PhD Student | University of Iceland | Irish |
| Simon Levin | Node leader | Princeton University | American (USA) |
| Malin Pinsky | Collaborator | Princeton University | American (USA) |
| Dane Klinger | Researcher | Princeton University | American (USA) |
| Emma Fuller | Collaborator | Princeton University | American (USA) |
| Juan A. Bonachela | Researcher | University of Strathclyde | Spanish |
| Andries Richter | Researcher | Wageningen University | German and Dutch |
| Ludmila Artemieva | Researcher | Moscow State University | Russian |

| | | | |
|---|---|---|---|
| Elena Rovenskaya | Collaborator | Moscow State University/ IIASA | Russian |
| Vera Timofeeva | Collaborator | Moscow State University | Russian |
| Elena Grigorenko | Collaborator | Moscow State University | Russian |
| Sergey Kryazhimskiy | Collaborator | Moscow State University | Russian |
| Alexey Smirnov | Collaborator | Moscow State University | Russian |
| Webjørn Barstad | Collaborator | Havfisk AS (formerly Aker Seafoods) | Norwegian |
| Dr. Cecilie Mauritzen | SAB (chair) | CICERO, Oslo | Norwegian |
| Prof. Marc Mangel | SAB | University of California, Santa Cruz | Canadian |
| Prof. Fiorenza Micheli | SAB | Stanford University | Italian |
| Prof. Sir Partha Dasgupta | SAB | University of Cambridge | Bangladeshi |
| Prof. James Wilen | SAB | University of California, Davis | USA |
| General Secretary Nina Jensen | SAB | WWF Norway | Norwegian |
| Anna Mazzarella | Administrative staff (Scientific Coordinator) | University of Oslo (CEES) | American (USA) |
| Camilla Tømte | Administrative staff | University of Oslo (CEES) | Danish |
| | | | **= 57 in total** |

**Totals:**

**By Type of Participant:**
Cluster Leaders: 5
Node Leaders: 5
Researchers: 6
Post-Docs: 3
PhD Students: 5
Collaborators: 23
SAB: 6
Admin: 2
Other: 2

**By Gender:**
Female: 21
Male: 36

**By Nationality:**
Norwegian: 12
French: 1
Spanish: 2
German: 7.5
Finnish: 2
Swedish: 4
Danish: 1
Dutch: 2.5
Icelandic: 6
American (USA): 6
Irish: 2
Italian: 2
Canadian: 1
English: 1
Russan: 6
Bangladeshi: 1

# SCIENTIFIC REPORTING

## 1) Progress and research results

***Status compared to project plan:***

At GreenMAR we have a goal to train a new generation of scientists, so our first priority was to hire our new PhD students and Post-Docs. We are happy to report that all positions are now filled, which is always the first major hurdle to clear. This can be quite time consuming, particularly in Nordic countries, and has resulted in a few delays (more details below) but we are very happy that all positions are now filled with good and well-qualified applicants, and we are now ready for all projects to begin.

The first step for GreenMAR was the Kick-Off meeting held in Oslo on the 26th and 27th of May, 2014. We had almost 50 people in attendance, including several members of the Scientific Advisory Board (SAB) and almost all of the Cluster Leaders and Researchers who were hired on the project and involved in writing it. The first day, everyone introduced himself or herself and we also had longer introductions from Nils Chr. Stenseth as the GreenMAR PI, Jostein Sundet representing Nordfork, Olav Holst-Dyrnes talking about Havfisk, and Nina Jensen introducing us to WWF Norway. This was extremely helpful and got everyone on the same page. The GreenMAR node leaders also had short introductory talks, as did each researcher and Post-Doc, which was really to get all the skills present in the room on the table. We also had a presentation from Cecilie Mauritzen as the head of the SAB, so that before starting the project, everyone involved in GreenMAR at this stage got a good idea about what was expected of them by the SAB. After all of the introductions were done, on the second day of the meeting we had something called the Market of Ideas, where the different research Clusters met in small groups in order to start planning collaborative projects and papers, and plan where they would like their work to take them over the GreenMAR funding period. The groups were in the same room and the setting was such that people could move freely if they were part of more than one cluster, or just to learn about or give input to other groups. Each group had to answer pertinent questions such as: What are the research challenges? Where are the opportunities? What can I contribute? We think it is essential to take on these questions as early as possible, particularly for such a short project, in order to start working together with common expectations and common goals. This led directly to the planning of a policy forum on blue growth that we hope will take place sometime in 2015. We also discussed the Summer School in Moscow (see more below on the collaboration with our Russian partner). We think that our Kick-off meeting was highly successful and we were extremely happy to have so many participants who worked together to come up with interesting plans for future collaborations.

On a regular basis GreenMAR members discuss via email, and have smaller within-Cluster or within-Node meetings, particularly when they are taking advantage of mobility finding and researchers or students are visiting other GreenMAR nodes. Additionally we had a Cluster Leader meeting over Skype in November 2014 to keep tabs on the progress, first individual meetings between each Cluster Leader with the Scientific Coordinator, and then a joint meeting with all Cluster Leaders. We plan to continue to have meetings like this with the Cluster Leaders and the Scientific Coordinator, hopefully quarterly, to keep on track as well as to lend whatever administrative support is needed to the Clusters. So far this has been extremely useful as we were able to help with some hiring problems in Iceland (more information on this below) and Wijnand Boonstra also had the good idea of having the next Cluster Leaders meeting be in-person, and to have all the newly hired Post-Docs and PhDs in attendance so they can meet each other and the rest of the network. We all agreed this was a good idea, so we held this meeting in February 2015. The main goal of the February meeting was to help newly hired Post-Docs and PhD students identify research questions, to learn what skills others in the network have, and to start thinking about whom they would like to collaborate with. More on this meeting will come in the annual report for 2015, but it is mentioned several times below and was considered to be highly successful.

GreenMAR scientists were also active in participating in conferences in 2014. Susa Niiranen is currently at the “Effects of Climate Change on the World Oceans” conference in Brazil. Three people from GreenMAR attended the India-EU workshop called “*Coastal zone management and impact on society*” in Kerala, India: Anna Winter, Andries Richter and Marco Llope. Richter gave a keynote speech there on "Understanding Complexity in social-ecological systems” and Llope gave an invited talk called “*Climate and fishing steer ecosystem regeneration to uncertain economic futures in the Baltic Sea*”. Andries Richter was also an invited participant at Behaviour, Economics and Nature Network (BENN) Workshop at the Beijer Institute in Stockholm 2- 4 June 2014, and he gave a talk on "*Using Economic Information to Anticpate Transitions in Social-Ecological Systems*" Word Congress of Environmental and Resource Economists; Istanbul, Turkey in June. Marcos Llope also gave several other talks: *“Resilience of the trophic cascades in the Black Sea and Baltic Sea regime shifts”* at ICES Annual Science Conference in

Spain in September, "*Regime shifts and multiple drivers in the Black Sea and Baltic Sea - lessons from their recent history"* at IMBER Open Science Conference in Bergen in June, and **"***Regeneration potential of the Baltic Sea inferred from historical records*", an invited talk at ICES/HELCOM Working Group on Integrated Assessments of the Baltic Sea (WGIAB) in Kiel (Germany) in Feb. Joel Durant gave a talk called "*Harvesting and Population Structure Effect on Population Growth*" at the American fishery society meeting in Quebec city in August, and he also gave a talk called "*Match-mismatch and climate warming, what can we expect?*" at the Hjort symposium in Bergen October 2014. We hope that a strong presence at conferences all over the world will give GreenMAR a reputation for good science and good science communication.

***Deviations from original plan and possible budget implications:***

We had some hiring delays in Iceland due to a lack of qualified applicants. There was a six months delay for PD8, now a PhD student, who was hired in November 2014 (Sigurdur Eyberg Johannesson). Additionally, as no qualified applicants applied for the game-theoretic part of the project, the project been partially geared to focus more on issues directly related to accounting for green growth, where ecological footprints will be assessed for the Icelandic fishing industry, and recommendations will be given for growth related aspects that can reduce industry related footprints. PhD3 was also hired in November (Fredrik Salenius), as such there will be a six month delay in the work to be conducted on those projects. PD7 was hired in January 2015 (Conor Byrne) and so there will be an eight-month delay in the work to be conducted there. Furthermore, that PD7 project has been transformed to a PhD project as Byrne was exceptionally qualified for the project.

As no one was hired on PD1 in 2014, Joël Durant and Leif Chr. Stige will simultaneously work full time on GreenMAR from the first of April, 2015. This will mean a delay in this work, but it will progress quite quickly with two sets on hands on the project from April. Durant will work on GreenMAR until summer 2015 (when the RCN-funded SUSTAIN project starts) and Stige will continue until the end of the project period.

Thorben Dunse will be employed by GreenMAR from summer 2015, which is later than planned, but he is already attending meetings (such as the meeting in February) and is contributing and planning what he will work on when his funding begins: for example, he has started collaborations with Joel Durant and Marcop Llope (at CEES), and the Icelandic Node. This was specifically discussed at the February 2015 meeting in Oslo.

The workshops we have planned in the proposal will change times because we are moving the locations of our annual meetings, this change has occurred in order to keep the upcoming 2015 meeting back-to-back with the NorMER annual meeting to facilitate collaboration between these two groups. Thus the workshop in Stockholm will move to year 2 (this September) and the workshop in Iceland to year 3, when the annual meeting with also be in Iceland, in order to keep travel costs low. This will not change anything substantial, as the content will remain the same.

***Main results including publications:***

As a result of the project meetings we have concretized our plans for collaborative research. This includes collaboration between the geologists and biologists in Cluster 1 in order to assess the biological effects of freshwater runoff from the Svalbard glaciers on the surrounding marine ecosystem. We envision one paper in which a 10-year time-series of Svalbard glacier freshwater will be linked to oceanographic and biological data, and one comparative study with Iceland and Greenland Sea, where large-scale biological effects of freshwater runoff are well documented. Furthermore, the researchers in Cluster 1 will collaborate with researchers in Cluster 2 in cross-ecosystem comparisons of the Barents Sea, Iceland and Baltic Sea. In addition to threshold modeling (Cluster 2), the group will try fitting simpler models of cod and their planktivorous prey in different systems. The prediction is that in some systems (Baltic, Iceland) planktivorous fish biomass has both a direct positive effect on cod and a time-lagged negative effect through competition with or predation on young cod. In other systems (Barents), planktivorous fish biomass is only expected to have the direct positive effect, because the young cod escape the planktivorous fish by being born in upstream areas. These differences should have some consequences for the cod-prey dynamics in terms of stability and the potential for the planktivores to take over the dominance.

There has also been discussion on the effect of glacier melt water on abiotic and biotic variables. Thorben Dunse mentioned the large glacier melting in the Svalbard region. It would be interesting in looking deeper into this by using the glacier total freshwater support to the Barents Sea. Here time series analysis will be performed using data from the glacier melt water with Norwegian monitoring data of salinity,

temperature as well as zooplankton data from the Barents Sea will be analysed. Further Niall McGinty mentioned that studies from Iceland have already shown the effect of melt water from glaciers on marine abiotic and food-web conditions. Leif Chr. Stige will drive this GreenMar project. A cross-ecosystem comparison has also been discussed, which could be performed in the future when the site specific statistical food-web models for the Barents Sea (Leif Chr. Stige/Durant), Iceland (McGinty/Llope), Baltic Sea (Blenckner/Llope) are done.

A dataset of fish, plankton and environmental variables has been put together for the seas around Iceland by Niall McGinty and Marcos Llope, who have also estimated, compared and selected GAMs and tGAMs models relating cod to environmental variables and plankton and estimated some preliminary tGAM models for capelin, copepods and diatoms. In relation to this work, GreenMAR collaborators from UiO and Iceland (Marteinsdottir, McGinty, Stenseth and Llope) have also discussed some questions that will be interesting to address from a time series point of view.

Work at Princeton by Malin Pinsky has shown that marine reserves may help fished species cope with the impacts of climate change, but this effect is not guaranteed. If fishing effort is concentrated into non-reserve areas, this may actually impede climate adaptation. The response of humans to reserve implementation is a critical and poorly understood aspect of this system.

Dane Klinger is currently leading four projects. Analysis of the production potential of offshore finfish aquaculture around the globe is nearly complete. Current and future (2030) production potentials are compared using biological performance data and oceanographic outputs from an Earth Systems Model (a publication is in the works, Publication 1). He has begun extending this analysis to determine the socially optimal species and locations for offshore finfish aquaculture, based on the first analysis and additional economic and ecological attributes (Publication 2). The third project under development is a framework to characterize different types of market interactions between fishery and aquaculture products and the associated fishing/farming incentives and strategies (Publication 3). His fourth and newest project is a 'perspective' paper on transferring the land sharing/sparing debate to the ocean to develop explicit strategies for wise use of increasingly privatized ocean resources (Publication 4).

GreenMAR Papers published in 2014 (GreenMAR network members in bold):


1. Downing, A. S., S. Hajdu, O. Hjerne, **S. A. Otto**, **T. Blenckner**, U. Larsson & M. Winder. 2014. Zooming in on size distribution patterns underlying species coexistence in Baltic Sea phytoplankton. Ecology Letters, 17: 1219-1227.

2. Varjopuro, R, E. Andrulewicz, **T. Blenckner**, T. Dolch , A-S. Heiskanen, M. Pihlajamäki, U. S. Brandt, **M. Valman**, K. Gee, T. Potts & I. Psuty. 2014. Coping with persistent environmental problems: systemic delays in reducing eutrophication of the Baltic Sea. Ecology and Society, 19(4): 48, http://dx.doi.org/10.5751/ES-06938-190448

3. **Boonstra, W.J.**, J. Hentati-Sundberg. 2014. Classifying fishers' behaviour: An invitation to fishing styles. Fish & Fisheries. Published online 21 August 2014. DOI: 10.1111/faf.12092

4. **Boonstra, W.J.**, **H. Österblom**. 2014. A chain of fools: or, why is it so hard to stop overfishing. Maritime Studies. Published online 4 December 2014. DOI 10.1186/s40152-014-0015-4

5. Olsson, P., Galaz, V., & **Boonstra, W. J.** 2014. Sustainability transformations: a resilience perspective. Ecology and Society, 19(4) 1.

6. Laugen, A.T., Engelhard, G.H., Whitlock, R., Arlinghaus, R., Dankel, D., Dunlop, E., **Eikeset, A. M.**, Enberg, K., Jørgensen, C., Matsumura, S., Nusslé, S., Urbach, D., Baulier, L., Boukal, D., Ernande, B., Johnston, F., Mollet, F., Pardoe, H., Therkildsen, N., Uusi-Heikkilä, S., Vainikka, A., Heino, M., Rijnsdorp, A.D. & Dieckmann, U (2014). Evolutionary impact assessment: accounting for evolutionary consequences of fishing in an ecosystem approach to fisheries management. ***Fish and Fisheries***. ISSN 1467-2960. *15*(1), p.65- 96. doi: 10.1111/faf.12007

7. Feng, Jianfeng; **Stige, Leif Christian**; **Durant, Joel** Marcel; Hessen, Dag Olav; Zhu, Lin; Hjermann, Dag Øystein; **Llope, Marcos** & **Stenseth, Nils Christian** (2014). Large-scale season-dependent effects of temperature and zooplankton on phytoplankton in the North Atlantic. *Marine Ecology Progress Series*. ISSN 0171-8630. *502*, s 25- 37 . doi: 10.3354/meps10724

8. **Kvile, Kristina Øie**; Dalpadado, Padmini; Orlova, Emma L.; **Stenseth, Nils Christian** & **Stige, Leif Christian** (2014). Temperature effects on Calanus finmarchicus vary in space, time and between developmental stages. *Marine Ecology Progress Series*. ISSN 0171-8630. *517*, s 85- 104 . doi: 10.3354/meps11024

9. Langangen, Øystein; **Stige, Leif Christian**; Yaragina, NA; Ottersen, Geir; Vikebø, Frode Bendiksen & **Stenseth, Nils Christian** (2014). Spatial variations in mortality in pelagic early life stages of a marine fish (Gadus morhua). *Progress in Oceanography*. ISSN 0079-6611. *127*, s 96- 107 . doi:10.1016/j.pocean.2014.06.003

10. **Stige, Leif Christian**; Dalpadado, Padmini; Orlova, Emma L.; Boulay, Ann-Cecilie; **Durant, Joel** Marcel; Ottersen, Geir & **Stenseth, Nils Christian** (2014). Spatiotemporal statistical analyses reveal predator-driven zooplankton fluctuations in the Barents Sea. *Progress in Oceanography*. ISSN 0079-6611. *120*, s 243- 253 . doi:10.1016/j.pocean.2013.09.006

We expect our production of papers will speed up now that we have hired all of our PhD students and Post-Docs.

***Collaboration with new partners:***

University of Cape Town: partner in the RCN-funded SCAMPI project, which is related to the objectives of GreenMAR Cluster 1.

Hokkaido University: 4-weeks research visit by Thorben Dunse. The expertise in oceanography at Hokkaido University is highly relevant for GreenMAR, as it fills the gap between glaciology and marine ecology, which was a concern for Dunse after the February meeting. This research visit has assuaged his concern that it would be difficult to fill this gap and contribute to the research being done by GreenMAR.

The Princeton Environmental Institute (PEI) and the Department of Ecology and Evolutionary Biology (EEB) have developed a Social-Environmental Research Network (**SEReNe**), which is supported by Global Collaborative Networks Fund. This network, supported in part by Santander Bank, is comprised of the Stockholm Resilience Centre (Stockholm University), the Centre for Ecological and Evolutionary Synthesis (University of Oslo) and the Venice Centre for Climate Change Studies (Ca'Foscari University of Venice). The goals are to understand how social and environmental processes are linked, to develop a sustainable relationship with the Earth, to mitigate climate change, put an end to poaching, and ensure natural-resource equity. To solve all these problems requires a detailed understanding of social, ecological, economic, and political processes. SEReNe will provide funding for people working on these issues to visit the partner universities in order to start up collaborations. The program is run by Simon Levine and James Watson, and in 2014 the Stockholm Resilience Center got five visitors from Princeton, including Simon Levine.

Niall McGinty in Iceland is a new collaborator working with Llope, McGinty has been added to the GreenMAR network and attended the February meeting.

GreenMAR researchers in Iceland have initiated collaboration with Iceland Fisheries to strengthen industry participation from the Icelandic side.

***The Nordic-Russian collaboration***

We received funding for: i) inviting MSU scientists and PhD students to our meetings, courses and workshop, ii) organizing a Summer School on Green Growth: Mathematical dimensions in Moscow for a week in Summer 2015, iii) a fellowship and mobility allowances for young and mid-career scientists. We are on full track with the first two points, while there have been some modifications in point iii.
We have invited MSU scientists to all our meetings and they have been actively contributing. Three of them have attended the Kick-off meeting in Oslo 2014. Two have been participating in the project meeting in February 2015 in Oslo. The organization of the Summer School is ongoing, and we are all very proud and excited about the current developments – see more information below about the Summer School.

We have not used some of the mobility fellowships yet, because we felt that these scientific interactions needed to be carefully planned, prepared, and aligned. As pointed out by one of our Russian colleagues at an early meeting: "The fellowships are means to an end – find scientific answers – they are not goals in

itself. We should solidify the content first.“ After all, our budget is limited, and we want to use these funds as wisely and targeted as possible. This does, however, not mean that research projects have not been initiated – on the contrary.

An initial planning meeting on the Nordic-Russian proposal has taken place in April 2014 in Vienna even before the GreenMAR kick off meeting to integrate MSU stronger into the “core” GreenMAR network, to discuss the Summer School and joint research. During the Kick-off meeting and the project meeting in February 2015, we have allocated time to discuss potential projects that could be pursued jointly. Five possible topics for collaboration were discussed: (1) network analysis of ecosystems, (2) agent-based modeling (ABM) of regional economies, (3) attainability domains for fishery models, (4) multi-criteria analysis for better decision-making, (5) evolution of social norms. All of those potential ideas are still on the table, and project (4) has been substantiated and is currently pursued involving scientists from MSU, Oslo, Iceland, and Wageningen. One of the problems in fisheries is typically that policy makers would like to reconcile several – potentially conflicting – objectives, such as profits, ecosystem health, and employment, which are hard to combine in formal optimization models. MSU scientists have developed a technique to analyze those multiple objectives without having to (arbitrarily) define weights in an objective function. This method will be applied to the case of fisheries. The Norwegian and Icelandic cod fisheries are candidate case studies. This project has just started, but we are confident that this will lead in a very exciting publication. It is likely that a mobility fellowship will be used to work on this this project.

Mobility, fellowships, and also the possibility to integrate more researchers and students from MSU into GreenMAR projects will be planned during the Summer School, which is a perfect opportunity to meet, and substantiate our collaboration further. We anticipate that mobility will start in the academic year 2015/2016 and continue towards the end of GreenMAR, and we have plenty of money in the budget to support substantial Russian-Nordic contact and collaboration.

Planning on the Summer School in Moscow – see description below – is going full steam ahead. We aim for about **50 participants** that will participate in this **2 weeks** lasting event. The key principles of the Summer School are to be **inclusive, inspiring**, and **interdisciplinary**.

We are **inclusive** by welcoming participants from Russia, the Nordic countries, and also other parts of the world. Scholarships funded by MSU have been made available to participants outside GreenMAR to make sure that excellent and highly motivated students can participate – irrespective of their funding situation. We have also recruited world-leading experts from outside our GreenMAR network as lecturers. The idea is to underscore that GreenMAR is an open and dynamic network – with knowledge not only percolating inside the GreenMAR network, but also in and out of the network.

The School aims not only to transmit knowledge, but also intends to **inspire**. Our learning goals do not stop at the scientific realm, but we hope to foster creativity and critical thinking. One example here is the talk “advice to young scientists” which will be given by Nils Chr. Stenseth during the Summer School. Another example is a creative session on cartoon drawing, theatre or video making that will take place.
Finally, the School is interdisciplinary – while the core of the Summer School centers around using mathematical models for better resource governance, those insights have also important implications for other disciplines. GreenMAR postdocs, who come from different disciplines (biology, sociology, economics, etc.) have a key role as bridge builders. Postdocs will take the lead on small projects that will be developed together with the PhD students during the course. A further advantage is that postdocs are typically somewhat caught in the middle, since they are no longer students, not yet tenured scientists. This role as “resource persons” will give them further experience on their way to become not only independent researchers, but also research leaders.

**Information about the**
**Summary of the Moscow Summer Academy on Economic Growth**
**and Governance of Natural Resources 2015 (MSA 2015):**
20 July – 1 August 2015


As the 21st century begins, humankind faces a challenge to find a wiser way to utilize Earth's resources to maintain economic growth, in developing countries as well as in the industrialized world, while avoiding overexploitation of ecosystem services and other natural resources. The global economy is still rooted in non-renewable resource exploitation; transition to renewable energy and sustainable resource use will occur only in response to incentives and institutional systems that reflect enthusiastic adoption of the need for change by policy-makers and business. This is a daunting task for many reasons, including complex feedbacks between the institutional and economic system that may lead to path-dependencies that hinder or prevent such transitions.

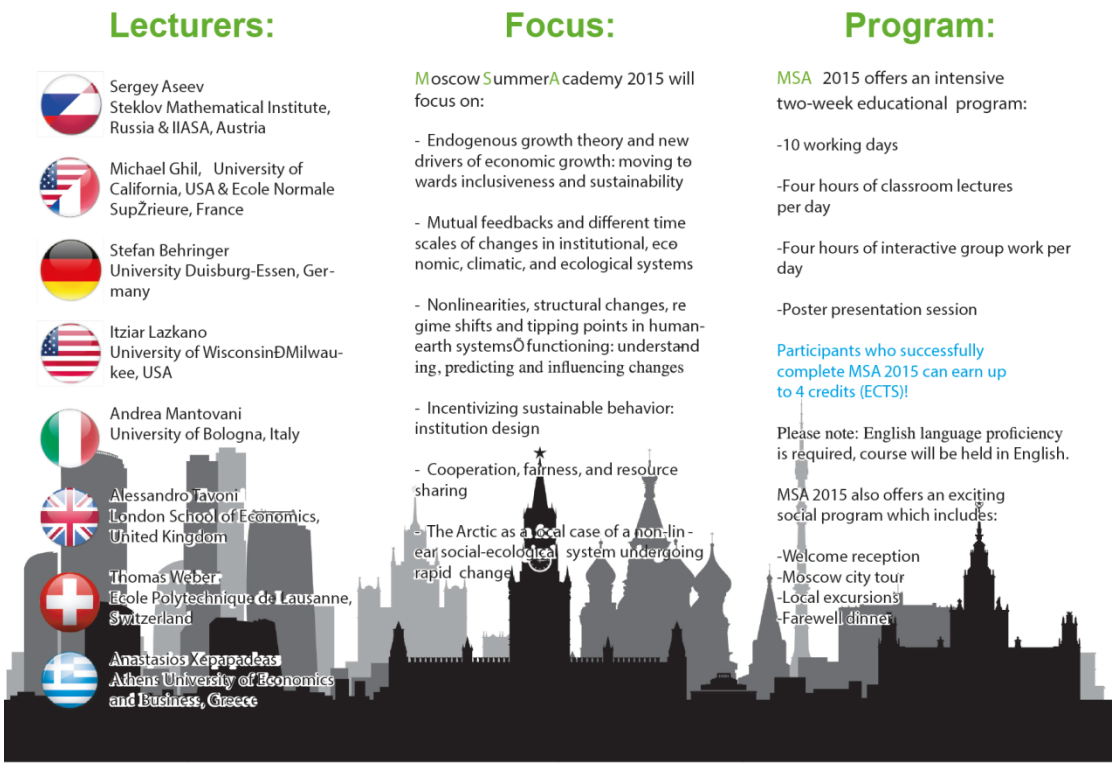
Moreover, growing globalization and an accelerating level of industrial development are contributing to a shifting of the Earth systems from a quasi-equilibrium state that has traditionally supported human society. Environmental regime shifts may give rise to institutional tipping points, which may also trigger sudden transitions in socio-economic systems; these create a strong need for policy instruments that can take into account the feedbacks between elements of the whole. The need to maintain economic growth without unacceptable damage to Earth's capacity to support human society is embodied in the concepts of "sustainable development" and "green growth". This summer school is designed to examine and develop some of the analytical tools that can assist in decision support for policy makers trying to maneuver in this complex space.

The scientific community plays a key role in analyzing options for policies aimed at facilitating an efficient and fair use of natural resources, while ensuring that Earth systems retain their functionality. Recent developments in policy science reflect the understanding that research useful for decision support can no longer work with linearized approximations, ignoring nonlinearities, potential structural changes and regime shifts. A new generation of science supporting policy that responds to these complex, global changes should address explicitly the issue of multiplicity of decision-makers and decision-making levels and their interactions. Moreover, the heterogeneity of agents involved in making and implementing decisions is playing an increasingly decisive role, highlighting the need to design fair and efficient institutions to support global policies on sustainable development.

MSA 2015 aims to attract a new generation of scientists from around the world to learn and discuss the challenges of natural resources management and economic growth, along with methodologies that are available to attack those challenges (e.g., optimal control theory, analysis of dynamic systems, and game theory with special focus on dynamic games and mechanism design).

The School will consider the Arctic as a special case, where the warming environment catalyzes changes in ecosystems and in opportunities for economic development, and where the small traditional population of the area will have to partner with national and international authorities to handle unprecedented challenges to traditional cultures, as well as opportunities for increased prosperity.

MSU Flyer:




***External funding (funding acquired in addition to NordForsk funding):***

In 2014, Joël Durant started as work package leader in a project financed by **RCN: SCAMPI - Seasonal to decadal Changes Affecting Marine Productivity: an Interdisciplinary investigation** (Researcher project - SANCOOP). http://www.mn.uio.no/cees/english/research/projects/461240/
Joël Durant will be work package leader for the WP: Influence of seasonal to decadal variability on fished marine resources and their predators. SCAMPI is highly relevant for Cluster 1 of GreenMAR, by asking, what are the implications of changes in fish phenology for predatory, non-fished species that may also be of conservation importance and for fisheries?

In 2014 Nils Chr. Stenseth and colleagues got funding by RCN: **Sustainable management of renewable resources in a changing environment: an integrated approach across ecosystems** (**SUSTAIN**). In this project we will address the general question of how combined anthropogenic and climatic changes affect different harvested ecosystems (particularly, but not only, in Arctic regions), and how management strategies can be improved to ensure sustainable exploitation and resilience, a theme relevant for GreenMAR.

Joël Durant will be work package leader for the WP: "Ecosystem resilience and climate change in a spatially structured and seasonal environment" where he will address the question of the shifts in species distributions, both spatially and temporally, caused by environmental changes and their effect on species interactions and their ecological consequences with regards to management implications.

External funding has also been acquired by Brynhildur Davidsdottir and colleagues in relation to PD7 and PD8, from the Nordic Council of Ministers through the **NORDBIO** project funneled through the Icelandic Ministry for the Environment and natural resources. This funding enables us to compare fisheries management regimes throughout all the Nordic countries in context with sustainable development and green growth.

SRC is also a partner in a new project called **INSPIRE** where Thorsten Blenckner is the PI in charge of that partner node. About the INSPIRE project from their web page: “Moving beyond existing knowledge, INSPIRE will for the major Baltic fish species take the leap from homogeneous to heterogeneous population dynamics, by accounting for spatial heterogeneity in population models and ecosystem-based fisheries management. Spatial heterogeneity, defined as changes in the abundance of fish over space,

which are not explainable by simple random (Poissonian) variability, can have different causes. The overall approach of INSPIRE is mechanistic in the sense that we aim to understand these causes and the underlying processes generating spatial heterogeneity, but also estimate its magnitude." This project is very much related to GreenMAR.

Wijnand Boonstra started to work in 2014 with his FORMAS Young Research Leader Grant (title: **Working knowledge in Swedish coastal fishery – Making cultural capital visible for sustainable use of coastal sea- and landscapes**) of approximately 30,000 euro. The objective of the research that is sponsored with this grant is to systematically study the working knowledge of Swedish coastal fishery, and to make it visible and accessible as cultural capital that can contribute to the further development of Swedish fisheries and the sustainable management of coastal sea- and landscapes. Since 1914 the total number of fishers in Sweden diminished with a dramatic 93%. This demise is not just a quantitative change in numbers of fishers, since it is especially coastal fishers that are disappearing. The loss of cultural capital that Swedish coastal fishers represent, i.e. 'their working knowledge and skills, implies a tremendous setback for sustainable management of coastal sea- and landscapes. The decline of marine biomass and biodiversity due to overfishing, together with the advent of peak oil, will require development trajectories that keep fisheries within local ecological boundaries. The cultural capital that coastal fishers embody and that is rooted in specific localities can serve as a foundation for new development trajectories. However, it is only when cultural capital becomes visible that it can be used for this purpose. The objective of this proposal is therefore to systematically study the working knowledge of Swedish coastal fishery, and to make it visible as cultural capital that can contribute to the sustainable management of coastal sea- and landscapes. The research will first identify through ethnographic and visual methods the types of local ecological knowledge and craftsmanship that Swedish coastal fishers embody. Next to that, it will investigate how fishers' cultural capital can be successfully communicated within mainstream fisheries science and management.

***Gender aspects of the research and the organisation of the project:***

In terms of the PhDs and Post-Docs hired as a direct result of GreenMAR's funding, we have a very balanced ratio of males to females (4 males and 4 females, namely Anna-Marie Winter, Susa Nirranen, Emma Björvik, Matilda Valman, Thorben Dunse, Fredrik Salenius, Sigurður Eyberg Jóhannesson, and Conor Byrne). In term of the entire network, we have 65% male participants and 35% are female, but there are simply more males in research which makes it hard to have a truly equal representation of good male and female scientists. We do think that because we are very equal in our hiring of male and female PhDs and Post-Docs that our actions will help this endemic imbalance to even out in the future.

We also have women in leadership roles, Anne Marie Eikeset is the co-PI and is very much involved in the running of the center, particularly as Nils Chr. Stenseth has a demanding schedule and is often unable to direct day-to-day business at GreenMAR. Brynhildur Davidsdottir is both a cluster leader and a node leader. Our Administrative staff is also two women (Anna Mazzarella and Camilla Thomsen).

We admit we are unhappy with our ability to recruit a balanced panel of speakers at the Moscow Summer School, as only 1 of 8 of our highlighted speakers (shown above on the MSU flyer) is a female (although we will have more speakers, some who will be women, giving shorter lectures, so the program will be more diverse than it seems currently). We worked extremely hard to recruit a more balanced program, and more female highlighted speakers were invited, but they were not available or did not accept our invitation. Our actual collaborators at MSU however include 4 females, so our Russian collaboration otherwise has a female-heavy gender balance, and as always we will strive in the future towards a better gender balance in all our courses and workshops.

We also had a short workshop after our February meeting for our newly hired PhDs and Post-Docs called "Innovation Incubator" was put together by SALT (salt.nu), which is an all-female independent consultant company based in Lofoten, Norway, and we hope to work more with SALT in the future. We also think that Nina Jensen from our SAB and WWF can be a role model to our young female scientists, as she is a young female global leader.

**To conclude**, we also plan to make a flyer showcasing the information from this report for distribution at annual meetings and elsewhere to advertise GreenMAR and the work that we are doing. We hope to gain a reputation for good science and for training a new generation of researchers to carry this forward into the future.

## 2) Researcher mobility

Please specify research stay abroad as well as visits by foreign researchers. Here mobility is defined as a stay abroad of at least 4 weeks duration.

| Name, job title, organization | Site of work | Purpose of Visit | Duration of Visit | Comments, output of visit |
|---|---|---|---|---|
| Anne Maria Eikeset, Cluster Leader, UiO | Princeton University, USA | Collaboration | 6 months | Joint manuscripts, initiated new collaborations for the PhDs and [Post-Docs within GreenMAR, planned long-term collaborations beyond GreenMAR |
| Anna-Marie Winter, PhD student, UiO | Wageningen University, Netherlands | Course work, collaboration | 5 months | Visit still ongoing, taking PhD courses in resource economics, working on two papers |
| Marcos Llope, Researcher, UiO | MARICE, Iceland | Collaboration | 1 month | Contact established<br>Discussion of ideas<br>Preliminary model results |
| Thorben Dunse: GreenMAR post-doc from summer 2015; UiO | Institute of Low Temperature Science, Hokkaido University, Sapporo, Japan | Collaboration | 1 month | Initiating glacier simulation; Identifying research questions concerning freshwater contribution from glaciers to the ocean and methods to answer them |
| Susa Niiranen, postdoc, SRC (SU) | Princeton University, USA | Collaboration | 1 month | Development of the size-structured food web model (with James Watson) |

| Number of: | |
|---|---|
| Visiting months | 14 months |
| Visiting researchers | 5 |